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Issue Article

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THE BEST APPROXIMATIONS OF RANDOM FIELDS IN ROOT-MEAN SQUARE AND UNIFORM METRIC

Abstract: *In the paper, we study the asymptotically best approximations of random fields by linear positive operators in the mean square and uniform metrics.*

Key words: *random field, r.f., linear positive operator, l.p.o., approximation, best constant, continuity module.*

Language: *English*

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Introduction

Denote by $\overline{C_\Omega}(R^2)$ the class of all real, measurable r.f.'s $\xi(t,s)$ uniformly continuous in the mean square (m.s.), defined on a probability space $(\Omega, \mathfrak{F}, P)$, $M|\xi(t,s)|^2 \le C$, $0 < C < \infty$, $(t,s) \in R^2$

The function

$$\omega_\xi^{(1)}(x_1,x_2) = \max_{\substack{|t-t'|\le x_1 \\ |s-s'|\le x_2 \\ -\infty<t,s<\infty}} \{M|\xi(t,s)-\xi(t',s')|^2\}^{\frac{1}{2}},$$

$$x_1, x_2 \ge 0,$$

is said to be the continuity module of the first type ([1], [6]) of a r.f. $\xi(t,s) \in \overline{C_\Omega}(R^2)$.

We call the function

$$\omega_\xi^{(2)}(x) = \max_{(t-t')^2+(s-s')^2 \le x^2} \{M|\xi(t,s) - \xi(t',s')|^2\}^{\frac{1}{2}},$$

$$x \ge 0$$

the continuity module of the second type of a r.f. $\xi(t,s) \in \overline{C_\Omega}(R^2)$.

The continuity modules $\omega_\xi^{(1)}(x_1,x_2)$ and $\omega_\xi^{(2)}(x)$ of $\xi(t,s) \in \overline{C_\Omega}(R^2)$ have the following properties:

1^0. For any $0 \le x_1 \le x'_1$, $0 \le x_2 \le x'_2$, the inequalities:

$$\omega_\xi^{(1)}(x_1, x_2) \le \omega_\xi^{(1)}(x'_1, x_2) \le \omega_\xi^{(1)}(x'_1, x'_2)$$

hold.

2^0. For any $n \in N$ and $0 \le x_1 \le x_2$,

$$\omega_\xi^{(1)}(n x_1, n x_2) \le n\omega_\xi^{(1)}(x_1, x_2).$$

3^0. For any

$$0 \le x_1 \le x_2, \quad \omega_\xi^{(2)}(x_1) \le \omega_\xi^{(2)}(x_2).$$

4^0. For any $n \in N$,

$$0 \le x_1 \le x_2, \quad \omega_\xi^{(2)}(nx) \le n\omega_\xi^{(1)}(x).$$

$5^0\ .\ \omega_{\xi}^{(1)}(\frac{\sqrt{2}}{2}x,\frac{\sqrt{2}}{2}x) \le\ \omega_{\xi}^{(2)}(x)\ \le \omega_{\xi}^{(1)}(x,x) \le \omega_{\xi}^{(2)}(x\sqrt{2}),\quad x \ge 0.$

Let $(X_k, Y_k)_{k=1}^{\infty}$ be a sequence of independent identically distributed real random vectors with a joint distribution function $F_{t,s}(x,y)$ depending on the parameters t and s such that (X_1,Y_1) has the mathematical expectation (t,s) and covariation matrix $\begin{pmatrix}\sigma_1(t) & 0\\ 0 & \sigma_2(s)\end{pmatrix}$, where the parameter (t,s) changes on the set $Q\subset R^2$.

Consider the approximation of $\xi(t,s) \in \overline{C_\Omega}(R^2)$ on the compact set $G \subset Q$ by the l.p.o.

$$P_n(\xi;t,s)=\int_{R^2}\xi(x,y)\,dF_{t,s}^{(n)}(x,y) \qquad (1)$$

Where $\quad F_{t,s}^{(n)}(x,y) = P\{\frac{S_n^{(1)}}{n} < x\ ; \frac{S_n^{(2)}}{n} < y\},$

$$S_n^{(1)} = \sum_{k=1}^n X_k, \qquad S_n^{(2)} = \sum_{k=1}^n Y_k,$$

the integral in (1) is understood in the m.s. sense.

Note that the asymptotically best approximations of random processes by l.p.o. are studied in work [13].

According to [5, p. 268], r.f. $P_n(\xi;t,s)$ is defined for all

$(t,s) \in Q$.

The results of [1], [6] imply that

$$\max_{(t,s)\in G}\{M|\xi(t,s) - P_n(\xi;t,s)|^2\}^{\frac{1}{2}} \le \quad C_1\,\omega_{\xi}^{(1)}(\tfrac{1}{\sqrt{n}},\tfrac{1}{\sqrt{n}})$$

and

$$\max_{(t,s)\in G}\{M|\xi(t,s) - P_n(\xi;t,s)|^2\}^{\frac{1}{2}} \le C_2\,\omega_{\xi}^{(2)}(\tfrac{1}{\sqrt{n}})$$

The smallest ("best", "optimal") constants that can be put instead of the constants C_1 and C_2 on the right sides of these inequalities,

$$C_1 = C_1(F) = \sup_{\substack{\xi\in\overline{C_\Omega}(R^2)\\ n\in N}}\{\frac{\max_{(t,s)\in G}\{M|\xi(t,s)-P_n(\xi;t,s)|^2\}^{\frac{1}{2}}}{\omega_{\xi}^{(1)}(\frac{1}{\sqrt{n}},\frac{1}{\sqrt{n}})}\}$$

and

$$C_2 = C_2(F) = \sup_{\substack{\xi\in\overline{C_\Omega}(R^2)\\ n\in N}}\left\{\frac{\max_{(t,s)\in G}\{M|\xi(t,s)-P_n(\xi;t,s)|^2\}^{\frac{1}{2}}}{\omega_{\xi}^{(2)}(\frac{1}{\sqrt{n}})}\right\},$$

respectively.

The study of the exact values of the smallest constants C_1 and C_2 leads to complex calculations related to the specifics of the distribution $F_t^{(n)}(x)$. Instead of them, we present in the work asymptotically optimal constants, i.e.

$$C_1^* = \overline{\lim_{n\to\infty}}\,[\sup_{\xi\in\overline{C_\Omega}(R^2)}\{\frac{\max_{(t,s)\in G}\{M|\xi(t,s)-P_n(\xi;t,s)|^2\}^{\frac{1}{2}}}{\omega_{\xi}^{(1)}(\frac{1}{\sqrt{n}},\frac{1}{\sqrt{n}})}\}] \text{ and}$$

$$C_2^* = \overline{\lim_{n\to\infty}}\,[\sup_{\xi\in\overline{C_\Omega}(R^2)}\{\frac{\max_{(t,s)\in G}\{M|\xi(t,s)-P_n(\xi;t,s)|^2\}^{\frac{1}{2}}}{\omega_{\xi}^{(2)}(\frac{1}{\sqrt{n}})}\}]$$

Introduce the following notations:

$$\sigma_1 = \sup_{(t,s)\in G}\{\sigma_1(t)\}, \qquad \sigma_2 = \sup_{(t,s)\in G}\{\sigma_2(s)\},$$

$$D_k = D_k(\sigma_1,\sigma_2) = \{(u,v); |u| \le \frac{k}{\sigma_1}, |v| \le \frac{k}{\sigma_2}\},$$

$$æ_1 = æ_1(\sigma_1,\sigma_2) = \sum_{k=0}^{\infty}\int_{R^2\setminus D_k} d\Phi(u,v), \text{ where}$$

$$\Phi(u,v) = \frac{1}{2\pi}\int_{-\infty}^{u}\int_{-\infty}^{v} exp\{-\frac{x^2+y^2}{2}\}dxdy.$$

$$Q_k = Q_k(\sigma_1,\sigma_2) = \{(u,v): k^2 \le \sigma_1^2u^2 + \sigma_2^2v^2 < (k+1)^2\},$$

$$æ_2 = æ_2(\sigma_1,\sigma_2) = \sum_{k=0}^{\infty}\int_{R^2\setminus Q_k} d\Phi(u,v),$$

$$\Phi(u,v) = \frac{1}{2\pi}\int_{-\infty}^{u}\int_{-\infty}^{v}\exp\{-\frac{x^2+y^2}{2}\}dxdy$$

Let $G \subset Q$ be any compact set, and the following conditions are satisfied:

(A_1): $\sup_{(t,s)\in G} M|X_1 - t|^6 \le L_1$, $\sup_{(t,s)\in G} M|Y_1 - s|^6 \le L_2$,

$0 < L_i < \infty, i = 1,2.$

(B_1): $\sigma_1 \equiv \sigma_1(t_0) = \sup_{(t,s)\in G}\sigma_1(t) > 0$,

$\sigma_2 \equiv \sigma_2(s_0) = \sup_{(t,s)\in G}\sigma_2(s) > 0$

(C_1): the set G is such that $(t_0, s_0) \in G$.

Theorem 1. If conditions (A_1), (B_1), (C_1) are satisfied, then

a) for any $\xi(t,s) \in \overline{C_\Omega}(R^2)$ and $\varepsilon > 0$, there exists $n_0(\varepsilon) \in N$ such that for all $n > n_0(\varepsilon)$, the following relation holds:

$$\max_{(t,s)\in G}\{M|\xi(t,s) - P_n(\xi;t,s)|^2\}^{\frac{1}{2}} \le$$
$$\le [æ_1(\sigma_1,\sigma_2) + \varepsilon]\omega_{\xi}^{(1)}(\tfrac{1}{\sqrt{n}},\tfrac{1}{\sqrt{n}})$$

b) this inequality is unimprovable for the class $\overline{C_\Omega}(R^2)$ in the sense that for any $\varepsilon > 0$, there exist $n_1(\varepsilon) \in N$ and a r.f. $\xi n(t,s) \in \overline{C_\Omega}(R^1)$ such that for all $n > n_1(\varepsilon)$, the inequality

$$\max_{(t,s)\in G}\{M|\xi(t,s) - P_n(\xi n;t,s)|^2\}^{\frac{1}{2}} >$$
$$> [æ_1(\sigma_1,\sigma_2) - \varepsilon]\,\omega_{\xi n}(\tfrac{1}{\sqrt{n}},\tfrac{1}{\sqrt{n}}) \quad \text{holds.}$$

Theorem 2. If conditions (A_1), (B_1), (C_1) are satisfied, then the relation

$$\overline{\lim_{n\to\infty}}\ \sup_{\xi\in\overline{C_\Omega}(R^2)}\{\frac{\max_{(t,s)\in G}[M|\xi(t,s)-Pn(\xi;t,s)|^2]^{\frac{1}{2}}}{\omega_{\xi}^{(1)}(\frac{1}{\sqrt{n}},\frac{1}{\sqrt{n}})}\} =$$
$$= æ_1(\sigma_1,\sigma_2) \text{ holds.}$$

Theorem 3. If conditions (A_1), (B_1), (C_1) are satisfied, then

a) for any $\xi(t,s) \in \overline{C_\Omega}(R^2)$ and $\varepsilon > 0$, there exists $n_0(\varepsilon) \in N$ such that for all $n > n_0(\varepsilon)$, the following relation holds:

$$\max_{t\in G}\{ M|\xi(t,s) - P_n(\xi;t,s)|^2\}^{\frac{1}{2}} \le$$

$$\le [æ_2(\sigma_1,\sigma_2) + +\varepsilon]\omega_\xi^{(2)}(\frac{1}{\sqrt{n}})$$

b) this inequality is unimprovable for the class $\overline{C_\Omega}(R^2)$ in the sense that for any $\varepsilon > 0$, there exist $n_1(\varepsilon) \in N$ and a r.f. $\xi n(t,s) \in \overline{C_\Omega}(R^1)$ such that for all $n > n_1(\varepsilon)$, the inequality

$$\max_{(t,s)\in G}\{ M|\xi(t,s) - P_n(\xi n;t,s)|^2\}^{\frac{1}{2}} >$$
$$> [æ_2(\sigma_1,\sigma_2) - \varepsilon]\ \omega_{\xi n}^{(2)}(\frac{1}{\sqrt{n}})$$

holds.

Theorem 4. Let conditions (A_1), (B_1), (C_1) be satisfied. Then the following relation holds:

$$\overline{\lim_{n\to\infty}}\ \sup_{\xi\in\overline{C_\Omega}(R^2)}\{\frac{\max_{(t,s)\in G}\{ M|\xi(t,s)-P_n(\xi;t,s)|^2\}^{\frac{1}{2}}}{\omega_\xi^{(2)}(\frac{1}{\sqrt{n}})}\} =$$
$$= æ_2(\sigma_1,\sigma_2) .$$

Consider the examples.

Let $\{(X_k, Y_k)\}_{k=1}^{\infty}$ be a sequence of independent identically distributed random vectors generating a l.p.o. $P_n(\xi, t, s)$.

Example 1. Let (X_1, Y_1) be a vector with independent components such that X_1 and Y_1 have a Bernoulli distribution with parameters t and s, respectively. Then the set or parameters $Q=[0,1]^2$ and the operator

$$P_n(\xi, t, s) = B_n(\xi, t, s) =$$
$$= \sum_{k=0,}^{n}\sum_{e=0}^{n} C_n^k C_n^e t^k s^e \cdot (1 - -t)^{n-k}(1-s)^{n-e} \cdot$$
$$\xi\left(\frac{k}{n};\frac{e}{n}\right)$$

is the Bernstein polynomial of two variables. If we take G=Q, then the asymptotically optimal constant in the estimate

$$\max_{(t,s)\in[0,1]^2}\{ M[\xi(t, s) - B_n(\xi, t, s)]^2\}^{\frac{1}{2}} \le$$
$$\le C_1\omega_\xi^{(1)}(\frac{1}{\sqrt{n}};\frac{1}{\sqrt{n}})$$

is $C_1^* = æ_1(\frac{1}{2},\frac{1}{2})$, and in the estimate

$$\max_{(t,s)\in[0,1]^2}\{ M[\xi(t, s) - B_n(\xi, t, s)]^2\}^{\frac{1}{2}} \le$$
$$C_2\omega_\xi^{(2)}(\frac{1}{\sqrt{n}}),$$

the asymptotically optimal constant is $C_2^* = æ_2(\frac{1}{2},\frac{1}{2})$.

Example 2. Let (X_1, Y_1) be a vector with uncorrelated components that have a Bernoulli distribution with parameters t and s, respectively, and a joint distribution:

$P\{X_1=1,Y_1=1\} = 0$, $P\{X_1=1,Y_1=0\} = t$,

$P\{X_1=0,Y_1=1\} = s$, $P\{X_1=0, Y_1=0\} = 1–t–s$.

Then

$$P_n(\xi, t, s) = \sum_{o\le k+e\le n} C_{n-e}^k C_n^e s^k(1 - t - s)^{n-e-k}\ \xi\left(\frac{k}{n};\frac{e}{n}\right)$$

is a Bernstein-type polynomial introduced by Lorentz [12].

In this case the set of parameters $Q=\{(t,s):\ 0 \le t + s \le 1\}$.

If we assume that G=Q, then the asymptotically optimal constant in the estimate

$$\max_{(t,s)\in[0,1]^2}\{ M[\xi(t, s) - P_n(\xi, t, s)]^2\}^{\frac{1}{2}}$$
$$\le C_1\omega_\xi^{(1)}(\frac{1}{\sqrt{n}};\frac{1}{\sqrt{n}})$$

is $C_1^* = æ_1(\frac{1}{2},\frac{1}{2})$, and in the estimate

$$\max_{(t,s)\in[0,1]^2}\{ M[\xi(t, s) - P_n(\xi, t, s)]^2\}^{\frac{1}{2}} \le C_2\omega_\xi^{(2)}(\frac{1}{\sqrt{n}}),$$

the asymptotically optimal constant is

$$C_2^* = æ_2(\frac{1}{2},\frac{1}{2}).$$

Example 3. Let (X_1, Y_1) be a vector with uncorrelated components that have a Poisson distribution with parameters t and s, respectively. Then

$$P_n(\xi, t, s) = \sum_{k=0}^{\infty}\sum_{e=0}^{\infty}\frac{(nt)^k(ns)^e}{k!\cdot e!} exp\{-n(t + s)\} \cdot$$
$$\xi\left(\frac{k}{n};\frac{e}{n}\right)$$

is the Mirakyan operator [7] for random fields and the set of parameters $Q = [0,\infty)^2$.

If $G = [0,1]^2$, then the asymptotically optimal constant in the estimate

$$\max_{(t,s)\in[0,1]^2}\{ M[\xi(t, s) - P_n(\xi, t, s)]^2\}^{\frac{1}{2}}$$
$$\le C_1\omega_\xi^{(1)}(\frac{1}{\sqrt{n}};\frac{1}{\sqrt{n}})$$

is $C_1^* = æ_1(1,1)$, and in the estimate

$$\max_{(t,s)\in[0,1]^2}\{ M[\xi(t, s) - P_n(\xi, t, s)]^2\}^{\frac{1}{2}} \le C_2\omega_\xi^{(2)}(\frac{1}{\sqrt{n}})$$

the asymptotically optimal constant is $C_2^* = æ_2(1,1)$.

In the deterministic case, i.e. when $\xi(t,s)$ is a non-random function, Theorems 1 – 4 imply the following results:

Let $\overline{C}(R^2)$ be the class of all uniformly continuous functions bounded on R^2. Consider the approximation of the function $f\ (t,s) \in \overline{C}(R^2)$ on a compact set $G \subset Q$ by the l.p.o.

$$P_n(f;t,s) = \int_{-\infty}^{\infty} f\ (x,y)\mathrm{d}F_{t,s}^{(n)}\ (x,y).$$

Denote by

$$\omega_f^{(1)}(x,y) = \sup_{\substack{|t-t'|\le x\\ |s-s'|\le y\\ -\infty<t,s<\infty}} |f(t,s) - f(t',s')|$$

the continuity module of the first kind, by

$$\omega_f^{(2)}(\delta) = \sup_{\substack{\sqrt{(t-t')^2+(s-s')^2}\le\delta\\ -\infty<t,s<\infty}} |f(t,s) - f(t',s')|$$

the continuity module of the second kind of a function $f\ (x,y)$ [11].

Theorem 5. If conditions (A_1), (B_1), (C_1) are satisfied, then

a) for any $f(t,s) \in \overline{C}(R^2)$ and $\varepsilon > 0$, there exists $n_0(\varepsilon) \in N$ such that for all $n > n_0(\varepsilon)$, the relation

$$\max_{(t,s)\in G} |f(t,s) - P_n(f;t,s)| \le \le [æ_1(\sigma_1,\sigma_2) + \varepsilon]\omega_f^{(1)}\left(\frac{1}{\sqrt{n}},\frac{1}{\sqrt{n}}\right)$$

holds;

b) this inequality is unimprovable for the class $\overline{C}(R^2)$ in the sense that for any $\varepsilon > 0$, there exist $n_1(\varepsilon) \in N$ and $fn(t,s) \in \overline{C}(R^2)$ such that for all $n > n_1(\varepsilon)$, the inequality

$$\max_{(t,s)\in G} |fn(t,s) - P_n(fn;t,s)| > > [æ_1(\sigma_1,\sigma_2) - \varepsilon]\omega_{fn}\left(\frac{1}{\sqrt{n}},\frac{1}{\sqrt{n}}\right)$$

holds.

Theorem 6. If conditions (A_1), (B_1), (C_1) are satisfied, then the following relation takes place:

$$\overline{\lim_{n\to\infty}} \sup_{f\in\overline{C}(R^2)} \left\{\frac{\max_{(t,s)\in G}|f(t,s)-P_n(f;t,s)|}{\omega_f^{(1)}\left(\frac{1}{\sqrt{n}},\frac{1}{\sqrt{n}}\right)}\right\} = æ_1(\sigma_1,\sigma_2).$$

Theorem 7. If conditions (A_1), (B_1), (C_1) are satisfied, then

a) for any $\xi(t,s) \in \overline{C_\Omega}(R^2)$ and $\varepsilon > 0$, there exists $n_0(\varepsilon) \in N$ such that for all $n > n_0(\varepsilon)$, the relation

$$\max_{(t,s)\in G} |f(t,s) - P_n(f;t,s)| \le \le [æ_2(\sigma_1,\sigma_2) + \varepsilon]\omega_f^{(2)}\left(\frac{1}{\sqrt{n}}\right) \quad \text{holds;}$$

b) this inequality is unimprovable for the class $\overline{C_\Omega}(R^2)$ in the sense that for any $\varepsilon > 0$, there exist $n_1(\varepsilon) \in N$ and a r.p. $\xi n(t,s) \in \overline{C_\Omega}(R^1)$ such that for all $n > n_1(\varepsilon)$, the inequality

$$\max_{(t,s)\in G} \{M|fn(t,s) - P_n(fn;t,s)|^2\}^{\frac{1}{2}} > > [æ_2(\sigma_1,\sigma_2) - \varepsilon]\,\omega_{fn}^{(2)}\left(\frac{1}{\sqrt{n}}\right)$$

holds.

Theorem 8. Let conditions (A_2), (B_2), (C_2) be satisfied. Then the following relation takes place:

$$\overline{\lim_{n\to\infty}} \sup_{f\in\overline{C}(R^2)} \left\{\frac{\max_{(t,s)\in G}|f(t,s) - P_n(f;t,s)|}{\omega_f^{(2)}\left(\frac{1}{\sqrt{n}}\right)}\right\} = æ_2(\sigma_1,\sigma_2).$$

Note that Theorems 5–8 are of independent interest and are new in the classical theory of approximation of nonrandom functions.

Let now $\xi(t,s) \in C_\Omega(R^2)$ be a separable sub-Gaussian continuous with probability one r.f. satisfying the condition

(A_2): $\left|\left|\xi(t,s) - \xi(u,v)\right|\right|_{sub} \le$

$$\le \omega\left(\sqrt{(t-u)^2 + (s-v)^2}\right),$$

$$(t,s),(u,v) \in R^2,$$

where $\omega(x)$ is the continuity module, for which there is an inverse function $\omega^{-1}(z)$, and the integral

$\int_0^1 \frac{\omega(z)dz}{z\sqrt{|lnz|}} < \infty$, the norm $||*||_{sub}$ is introduced in [4].

With respect to the sequence of distribution functions $F_{t,s}^{(n)}(x,y)$, suppose that the following conditions are satisfied:

(B_2): partial derivatives with respect to t and s of functions $dF_{t,s}^{(n)}(x,y)$ exist and are continuous functions of (t,s)∈ Q for any $n \in N$, $(x,y) \in R^2$

(C_2): $[dF_{t,s}^{(n)}(x,y)]'_t = \rho_{t,s}^{n,1}(x,y)dF_{t,s}^{(n)}(x,y)$,
$[dF_{t,s}^{(n)}(x,y)]'_s = \rho_{t,s}^{n,2}(x,y)\,dF_{t,s}^{(n)}(x,y)$,

where continuous for $(t,s)\in Q$ functions $\rho_{t,s}^{n,i}(x,y)$, $(x,y) \in R^2$ are such that

$$\sup_{(t,s)\in Q} \int_{R^2} |\rho_{t,s}^{n,i}(x,y)|dF_{t,s}^{(n)}(x,y) < \infty, \quad i = 1,2.$$

If conditions (B_2) and (C_2) are satisfied, then for any

(t,s) ∈ Q, the partial derivatives with respect to *t* and *s* of the r.f. $P_n(\xi;t,s)$ exist with the probability one [4, p. 268], and

$$Pn(\xi;t,s)\,]'_t = \int_{R^2} \xi(x,y)|\rho_{t,s}^{n,1}(x,y)|dF_{t,s}^{(n)}(x,y) \equiv P_{n,1}(\xi;t,s),$$

$$[Pn(\xi;t,s)\,]'_s = \int_{R^2} \xi(x,y)|\rho_{t,s}^{n,2}(x,y)|dF_{t,s}^{(n)}(x,y) \equiv P_{n,2}\,\xi;t,s).$$

Obviously, r.f.'s $P_{n,i}(\xi;t,s)$ are sub-Gaussian, i.e.

$$M\,P_{n,i}(\xi;t,s) = 0, \quad \sup_{(t,s)\in Q} ||Pn,i(\xi;t,s)||_{sub} < \infty, \quad i = 1,2.$$

Assume that they satisfy the condition

(D_2): there exists a sequence of positive numbers $(\alpha_{n,i})_{n=1}^{\infty}$ such that для любого $n \in N$,

$$\sup_{(t,s)\in Q} ||Pn,i\,(\xi;t,s)||_{sub} \le \alpha_{n,i}, \quad i=1,2.$$

It is not difficult to verify that the conditions (B_2), (C_2), (D_2) are satisfied for classical operators such as Bernstein, Weierstrass, Mirakyan operators, etc.

Investigate the r.f. $\eta_n(t,s) = \frac{\xi(t,s)-Pn(\xi;t,s)}{c_0\omega(\frac{1}{\sqrt{n}})}$ on the set G,

Where $c_0 = \sigma_1 + \sigma_2 + 1$, $\sigma_1 = \sup_{(t,s)\in G} \sigma_1(t)$,

$\sigma_2 = \sup_{(t,s)\in G} \sigma_2(s)$.

Denote by d_G the diameter of the set G.

Set $c_1 = \sqrt{2ln(d_G+2)}$, $q_n = \frac{c_0\omega(d_G)}{\omega(d_G)+2d_G\sqrt{\alpha_{n,1}^2+\alpha_{n,2}^2}}$,

$$\gamma_n = \frac{1}{2}\{c_1 + \sqrt{ln\frac{1}{\omega^{-1}\left(\frac{q_n}{2}\omega\left(\frac{1}{\sqrt{n}}\right)\right)}} + \frac{1}{q_n\omega(\frac{1}{\sqrt{n}})}\int_0^{\omega^{-1}(\frac{q_n}{2}\omega(\frac{1}{\sqrt{n}}))}\frac{\omega(z)dz}{z\sqrt{|lnz|}}\},$$

where $\omega^{-1}(z)$ is the inverse to $\omega(x)$ function.

Theorem 9. Let conditions (A_2) – (D_2) be satisfied. Then for any $n \in N$ and for all $z \geq 64$, the inequality

$$P\{\max_{(t,s)\in G}|\frac{\eta_n(t,s)}{\gamma_n}| \geq 2z\} \leq 2exp\{-\frac{z^2}{2}\gamma_n^2\}$$

is valid.

Corollary. Let $\omega(x)$ in condition (A_2) be such that $\omega\left(\frac{1}{\sqrt{n}}\right)\gamma_n \downarrow 0$. If the conditions of Theorem 9 be satisfied, then for any $\varepsilon > 0$, $0 < \delta < 1$, for all $n \in N$,

$$n \geq n_0(\varepsilon,\delta) = $$
$$= min\{n \in N: 2c_0\omega(\frac{1}{\sqrt{n}})(64\gamma_n + \sqrt{2ln\frac{2}{\delta}}) \leq \varepsilon\},$$

the inequality

$P\{\max_{(t,s)\in G}|\xi(t,s) - P_n(\xi;t,s)| < \varepsilon\} \geq 1-\delta$ holds.

It should be noted that approximations of random processes in a uniform metric is considered in the works [2], [3], [8-10] and [13].

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Issue Article

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REFERENCE DATA OF PRESSURE DISTRIBUTION ON THE SURFACES OF AIRFOILS HAVING THE NAMES BEGINNING WITH THE LETTER U

Abstract: *The results of the computer calculation of air flow around the airfoils having the names beginning with the letter U are presented in the article. The contours of pressure distribution on the surfaces of the airfoils at angles of attack of 0, 15 and -15 degrees in conditions of the subsonic airplane flight speed were obtained.*

Key words: *airfoil, angle of attack, pressure, surface.*

Language: *English*

Citation: Chemezov, D., et al. (2023). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter U. *ISJ Theoretical & Applied Science, 10 (126),* 306-327.

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Scopus ASCC: *1507.*

Introduction

Creating reference materials that determine the most accurate pressure distribution on the airfoil surfaces is an actual task of the airplane aerodynamics.

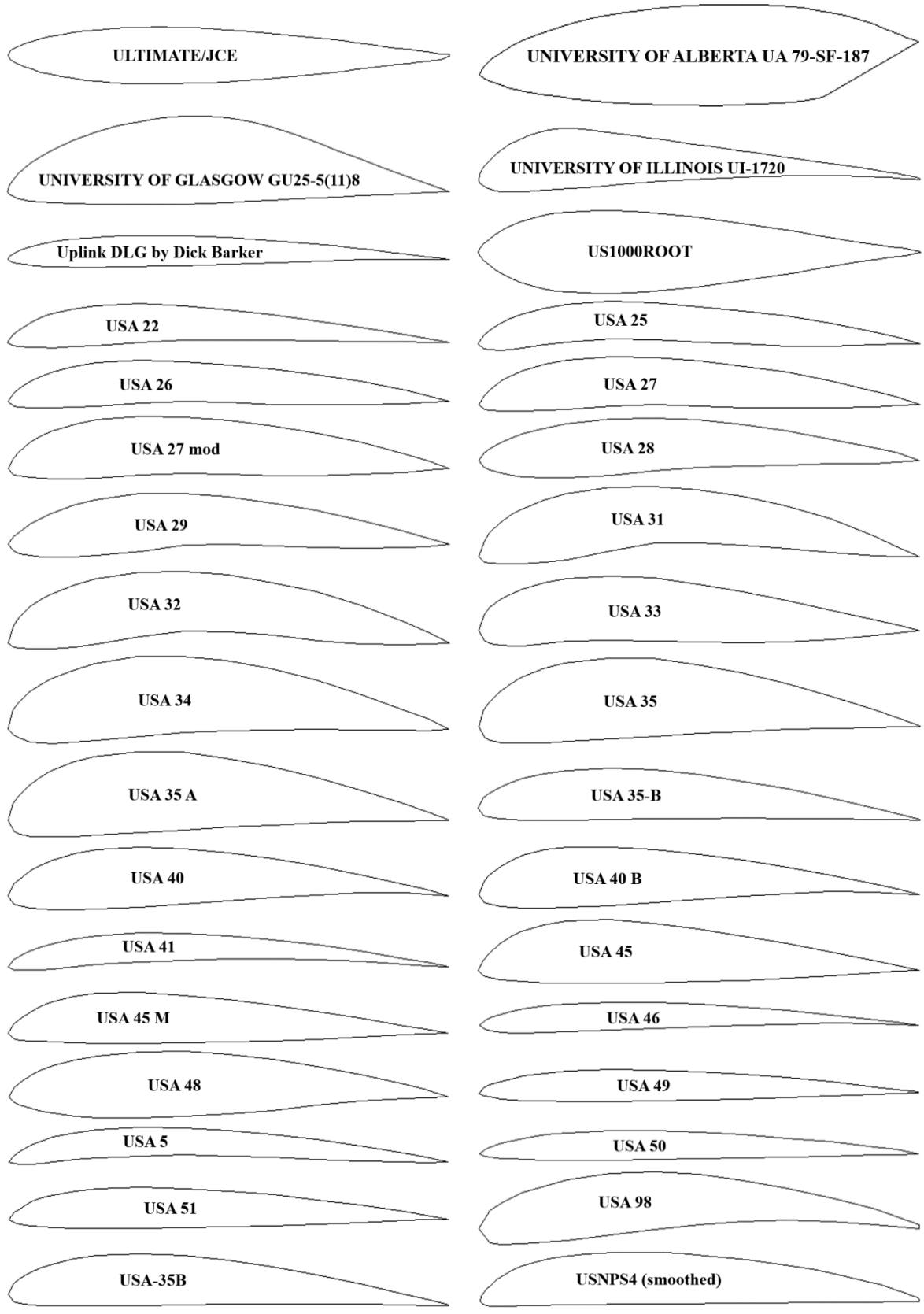
Materials and methods

The study of air flow around the airfoils was carried out in a two-dimensional formulation by means of the computer calculation in the *Comsol Multiphysics* program. The airfoils in the cross section were taken as objects of research [1-37]. In this work, the airfoils having the names beginning with the letter *U* were adopted. Air flow around the airfoils was carried out at angles of attack (α) of 0, 15 and -15 degrees. Flight speed of the airplane in each case was subsonic. The airplane flight in the atmosphere was carried out under normal weather conditions. The geometric characteristics of the studied airfoils are presented in the Table 1. The geometric shapes of the airfoils in the cross section are presented in the Table 2.

Table 1. The geometric characteristics of the airfoils.

Airfoil name	Max. thickness	Max. camber	Leading edge radius	Trailing edge thickness
ULTIMATE/JCE	12.85% at 34.2% of the chord	0.05% at 0.0% of the chord	0.8961%	0.5804%
UNIVERSITY OF ALBERTA UA 79-SF-187	29.62% at 67.5% of the chord	5.89% at 100.0% of the chord	0.2016%	10.27%
UNIVERSITY OF GLASGOW GU25-5(11)8	19.99% at 40.0% of the chord	7.13% at 45.0% of the chord	1.3448%	0.0%
UNIVERSITY OF ILLINOIS UI-1720	13.8% at 17.9% of the chord	4.64% at 23.8% of the chord	2.1541%	0.0614%
Uplink DLG by Dick Barker	7.0% at 29.1% of the chord	1.8% at 39.3% of the chord	0.3639%	0.0%
US1000ROOT	18.57% at 27.1% of the chord	0.13% at 0.0% of the chord	0.6962%	0.0096%
USA 22	9.1% at 20.0% of the chord	4.42% at 40.0% of the chord	0.785%	0.1%
USA 25	8.28% at 20.0% of the chord	5.24% at 30.0% of the chord	0.9853%	0.0%
USA 26	9.82% at 20.0% of the chord	4.34% at 40.0% of the chord	1.0195%	0.0%
USA 27	11.07% at 30.0% of the chord	5.1% at 40.0% of the chord	1.128%	0.02%
USA 27 mod	13.29% at 30.0% of the chord	5.1% at 40.0% of the chord	1.5494%	0.024%
USA 28	13.16% at 30.0% of the chord	3.75% at 50.0% of the chord	1.239%	0.0%
USA 29	13.16% at 30.0% of the chord	5.54% at 40.0% of the chord	1.242%	0.0%
USA 31	14.86% at 20.1% of the chord	9.36% at 39.9% of the chord	2.2425%	0.0%
USA 32	14.72% at 20.0% of the chord	9.33% at 40.0% of the chord	2.0712%	0.0%
USA 33	14.19% at 30.0% of the chord	4.86% at 30.0% of the chord	3.4496%	0.0%
USA 34	17.99% at 30.0% of the chord	7.7% at 40.0% of the chord	2.9586%	0.0%
USA 35	18.14% at 30.1% of the chord	6.41% at 40.1% of the chord	4.0949%	0.43%
USA 35 A	18.14% at 30.1% of the chord	6.41% at 40.1% of the chord	4.0949%	0.43%
USA 35-B	11.61% at 30.0% of the chord	5.96% at 30.0% of the chord	1.6642%	0.25%
USA 40	13.32% at 30.0% of the chord	4.19% at 40.0% of the chord	1.987%	0.1%
USA 40 B	13.63% at 20.0% of the chord	4.0% at 40.0% of the chord	2.3536%	0.0%
USA 41	6.6% at 30.0% of the chord	4.49% at 40.0% of the chord	0.7349%	0.0%
USA 45	14.52% at 30.1% of the chord	4.14% at 30.1% of the chord	1.404%	0.0%
USA 45 M	11.63% at 30.0% of the chord	3.32% at 30.0% of the chord	1.1829%	0.0%
USA 46	6.54% at 20.0% of the chord	2.17% at 40.0% of the chord	0.7365%	0.0%
USA 48	14.9% at 30.0% of the chord	2.88% at 40.0% of the chord	1.3037%	0.0%
USA 49	7.25% at 30.0% of the chord	1.73% at 40.0% of the chord	0.6395%	0.23%
USA 5	6.38% at 30.0% of the chord	4.53% at 40.0% of the chord	0.6074%	0.0%
USA 50	7.04% at 30.0% of the chord	1.95% at 40.0% of the chord	0.6436%	0.0%
USA 51	9.33% at 30.0% of the chord	2.57% at 30.0% of the chord	0.7526%	0.0%
USA 98	14.3% at 30.0% of the chord	6.6% at 50.0% of the chord	3.0712%	0.9%
USA-35B	11.61% at 30.0% of the chord	3.19% at 30.0% of the chord	1.6642%	0.25%
USNPS4 (smoothed)	11.94% at 34.2% of the chord	5.02% at 34.2% of the chord	1.0858%	0.7756%
Note: *USA 35-B (U.S. Navy (USA)).*				

Table 2. The geometric shapes of the airfoils in the cross section.



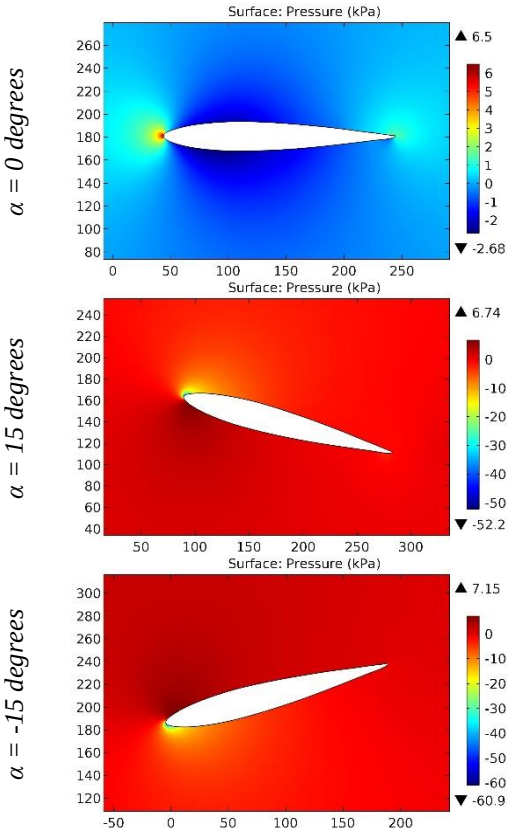


Figure 1. The pressure contours on the surfaces of the ULTIMATE/JCE airfoil.

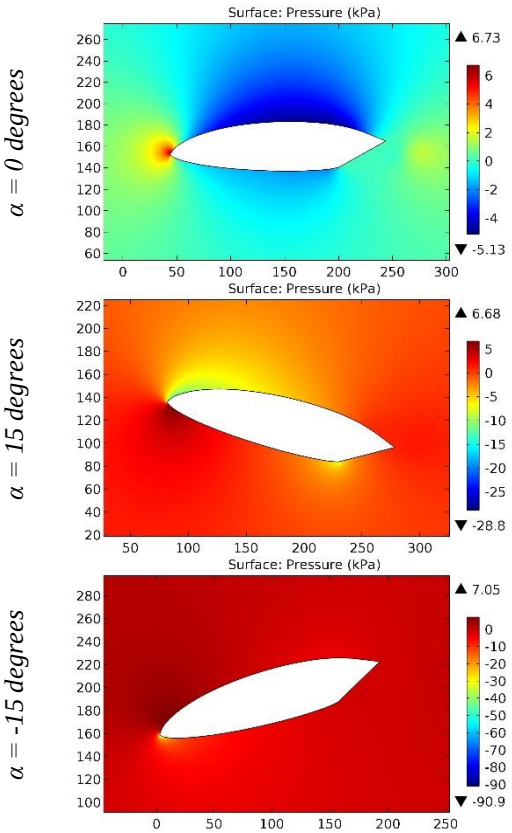


Figure 2. The pressure contours on the surfaces of the UNIVERSITY OF ALBERTA UA 79-SF-187 airfoil.

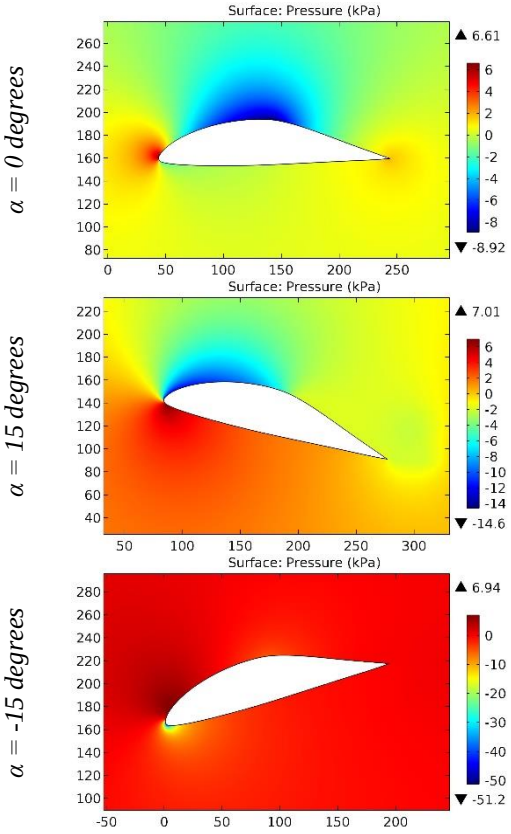


Figure 3. The pressure contours on the surfaces of the UNIVERSITY OF GLASGOW GU25-5(11)8 airfoil.

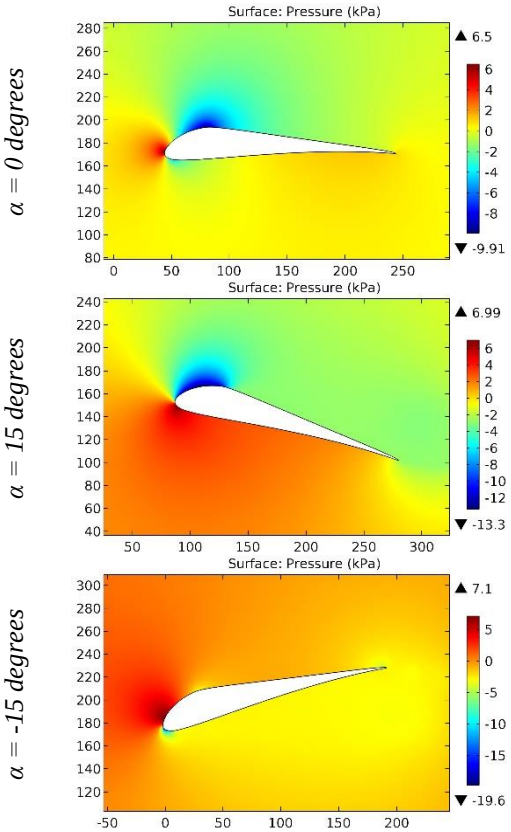


Figure 4. The pressure contours on the surfaces of the UNIVERSITY OF ILLINOIS UI-1720 airfoil.

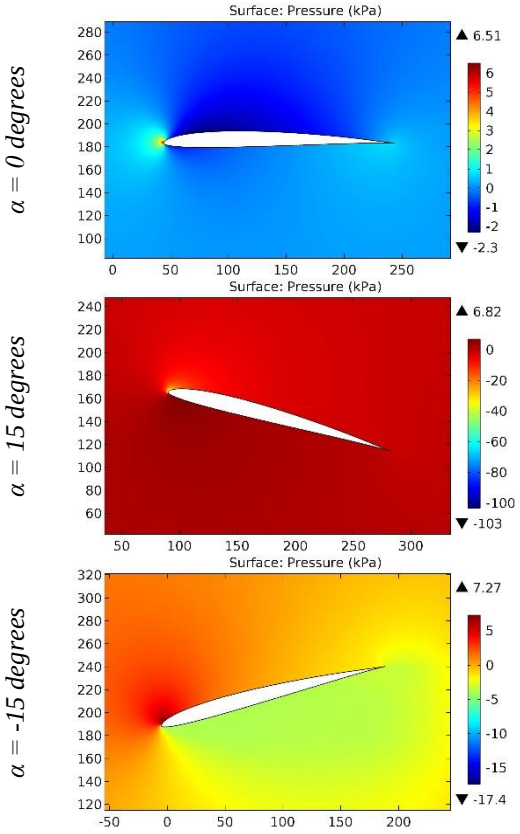


Figure 5. The pressure contours on the surfaces of the Uplink DLG by Dick Barker airfoil.

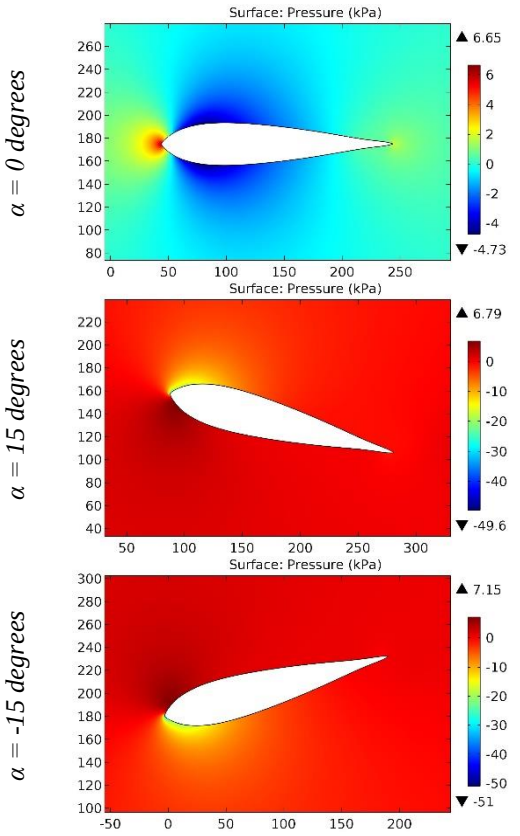


Figure 6. The pressure contours on the surfaces of the US1000ROOT airfoil.

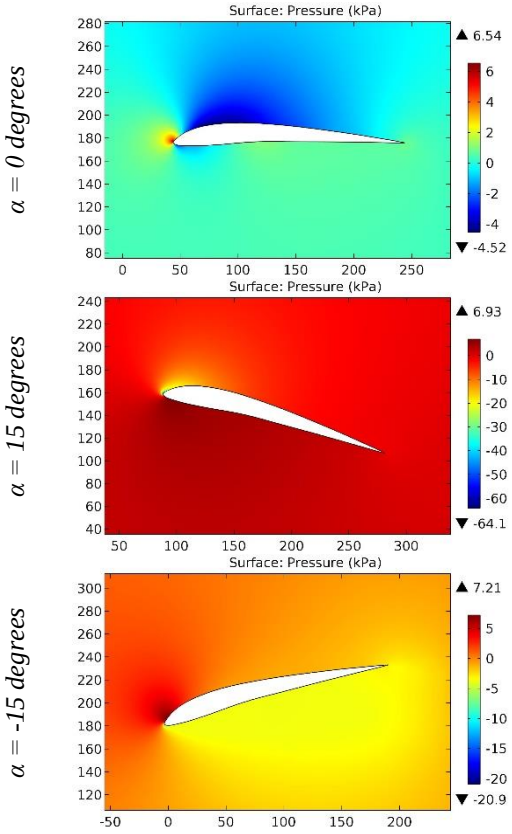


Figure 7. The pressure contours on the surfaces of the USA 22 airfoil.

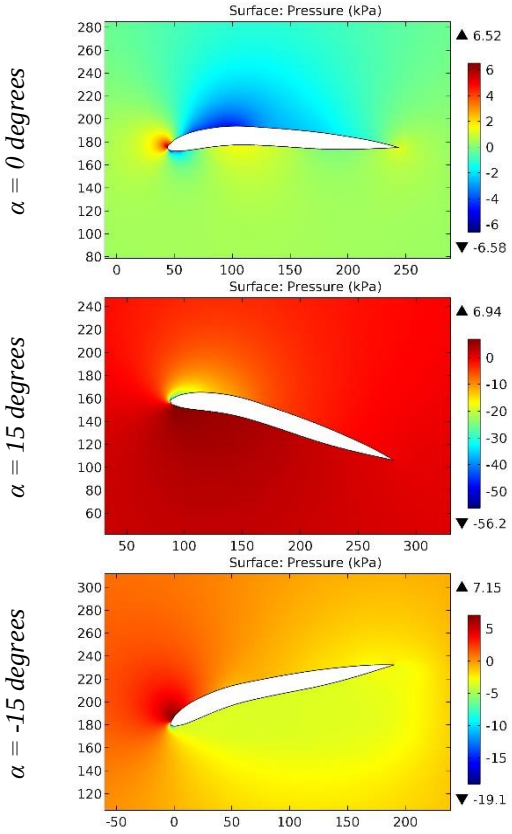


Figure 8. The pressure contours on the surfaces of the USA 25 airfoil.

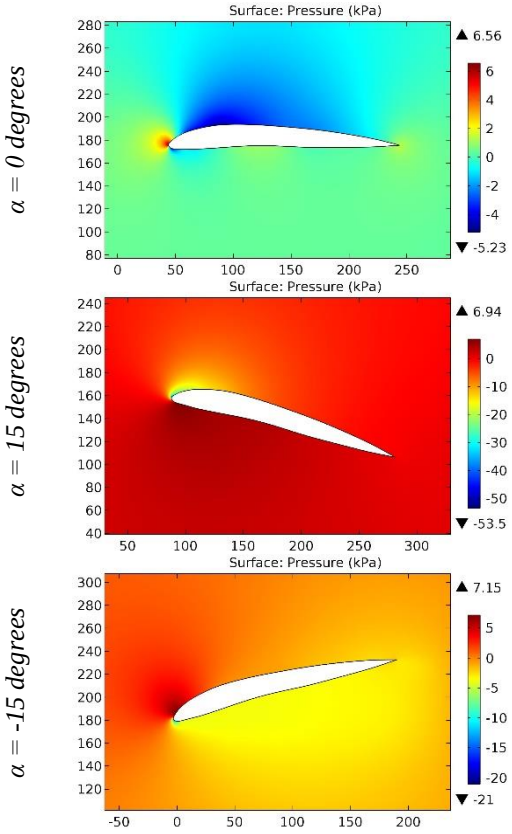


Figure 9. The pressure contours on the surfaces of the USA 26 airfoil.

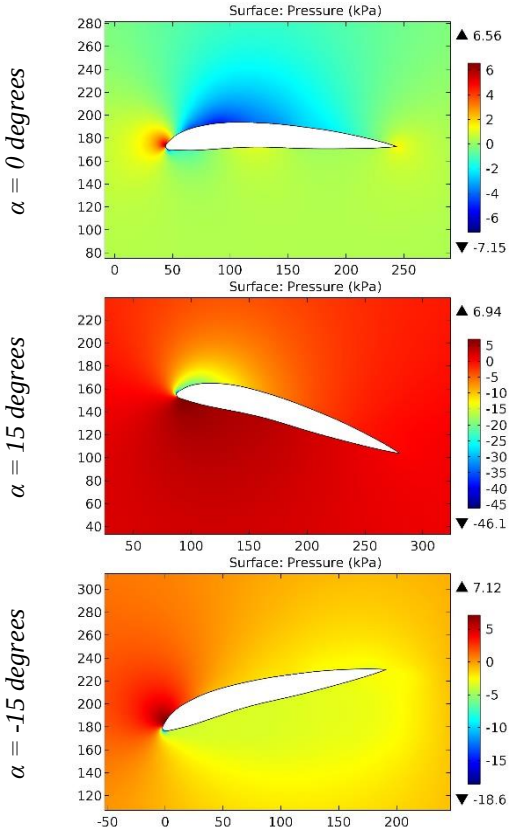


Figure 10. The pressure contours on the surfaces of the USA 27 airfoil.

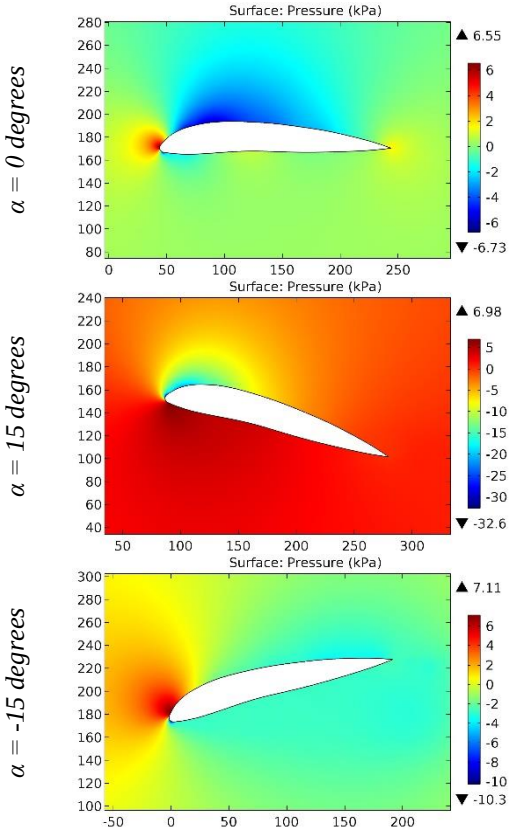


Figure 11. The pressure contours on the surfaces of the USA 27 mod airfoil.

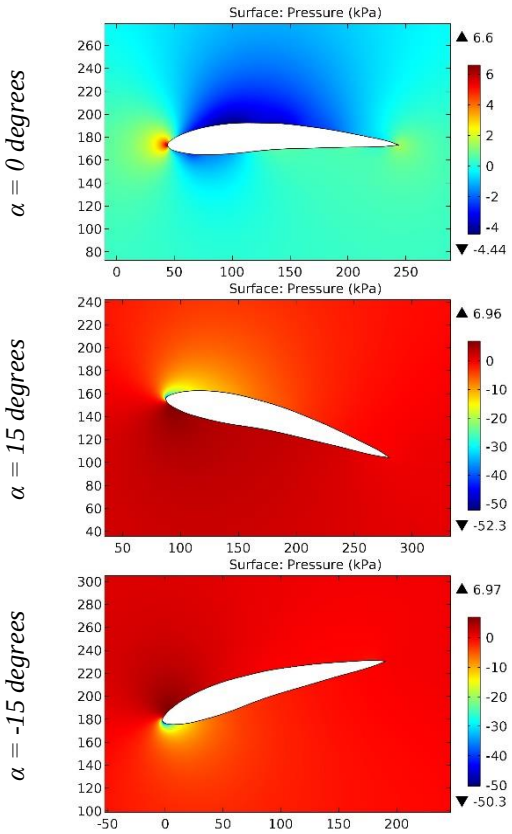


Figure 12. The pressure contours on the surfaces of the USA 28 airfoil.

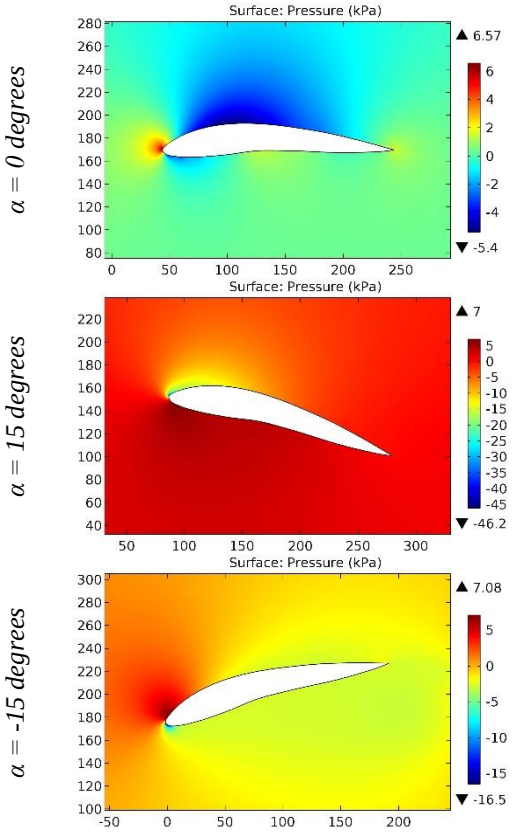


Figure 13. The pressure contours on the surfaces of the USA 29 airfoil.

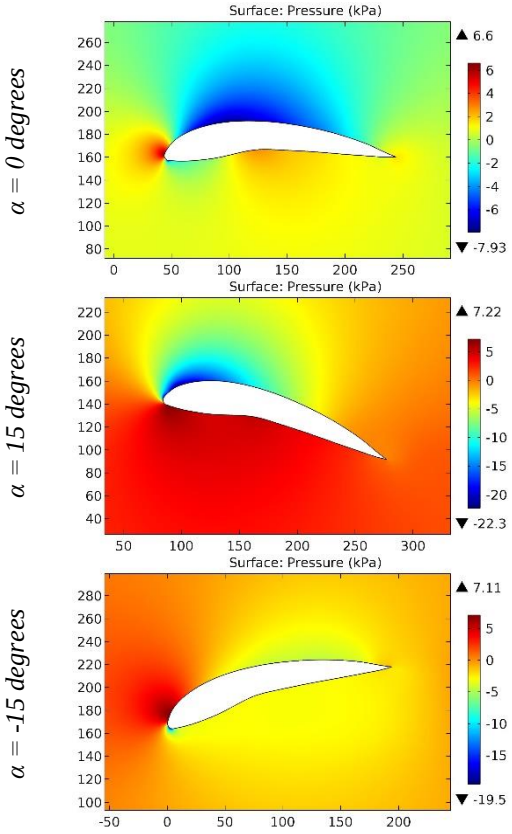


Figure 14. The pressure contours on the surfaces of the USA 31 airfoil.

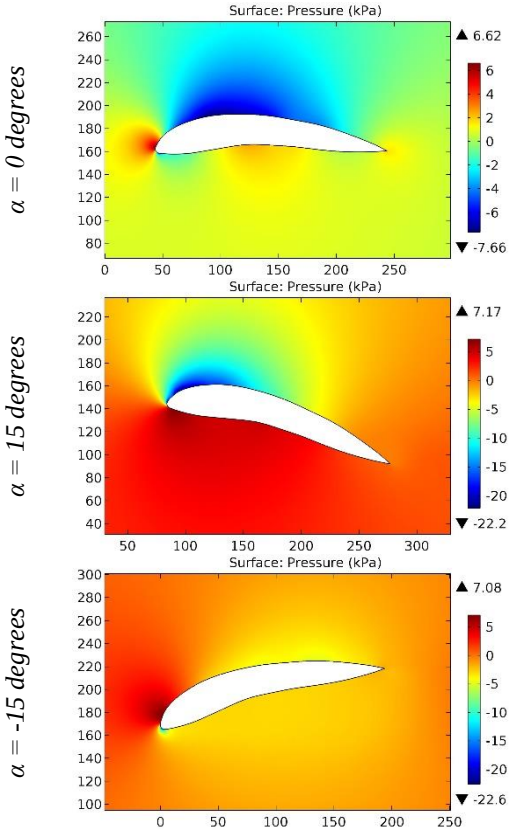


Figure 15. The pressure contours on the surfaces of the USA 32 airfoil.

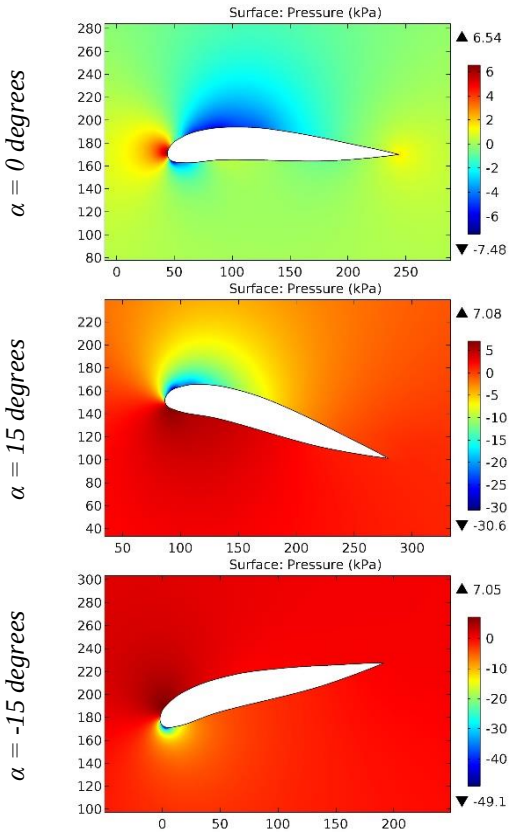


Figure 16. The pressure contours on the surfaces of the USA 33 airfoil.

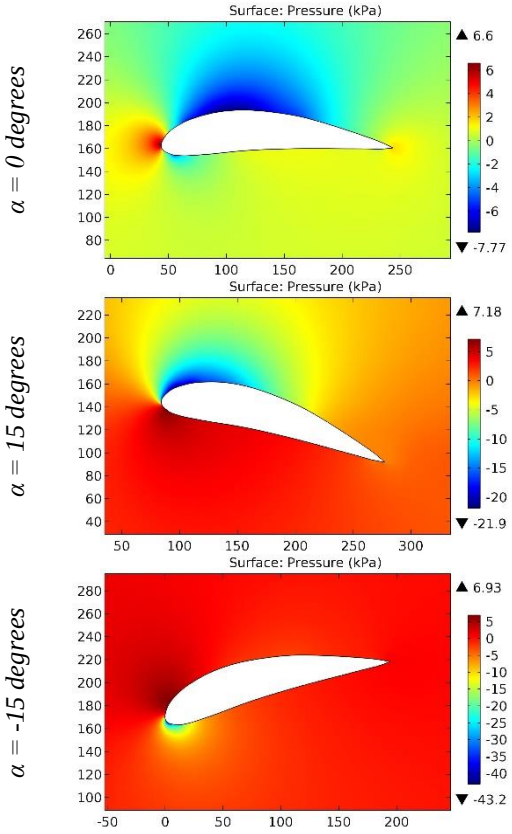


Figure 17. The pressure contours on the surfaces of the USA 34 airfoil.

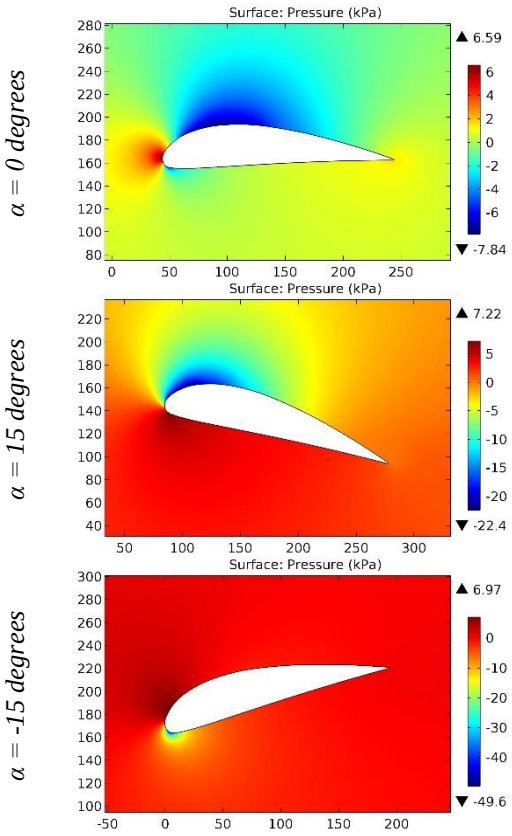


Figure 18. The pressure contours on the surfaces of the USA 35 airfoil.

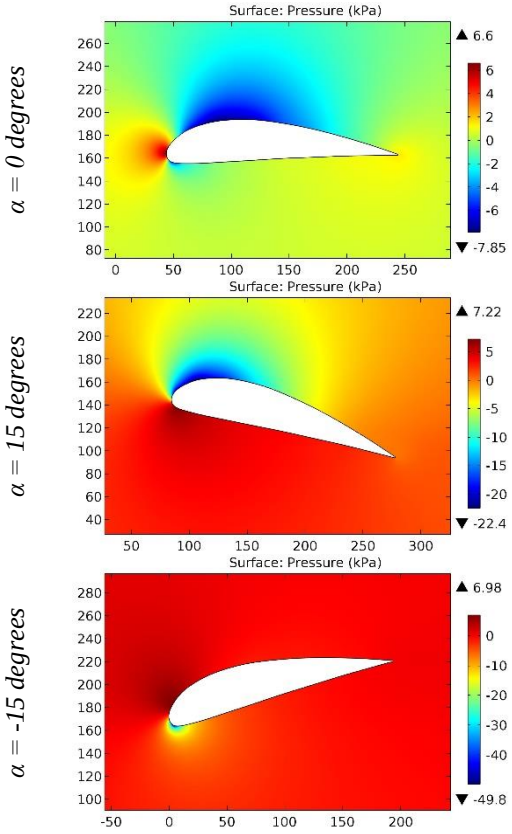


Figure 19. The pressure contours on the surfaces of the USA 35 A airfoil.

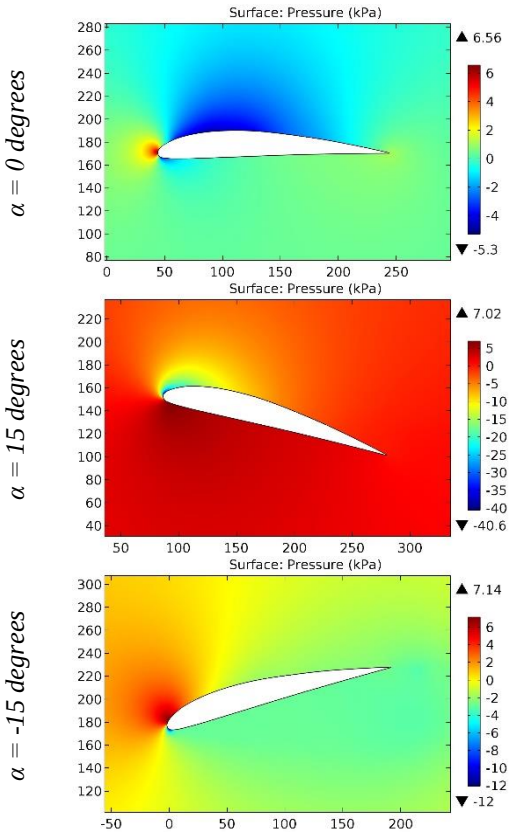


Figure 20. The pressure contours on the surfaces of the USA 35-B airfoil.

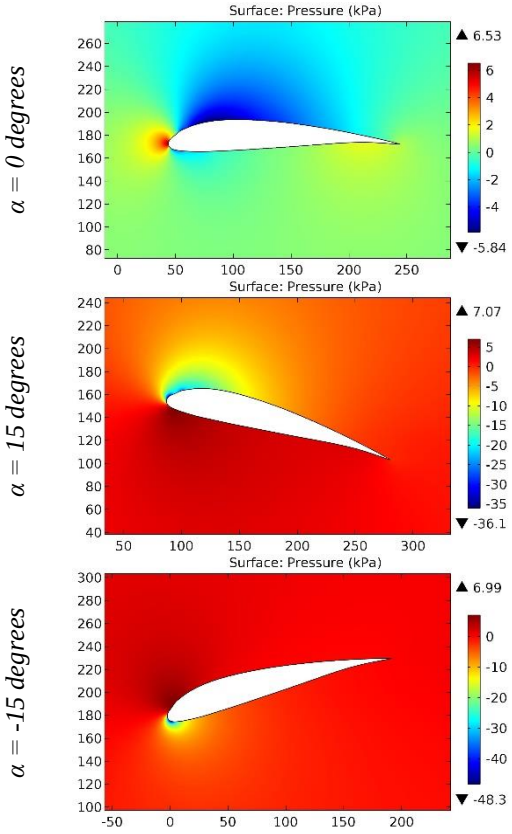


Figure 21. The pressure contours on the surfaces of the USA 40 airfoil.

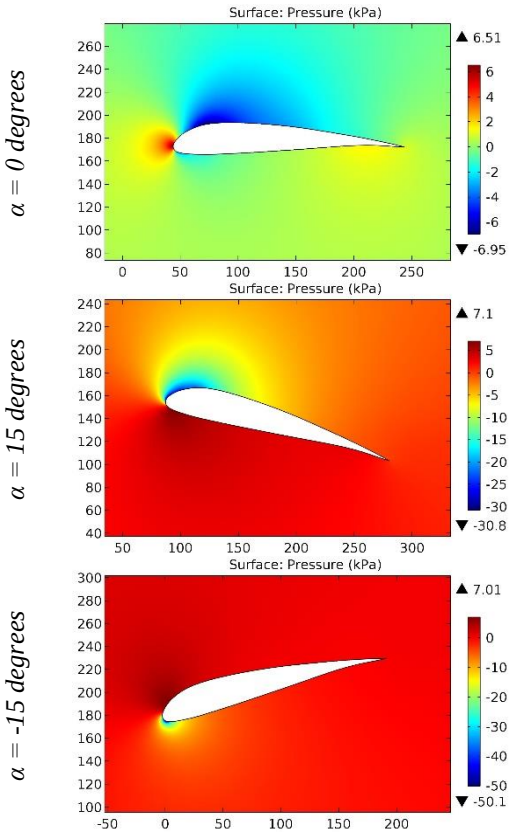


Figure 22. The pressure contours on the surfaces of the USA 40 B airfoil.

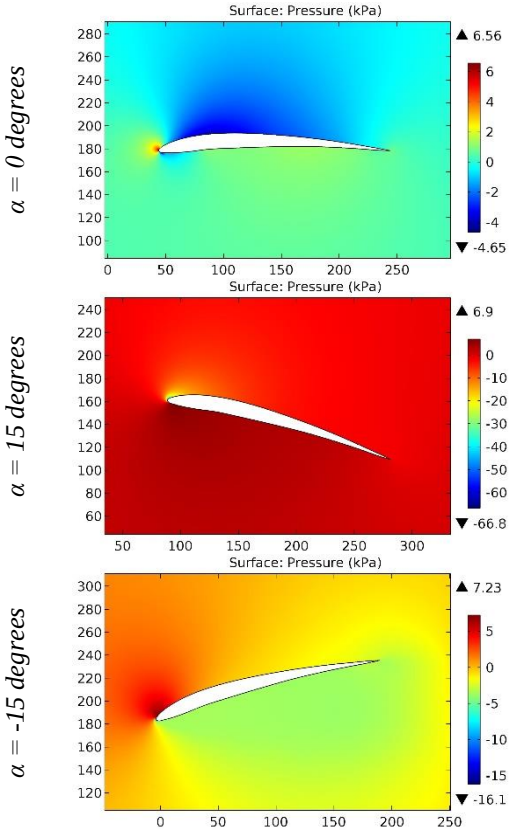


Figure 23. The pressure contours on the surfaces of the USA 41 airfoil.

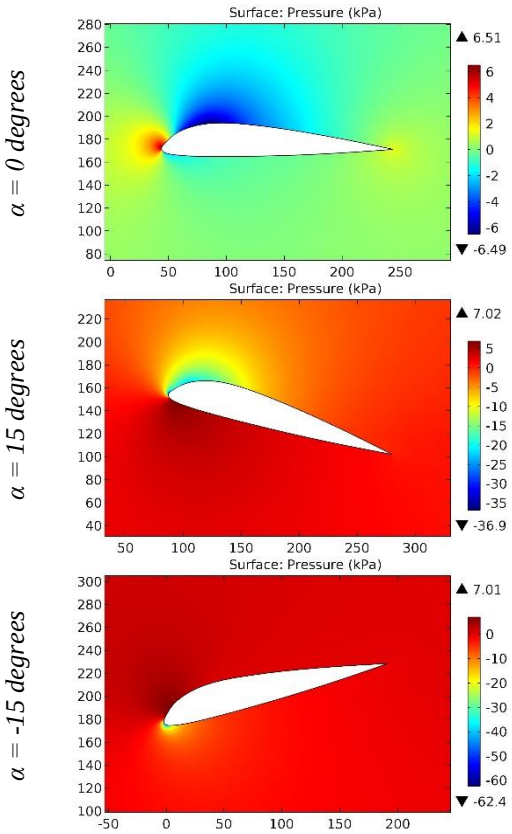


Figure 24. The pressure contours on the surfaces of the USA 45 airfoil.

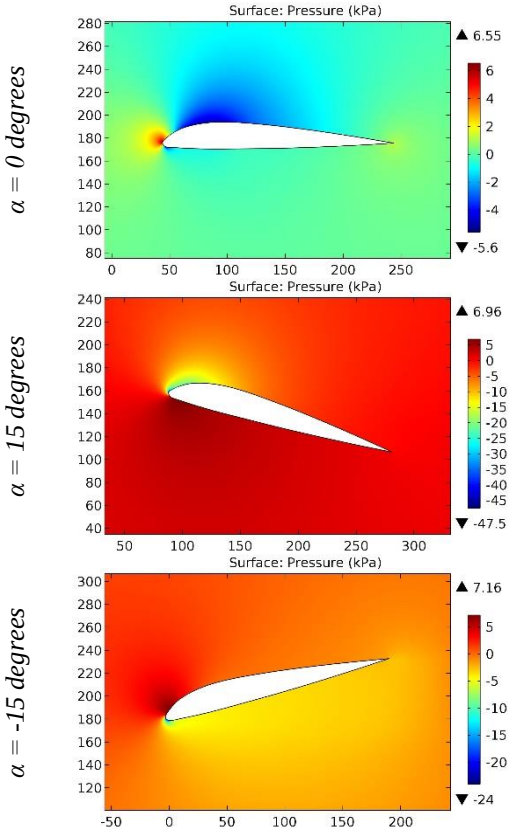


Figure 25. The pressure contours on the surfaces of the USA 45 M airfoil.

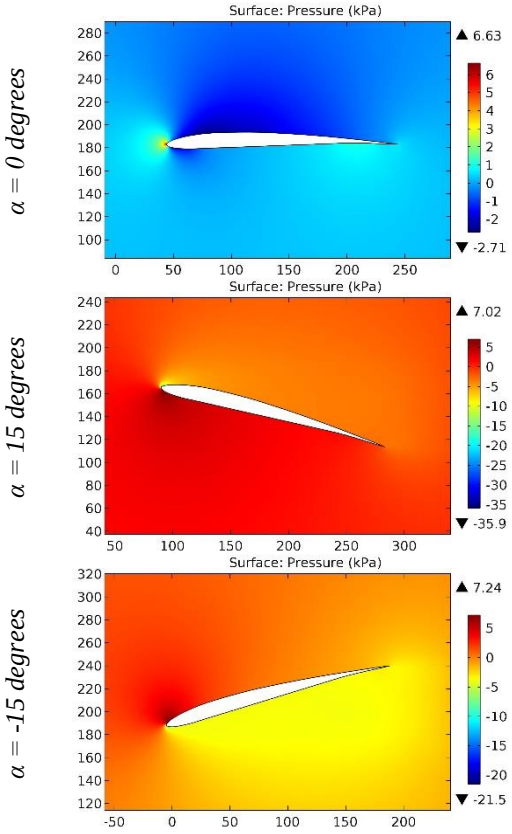


Figure 26. The pressure contours on the surfaces of the USA 46 airfoil.

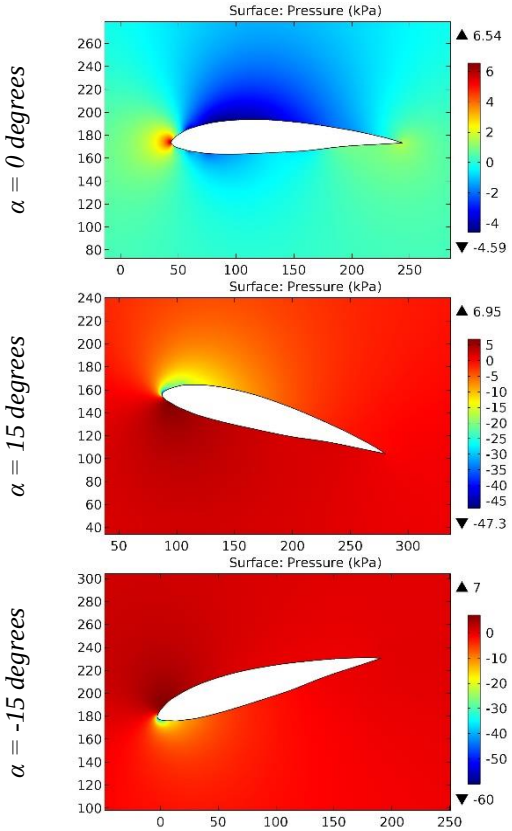


Figure 27. The pressure contours on the surfaces of the USA 48 airfoil.

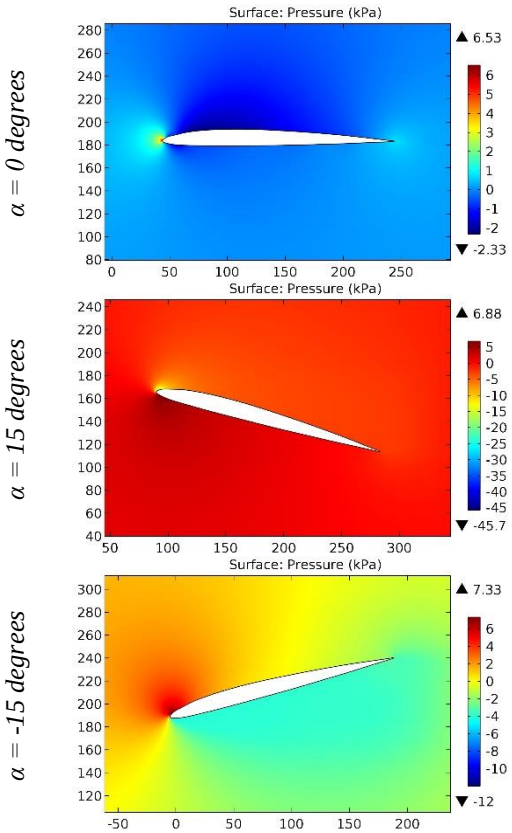


Figure 28. The pressure contours on the surfaces of the USA 49 airfoil.

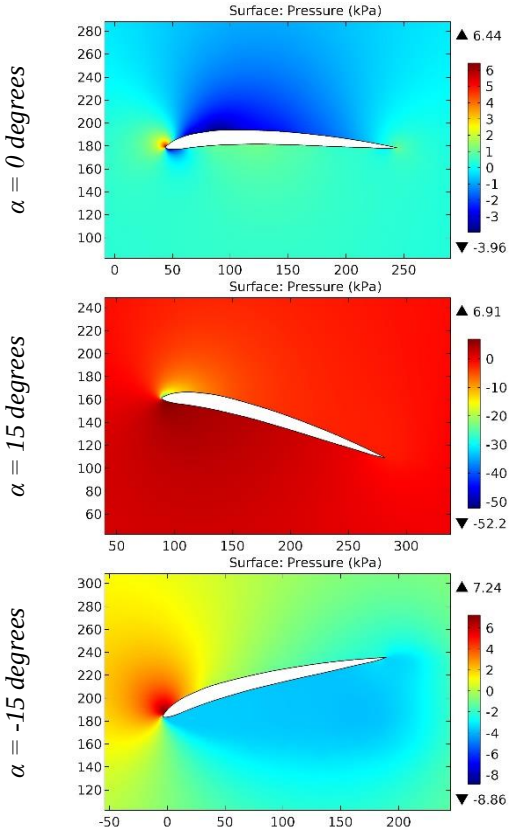


Figure 29. The pressure contours on the surfaces of the USA 5 airfoil.

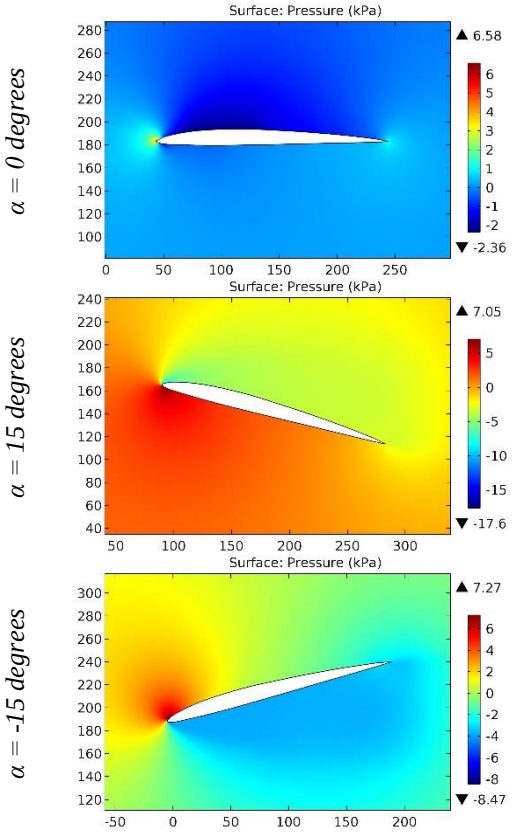


Figure 30. The pressure contours on the surfaces of the USA 50 airfoil.

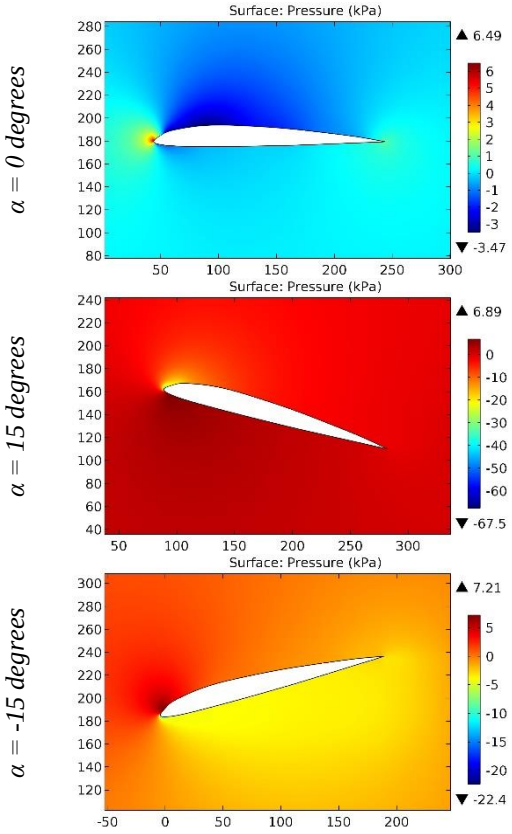


Figure 31. The pressure contours on the surfaces of the USA 51 airfoil.

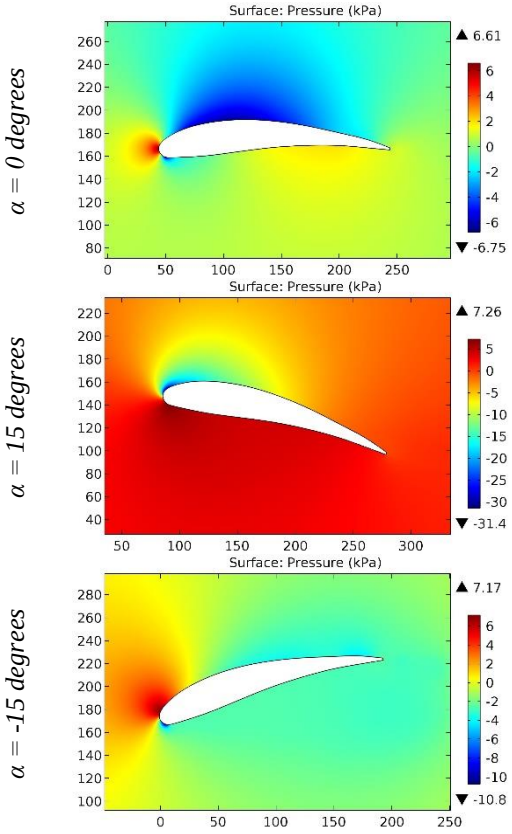


Figure 32. The pressure contours on the surfaces of the USA 98 airfoil.

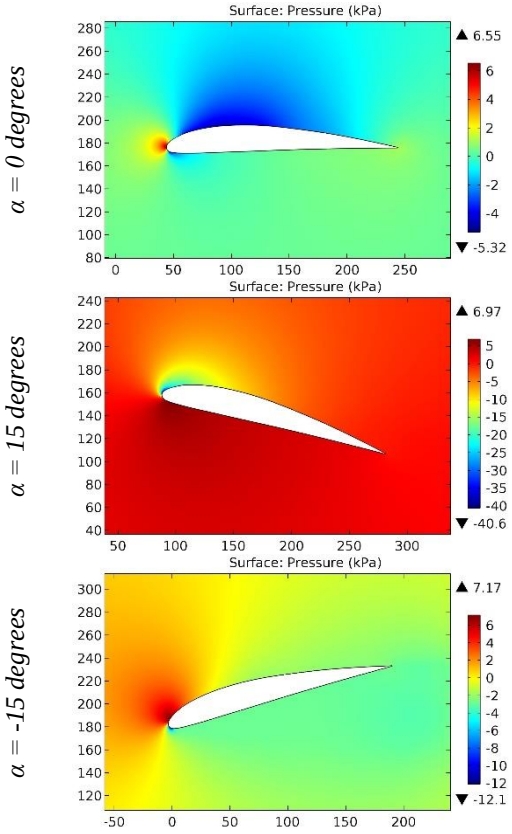


Figure 33. The pressure contours on the surfaces of the USA-35B airfoil.

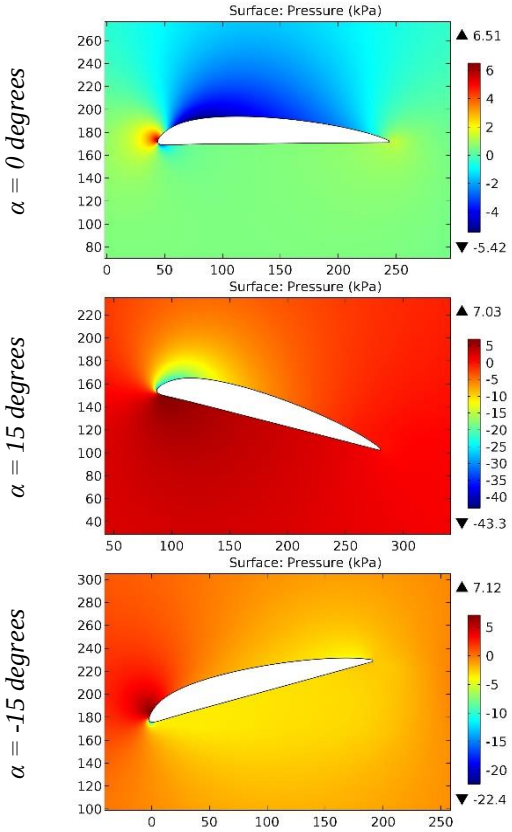


Figure 34. The pressure contours on the surfaces of the USNPS4 (smoothed) airfoil.

Results and discussion

The calculated pressure contours on the surfaces of the airfoils at different angles of attack are presented in the Figs. 1-34. The calculated values on the scale can be represented as the basic values when comparing the pressure drop under conditions of changing the angle of attack of the airfoils.

34 airfoils of the USA, UNIVERSITY and other types were subject to consideration. All airfoils are asymmetrical.

The UNIVERSITY OF ALBERTA UA 79-SF-187 airfoil has the maximum thickness. The minimum thickness is specified for the USA 5 airfoil. The maximum camber of 9.36% is determined for the USA 31 airfoil.

A minimum camber of 0.05% is specified for the ULTIMATE/JCE airfoil. The largest leading edge radius was observed for the USA 35 and USA 35 A airfoils, and the minimum radius was observed for the UNIVERSITY OF ALBERTA UA 79-SF-187 airfoil. The greatest thickening of the trailing edge is made in the UNIVERSITY OF ALBERTA UA 79-SF-187 airfoil. Most airfoils do not have a trailing edge thickening.

Let us consider the aerodynamic characteristics of the airfoils described above.

The ULTIMATE/JCE airfoil is subjected to almost the same intensity of pressure distribution on the leading edge both during climb and descent of the airplane, due to minimal camber. But the amount of drag when climb is less than when descent of the airplane.

The configuration of the UNIVERSITY OF ALBERTA UA 79-SF-187 airfoil during the airplane maneuvers leads to a greater spread in the distribution of negative pressure on the leading edge. When an airplane descends, the pressure on the leading edge is approximately 3 times greater than when it climbs.

The USA 5 airfoil, when the airplane climb, has a greater lift force due to the difference in pressure on the upper and lower surfaces. The pressure difference on the upper and lower surfaces is much smaller as the airplane descent.

The USA 31 airfoil, which has maximum camber in the cross section, is subject to negligible pressures acting on the surfaces and edges of the wing. A convex upper surface contributes to the formation of negative pressure on it at angles of attack of 0 and 15 degrees, and a negative angle of attack causes positive pressure on this surface.

For the USA 35 and USA 35 A airfoils, when the airplane climb, a pressure difference arises on the upper and lower surfaces, which is approximately two times smaller than when descent.

Conclusion

Depending on the geometry of the airplane wing, airfoils can be subjected to maximum drag, both during climb and descent. In particular cases, the positive effect of the camber magnitude and the small thickness of the airfoils in the cross section on the aerodynamic characteristics of the airplane wings was noted. The greatest pressure difference on the wing surfaces is the UNIVERSITY OF ALBERTA UA 79-SF-187 model from the above-considered airfoils.

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	JIF	= 1.500	SJIF (Morocco)	= 7.184	OAJI (USA)	= 0.350

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Issue Article

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REFERENCE DATA OF PRESSURE DISTRIBUTION ON THE SURFACES OF AIRFOILS HAVING THE NAMES BEGINNING WITH THE LETTER V

Abstract: *The results of the computer calculation of air flow around the airfoils having the names beginning with the letter V are presented in the article. The contours of pressure distribution on the surfaces of the airfoils at angles of attack of 0, 15 and -15 degrees in conditions of the subsonic airplane flight speed were obtained.*

Key words: *airfoil, angle of attack, pressure, surface.*
Language: *English*

Citation: Chemezov, D., et al. (2023). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter V. *ISJ Theoretical & Applied Science, 10 (126)*, 328-332.

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Introduction

Creating reference materials that determine the most accurate pressure distribution on the airfoil surfaces is an actual task of the airplane aerodynamics.

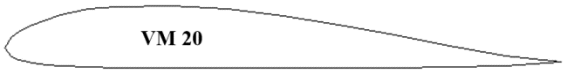
Materials and methods

The study of air flow around the airfoils was carried out in a two-dimensional formulation by means of the computer calculation in the *Comsol Multiphysics* program. The airfoils in the cross section were taken as objects of research [1-37]. In this work, the airfoils having the names beginning with the letter *V* were adopted. Air flow around the airfoils was carried out at angles of attack (α) of 0, 15 and -15 degrees. Flight speed of the airplane in each case was subsonic. The airplane flight in the atmosphere was carried out under normal weather conditions. The geometric characteristics of the studied airfoils are presented in the Table 1. The geometric shapes of the airfoils in the cross section are presented in the Table 2.

Table 1. The geometric characteristics of the airfoils.

Airfoil name	Max. thickness	Max. camber	Leading edge radius	Trailing edge thickness
VL62-JAP	7.01% at 30.0% of the chord	6.84% at 40.0% of the chord	0.6927%	0.25%
VM 20	11.05% at 30.0% of the chord	5.53% at 30.0% of the chord	1.3142%	0.0%
Note: *VM 20 (France).*				

Table 2. The geometric shapes of the airfoils in the cross section.



Results and discussion

The calculated pressure contours on the surfaces of the airfoils at different angles of attack are presented in the Figs. 1-2. The calculated values on the scale can be represented as the basic values when comparing the pressure drop under conditions of changing the angle of attack of the airfoils.

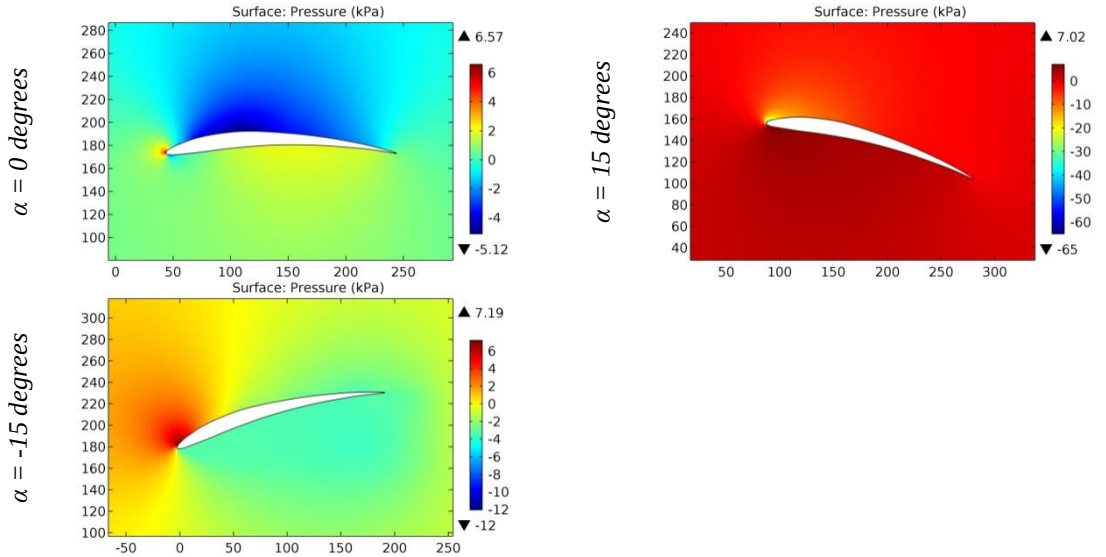


Figure 1. The pressure contours on the surfaces of the VL62-JAP airfoil.

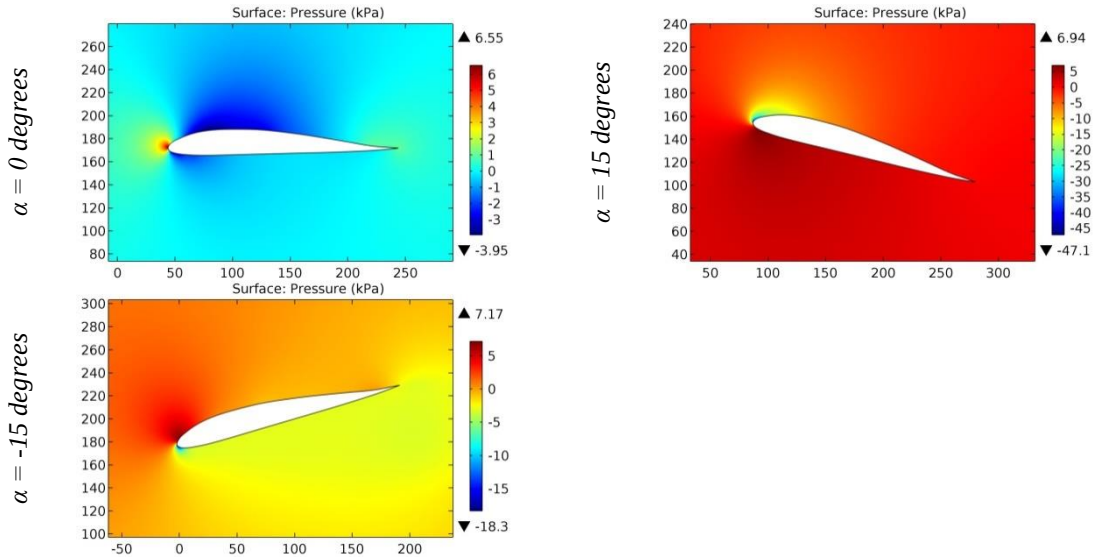


Figure 2. The pressure contours on the surfaces of the VM 20 airfoil.

The considered airfoils are asymmetrical. The maximum thickness is observed in the VM 20 airfoil, however, the maximum camber along the chord length is noted in the VL62-JAP airfoil. The ratio of the leading edge radii of the two airfoils is approximately 1:2. At the same time, it is noted that the VL62-JAP airfoil has a thickening on the trailing edge, and the VM 20 airfoil does not have it.

Let us compare the aerodynamic properties of the considered airfoils.

At an angle of attack of 0 degrees, a positive pressure arises on the leading edge of the airfoils, characterizing the drag, approximately the same in each case. During the climb of the airplane, the difference in pressures on the leading edge is significantly different: the drag on the leading edge of the VL62-JAP airfoil is higher than on the leading edge of the VM 20 airfoil. When the airplane descends, the pressure on the leading edge of the VL62-JAP airfoil is less than when the airplane descent with a wing having the VM 20 airfoil in the cross section. Thus, it can be concluded that the lifting force of the VL62-JAP airfoil when the airplane descent is greater than the lifting force of the VM 20 airfoil, which characterizes the best aerodynamic qualities of the first profile.

Conclusion

The large amount of camber of the VL62-JAP airfoil leads to an increase in drag on the leading edge, but also increases the lift of the airplane wing during descent. The large thickness of the VM 20 airfoil ensures a decrease in the drag coefficient during the climb of the airplane, but reduces the lift when the flight altitude decreases.

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3rd ORDER TRANSIENT GEOMETRIC-GETTING NUMERICAL SERIES AND THEIR CHARACTERISTICS

Abstract: *Here are the geometric and numerical series addition performed with the same number of thresholds and the 3rd order transitive geometric number of new number sequences obtained as a result of subtraction operations series organized by proved. At the same time this type of ridges its features have been studied.*

Key words: *geometric and number series, limits, collection and exit, difference, multiply.*

Language: *English*

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Introduction

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It is known that a numerical sequence is such a sequence of numbers that, starting from the second limit, each of its limit from himself previous limit the same one of the number from the total is taken [1, 2]. other to the definition according to finite if the sequence of its first differences in the sequence remains constant ($a_i - a_{i-1} = d$) , 1st compilation to this sequence number series it is said [3].

If *m* - th of differences sequence stable has been ($m - 1$) - th of differences sequence stable if not, then to sequence *m* - th compilation number series it is said [3, 4]. This in definition record those who are common has been both name (1- c compilation), both too high compiled number ranges coverage does.

Appreciation according to geometric series so number is the sequence that the second too much starting with his each onelimit from himself previous limit ratio stable remains [1, 2].

The number and geometric ranges between connection about is reported that if $y_1, y_2, \cdots, y_n$

the difference *d* which is number is a series $x_1, x_2, \dots, x_n$ $q = a^d$, then $a^{x_1}, a^{x_2}, a^{x_3}, \dots$ sequence having an accent geometric is a series [4]. This the same based strength of the tops consistently as change contains does. $x_1, x_2, \dots, x_n$ Actually in question of the relationship $a > 0$, the difference *d* the number of series with, stroke *q* which is geometric series between connection that it is not it is obvious. Here new one of sequence u_n purchase given. This sequence to work geometric series organize does. Y.N. Sukonnikin u_n [5] investigation numerical-geometric which he called a series to sequence dedication has been done. Numerical-geometric series sequence has been in the recurrent case so given: $u_{n+1} = qu_n + d$, (1)
here q and d – are constants.

In the article it is said that numerical-geometric series special case $q = 1$ when $d = 0$ number series, when to work geometric is a series. This line up (1) initially in relation to $n = 1,2,3,\dots, q \neq 1, d \neq 0$ to be intended is held.

Numerical-geometric line up limit revealed formula is as follows:

$$u_{n+1} = q^n\left(u_1 + \frac{d}{q-1}\right) - \frac{d}{q-1}. \quad (2)$$

The same at the time numerical-geometric series 2nd compilation turning there was a sequence

$$u_{n+1} = (q+1)u_n - qu_{n-1} \quad (3)$$

equation with is given.

$$d = \frac{u_n^2 - u_{n-1}u_{n+1}}{u_n - u_{n-1}}$$

Numerical-geometric line up the difference so appointment is:

$$a_n = u_{n+1} - u_n \quad (4)$$

Submission which is numerical-geometric line up 2nd compilation turning sequence naming [5] it seems his first of differences sequence geometric series formation with is connected. This is numerical-geometric in the series (5) sequence, stroke q which is geometric is a series.

The actuality of the subject. Instead, on the same number of terms of the given geometric and numerical series addition and subtraction given Examining the geometric-numerical series obtained as a result of actions and Deriving the appropriate formulas for determining their main indicators of this field of science deepens and serves its development. The possibilities of applying the obtained results in various fields of science expands . This point of view topic is relevant.

The purpose of the study. Conducted on the same numbered limits of the given geometric and numerical series addition and subtraction geometric-numerical series consisting of new sequences obtained as a result of actions characteristics to investigate and key indicators certain is to do.

Research object. Conducted on the same numbered limits of the given geometric and numerical series transactions as a result received new are sequences .

Research methods. Theoretical studies of the same numerical limits of given geometric and numerical series on conducted transactions as a result received new of sequences characteristics to study service does.

Materials and discussions

With the direct participation of the limits and other important indicators of the given geometric and numerical series it is important to study the new sequences obtained . On limits of geometric and numerical series instead of collection made and exit received from operations of new sequences characteristics let's investigate.

Theorem 1. Given geometric and number line up and either number and geometric line up from the first a sequence consisting of the sum of the terms of the same number starting from constitutes a geometric-numerical series and his the second differences form a new geometric series. The product of this series is the given geometric seriesequal to the multiplication has been limits number to work two limit is less.

$$b_n = b_1 + d(n-1)$$

$$b_1 a_n a_1$$

Theorem from the condition it appears whom one geometric and one number series is given. Let's catch it that geometric series $a_n = a_1 q^{n-1}$, number series and formulas with is given here and b_n – suitable a_n the *nth* limit of geometric and numerical series ; and – respectively, geometric and numerical series first limit; *q* – geometric series stroke; *d* – the numerical sequence difference; *n* – suitable series limits common is the number.

$a_1, a_2, \dots, a_n$

$b_1, b_2, \dots., b_n$

In the given formulas n=1,2,3... determine the corresponding limits of the corresponding series by writing the values make becomes I mean

geometric series hit *q* , number series difference *d* .

This of ridges the same No limits collecting the following sequence we get:

...,

$$g_1 = a_1 + b_1,$$
$$g_2 = a_2 + b_2 = a_1 q + b_1 + d,$$
$$g_3 = a_3 + b_3 = a_1 q^2 + b_1 + 2d$$
$$g_4 = a_4 + b_4 = a_1 q^3 + b_1 + 3d,$$

$$g_{n-2} = a_{n-2} + b_{n-2} = a_1 q^{n-3} + b_1 + d(n-3)$$
$$g_{n-1} = a_{n-1} + b_{n-1} = a_1 q^{n-2} + b_1 + d(n-2)$$
$$g_n = a_n + b_n = a_1 q^{n-1} + b_1 + d(n-1) \quad (6)$$

here g_1, g_2, ..., g_n, – geometric-numerical line up limits replaced expression; *n* – both too geometric number line up limits is the number. g_1, g_2 g_n

Every two given from the ridges organize where for new sequence (7),

for now conditional as,

geometric-numerical series ,..., let's call it

Now we determine the first differences of $d_{1,i}$ this series:

$$d_{1,1} = g_2 - g_1 = a_1 q + b_1 + d - a_1 - b_1 = a_1(q-1) + d,$$
$$d_{1,2} = g_3 - g_2 = a_1 q^2 + b_1 + 2d - a_1 q - b_1 - d = a_1 q(q-1) + d,$$
$$d_{1,3} = g_4 - g_3 = a_1 q^3 + b_1 + 3d - a_1 q^2 - b_1 - 2d = a_1 q^2(q-1) + d$$

...,

$$d_{1,n-3} = g_{n-2} - g_{n-3} = a_1 q^{n-3} + b_1 + d(n-3) - a_1 q^{n-4} - b_1 - d(n-4) = \\ = a_1 q^{n-4}(q-1) + d$$
$$d_{1,n-2} = g_{n-1} - g_{n-2} = a_1 q^{n-2} + b_1 + d(n-2) - a_1 q^{n-3} - b_1 - d(n-3) = \\ = a_1 q^{n-3}(q-1) + d$$
$$d_{1,n-1} = g_n - g_{n-1} = a_1 q^{n-1} + b_1 + d(n-1) - a_1 q^{n-2} - b_1 - d(n-2) = \\ = a_1 q^{n-2}(q-1) + d$$

$d_{1,i}$ (7)

here $i = n-1$ – first of differences suitable limit price; *i* – geometric-numerical line up first of differenceslimits is the number, .

First of differences (7) from the sequence use by doing (6) geometric-numerical of the ridge the second differences

$d_{2,m}$ Now we determine it:

$$d_{2,1} = d_{1,2} - d_{1,1} = a_1 q(q-1) + d - a_1(q-1) - d = a_1(q-1)^2 = v_1,$$
$$d_{2,2} = d_{1,3} - d_{1,2} = a_1 q^2(q-1) + d - a_1 q(q-1) - d = a_1 q(q-1)^2 = v_2$$

,...,

$$d_{2,m-1} = d_{1,n-2} - d_{1,n-3} = a_1 q^{n-3}(q-1) + d - a_1 q^{n-4}(q-1) - d = \\ = a_1 q^{n-4}(q-1)^2 = v_{m-1}$$
$$d_{2,m} = d_{1,n-1} - d_{1,n-2} = a_1 q^{n-2}(q-1) + d - a_1 q^{n-3}(q-1) - d = \\ = a_1 q^{n-3}(q-1)^2 = v_m$$

$d_{2,m}$ – (8)

$m = i - 1 = n - 2$ second here of differences suitable limit price; *m* – the second of differences in sequence of limitsis the number, .

$v_1, v_2, \dots, v_m$ (8)

in sequence $d_{2,1}, d_{2,2}, \dots, d_{2,m}$ and or limits is the number.

$m = \mathrm{n} - 2$

Second of differences consisting of sequence, to the definition according to Yes having a number new geometricseries to be of the stroke for stable to be conditional must be paid . This of sequence hit find:

$$\frac{v_2}{v_1} = \frac{a_1 q(q-1)^2}{a_1(q-1)^2} = q, \dots,$$
$$\frac{v_m}{v_{m-1}} = \frac{a_1 q^{n-3}(q-1)^2}{a_1 q^{n-4}(q-1)^2} = q.$$

$v_1, v_2, \dots, v_m$

Received strokes equal to be shows that the second of differences sequence consisting of accented geometric line up stroke with is the same and of this series number of thresholds too

$m = \mathrm{n} - 2$- is _ m

$n = \mathrm{m} + 2$ in his statement *n* - in by writing instead received new geometric line up limits so can be:

$v_1 = a_1(q-1)^2$, $v_2 = a_1 q(q-1)^2$,...,
$v_m = a_1 q^{m-1}(q-1)^2$,

where *m* =1,2,3,...by writing, *a 1* and it is possible to set any limit according to the values of *q* . Theorem 1 for received suitable geometric-numerical line up (6) nth _ limit so is written:

$g_n = a_1 q^{n-1} + b_1 + d(n-1)$. (6a)

from the sequence new geometric line up m _ limit is as follows:

$v_m = a_1 q^{m-1}(q-1)^2$. (9a)

$g_1,g_2,...,g_n$ (6) geometric-numerical of the ridge n-first limit total the following is like:

$$S_n = g_1 + g_2 + \cdots + g_n = a_1 + b_1 + a_2 + b_2 + \cdots + a_n + b_n = \\ = \frac{a_1(q^n-1)}{q-1} + \frac{b_1+b_n}{2}n$$

and either

$$S_n = \frac{a_1(q^n-1)}{q-1} + \frac{2b_1+d(n-1)}{2}n. \quad (10a)$$

New geometric the ridge $v_1, v_2, \dots, v_m$, (9) sequence based on his *m* - the first limit total to work the following whom appointment is done:

$$S_m = \frac{v_1(q^m-1)}{q-1} = a_1(q^m-1)(q-1). \quad (11)$$

Theorem 2. The given geometry line up starting with the first each one limit with given number a sequence consisting of the difference of the same numbered terms of the series constitutes a geometric-numerical series and itsthe second differences form a new geometric series. This series of the given geometric sequence equal to the multiplication has been limits number to work two limit is less.

As in Theorem 1, suppose a geometric series and a_n numerical series b_n given. Theorem condition according to given geometric series , from the first starting with each one extreme given number line up the same No limit if we leave received new sequence it happens like this:

$$\begin{aligned} &g_1 = a_1 - b_1 = a_1 + (-b_1), \\ &g_2 = a_2 - b_2 = a_2 + (-b_2) = a_1q + (-b_1 - d), \\ &g_3 = a_3 - b_3 = a_3 + (-b_3) = a_1q^2 + (-b_1 - 2d) \\ &g_4 = a_4 - b_4 = a_4 + (-b_4) = a_1q^3 + (-b_1 - 3d) \\ &\dots, \\ &g_n = a_n - b_n = a_n + (-b_n) = a_1q^{n-1} + [-b_1 - d(n-1)]. \end{aligned} \quad (12)$$

(12) in sequence exit practical collection with being replaced theorem 1-in condition suitable as received. Then according to theorem 1 of the new sequence of (12). to organize a geometric-numerical series and his second consisting of differences of sequence to work new the formation of a geometric series is obtained. This the product of the series is the given geometric series hit is equal to and and the number of limits is given than that of the series two limit is low. This case too new geometric in series (9). which is like (6) and (12) of sequences spelling comparison if we do to see happens that only the difference (12) each in writing of the second summation for the limit opposite sign, that is, it is negative. (6) and (12) that the first collected ones of the geometric series in the corresponding limits of the sequences are the same, but number to the series belong which is the second of those gathered opposite marked to be at the expense of received geometric-numerical The limits of the series with the same number are different in price. It is clear from the above that the first of the sequence obtained after the addition operation performed on the limits of the given series and when determining their second difference, the indices of the numerical series are completely corrected, on the contrary, given geometric line up indicators to work new geometric the ridge they form.

These reasons, the same numbered terms of the geometric series and the same numbered terms of the numerical series collection on or the arithmetic sequence of the sequence obtained as a result of subtraction operations of being named based that it is shows.

New geometric line up done coming for before geometric-numerical line up first and the second differences need to be determined. The transition to a new geometric series is the second of the geometric-number seriesof differences after the head to give his 3 rd compilation transitive geometric-numerical series naming conditions .

If the limits and other indicators of the given geometric and numerical series are the same for both theorems if so, of the limits of the received geometric-numerical series prices will be different. Despite this, received new geometric of the series indicators absolutely the same happens.

Theorem 2 for received geometric-numerical line up (12) *n* - th limit is as follows:

$$g_n = a_1q^{n-1} - b_1 - d(n-1). \quad (12a)$$

This case received new geometry line up *m* - th limit (9a) formula with statement is being

$g_1,g_2,...,g_n$

$$S_n = g_1 + g_2 + \cdots + g_n = a_1 - b_1 + a_2 - b_2 + \cdots + a_n - b_n = \\ = \frac{a_1(q^n-1)}{q-1} - \frac{b_1+b_n}{2}n$$

(12) geometric-numerical of the ridge *n* - the first the sum of the limit so appointment is done:

and either

$$S_n = \frac{a_1(q^n-1)}{q-1} - \frac{2b_1+d(n-1)}{2}n. \quad (13)$$

New geometric the ridge $v_1, v_2, \dots, v_m$, (9) sequence based on his *m* - the first limit total theorem in 1 (11) formula with appointment we do

Theorem 3. Given number line up from the first starting with each one limit with given geometric The sequence consisting of the difference of the same numbered terms of the series constitutes a geometric-

numerical series and its the second differences form a new geometric series. This series of the given geometric sequence is equal to the product and the sign of its limits changes oppositely, and the number of its terms is two less. For example, number series a_n and b_n geometric series is given. According to the condition of the theorem, the given numerical sequence , starting from the first, each one if we subtract the same numbered limit of the given geometric series from the limit received new sequence so can:

$$g_1 = b_1 - a_1 = b_1 + (-a_1) = -a_1 + b_1,$$
$$g_2 = b_2 - a_2 = b_2 + (-a_2) = -a_2 + b_2 = -a_1q + b_1 + d,$$
$$g_3 = b_3 - a_3 = b_3 + (-a_3) = -a_3 + b_3 = -a_1q^2 + b_1 + 2d$$
$$g_4 = b_4 - a_4 = b_4 + (-a_4) = -a_4 + b_4 = -a_1q^3 + b_1 + 3d$$
$$,...,$$
$$g_n = b_n - a_n = b_n + (-a_n) = -a_n + b_n = -a_1q^{n-1} + b_1 + d(n-1). \quad (14)$$

(14) sequence also, in (12). as in the subtraction operation replaced by summation, theorem Received in accordance with the condition of 1. Then (14) makes the new sequence a geometric-numerical series and sequence consisting of its second difference and forms a new geometric series. Previous in this series in theorems from those received the difference his of the sign of limits of the given on the contrary change.

For example, for the considered case, if the limits of the given geometric series have a positive sign , the new geometric line up limits sign on the contrary, it will change and negative will be.

Thus, it consists of the second difference of the geometric-numerical series obtained under the conditions of theorem 3 the sequence also forms a new geometric series. The product of this series to the product of the given geometric series is equal to limits sign on the contrary changes, limits number to work two limit is less.

New geometric line up limits (14) and (9) entries suitable as so can be:

$$v_1 = -a_1(q-1)^2,$$
$$v_2 = -a_1q(q-1)^2$$
$$,...,$$
$$v_m = -a_1q^{m-1}(q-1)^2, \quad (15)$$

here $m = 1,2,3,...$, known a_1 and of q _ relevant prices suitable (15) new geometricof the ridge any limit appointment make possible.

Theorem 3 for received suitable geometric-numerical line up (14) n - th limit so is written:

$$g_n = -a_1q^{n-1} + b_1 + d(n-1). \quad (14a)$$

New geometric m - th of the series limit to (15). suitable as such statement is:

$$v_m = -a_1q^{m-1}(q-1)^2. \quad (15a)$$

$g_1,g_2,...,g_n$

$$S_n = g_1 + g_2 + \cdots + g_n = -a_1 + b_1 - a_2 + b_2 - \cdots - a_n + b_n =$$
$$= \frac{-a_1(q^n-1)}{q-1} + \frac{b_1+b_n}{2}n$$

(6) geometric-numerical of the ridge n-first limit total so is taken:

and either

$$S_n = \frac{-a_1(q^n-1)}{q-1} + \frac{2b_1+d(n-1)}{2}n \quad (16)$$

New geometric the ridge $v_1, v_2, \dots, v_m$, (15) sequence based on his m – the first limit total so appointment we do:

$$S_m = \frac{v_1(q^m-1)}{q-1} = -a_1(q^m-1)(q-1). \quad (17)$$

Example 1. If of each number of thresholds 6, stroke q=3 which is geometric series

2, 6, 18, 54, 162, 486 and given a numerical sequence with difference d=2 3, 5, 7, 9, 11, 13 the 3rd set of transition geometric-numerical series obtained by collecting the terms with the same number starting from and new geometric line up limits and of the latter hit appointment do it

According to the condition of the example, by performing the summation of the limits , the 3rd arrangement is a transitive geometry. number line up limits appointment we do:

5,11,25,63,173,499. (M1)

Geometric-numerical line up (M1) first differences we find:

$d_{1,1} = 6, d_{1,2} = 14, d_{1,3} = 38, d_{1,4} = 110, d_{1,5} = 326.$

First of differences 6, 14, 38, 110, 326 sequence based on geometric-numerical of the ridge the second differencesappointment we do:

$d_{2,1} = 8, d_{2,2} = 24, d_{2,3} = 72, d_{2,4} = 216.$

Second of differences

8, 24, 72, 216 (M2)

sequence new geometric series that it is certain make for his hit we find:

$q_1 = 24:8 = 3, q_2 = 72:24 = 3, q_3 = 216:72 = 3.$

Received strokes equal to be with geometric-numerical of the ridge the second of differences consisting ofof sequence stroke q=3 which is new geometric series which is certain was done.

$m = n - 2 = 6 - 2 = 4$ (9a) formula based on too new geometric line up limits certain let's:Limits being the number

$$v_1 = 2 \cdot 1 \cdot 4 = 8, v_2 = 2 \cdot 3 \cdot 4 = 24, v_3 = 2 \cdot 9 \cdot 4 = 72, v_4 = 2 \cdot 27 \cdot 4 = 216$$

is taken.

Example 2. Based on the conditions of Example 1, the same number of the same number of the geometric series is the same number of the numerical series the limits of the 3rd set of commutative geometric-numerical series obtained by subtracting the limit of number and this series the second of differences consisting of sequences new geometric line up limits and set the stroke do it

First give an example condition suitable as the 3rd compilation transitive geometric-numerical line up limits appointment we do:

–1, 1, 11, 45, 151, 473. (M3)

Geometric-numerical of the ridge (M3) first differences we find:

$d_{1,1} = 2, d_{1,2} = 10, d_{1,3} = 34, d_{1,4} = 106, d_{1,5} = 322.$

First of differences 2, 10, 34, 106, 322 sequence based on geometric-numerical line up the second differencesappointment we do:

$d_{2,1} = 8, d_{2,2} = 24, d_{2,3} = 72, d_{2,4} = 216.$

The product of the new geometric series (M2) obtained since the values of the second differences are the same as in example 1 ,limits number, also other prices there too same as received will be.

Example 3. If each the number of terms of one 5, the difference d=3 which is number series

3, 6, 9, 12, 15 and the geometric series with the term q=3 5, 15, 45, 135, 405 is given, then the numerical series, Starting from the first, the same number of the geometric series from the end of the same number taken if we exceed the limit 3 rd compilation transitive geometric-numerical line up limits and new geometric line up limits and hit appointment do it

For example condition suitable as, of limits deduction instead of giving geometric-numerical line up limits appointment we do:

-2, -9, -36, -123, -390. (M4)

Geometric-numerical of the ridge (M4) first differences we find:

$d_{1,1} = -7, d_{1,2} = -27, d_{1,3} = -87, d_{1,4} = -267$.

First of differences -7, -27, -87, -267 sequence based on geometric-numerical line up the second differencesappointment we do:

$d_{2,1} = -20, d_{2,2} = -60, d_{2,3} = -180$.

Second of differences

-20, -60, –180 (M5)

sequence new geometric series that it is certain make for his hit we find: $q_1 = 3, q_2 = 3, q_3 = 3.$

A sequence consisting of the second differences of a geometric-numerical series with the received points being equal It is certain that there is a new geometric series with variable q=3, opposite sign and different values was done.

$m = n - 2 = 5 - 2 = 3$

Based on the formula (15a), let's determine the limits of the new geometric series:Limits being the number

$v_1 = -5 \cdot 1 \cdot 4 = -20, v_2 = -5 \cdot 3 \cdot 4 = -60, v_3 = -5 \cdot 9 \cdot 4 = -180$

is taken.

The result

1. Studies have shown that **v** given geometric and numerical series, starting from the first one, are the samea sequence consisting of the sum of the terms of no The 3rd arrangement forms a commutative geometric-numerical series and his the second differences form a new geometric series. The product of this series is the given geometric seriesequal to the multiplication has been limits number to work two limit is less.
2. It is established that with each term of the given geometric series, starting from the first one the sequence consisting of the difference of the same numbered terms of the given numerical series, the 3rd arrangement, transitive geometryconstitutes a number series and its the second differences form a new geometric series. This series stroke given geometric line up hit equal to and the number of limits two terms less.
3. It has been proven that given given by each term of the numerical series, starting from the first one The sequence consisting of the difference of the same numbered terms of the geometric series is the 3rd set of transitive geometric constitutes a number series and its the second differences form a new geometric series. This series whose product is equal to the product of the given geometric series, and the sign of its terms changes oppositely, the terms ofnumber to work two limit is less.
4. Given geometric and number ridges, from the first starting with the same No limits on conducted collection and exit deeds as a result received new of sequences 3 rd compilation transitive naming the geometric-numerical series is justified . For the formation of a new geometric series first, it is necessary to determine the first and second differences of the geometric-numerical series. New geometry the transition to the series occurs after the second differences of the geometric-numerical series , its 3rd arrangement transitive geometric-numerical naming the series conditions .

The novelty of the research work. It has been proved that if a given *m* number of 1- If we multiply

the terms of the same numbers of the number series, then the new sequence of numbers obtained *The m* - th arrangement forms a number series. For the first time, the general difference of high-order numerical series and the 2nd compilation number line up n-first limits of the total formulas removed .

Importance of research work. The obtained results can be included in the textbooks of the respective schools. Various science in the fields number sequence with connected with issues related conducted research in their work, of researchers math knowledge service to enrichment who did math is a device.

Research of work economic effect. Instead given investigation theoretical importance occupation does and the specific scientific-research work used to enrich the researcher's knowledge conclusion as a result own the opposite find can

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Impact Factor:					
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Issue Article

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METHODS AND TECHNIQUES OF TEACHING VOCABULARY FOR ADULT LEARNERS

Abstract: *The article deals with adult students' vocabulary teaching possibilities and outline suitable ways of effective and comfortable dealing with them. Adults are in many cases not really interested in language, but in what they do through it.*

Key words: *teaching, students, adults, motivation, strategy, habit, education, principle.*

Language: *English*

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Introduction

Adult students are completely different form children or adolescent students. Compared to younger group of students, adults do not need that much demonstration but ask for more explanation and formulation of principles. They are matured, their intelligence has already developed. They went through a whole educational system and they dispose of rich personal experience. They have also developed specific habits and have specific expectations. Adults are in many cases not really interested in language, but in what they do through it. That is to say, adult students view language as an instrument for doing other things. It is not always easy for them to make a decision of enrolling to a language course. They know they need to learn English for some reason - they dispose of a high degree of extrinsic motivation. But they also know that they will be in the same class with other students. This fact can be quite stressful for some of them. They are sure that "others'" level of English will be different from theirs, that they might not be good enough and the "others" might see it. It is not a pleasant idea and can play a key role in their final decision to "go for it" or not.

Quite interesting is the transformation of an attitude towards goals and their fulfilling in connection with the age of students and their mental development. Young learners can learn English with remarkable ease, enthusiasm and naturalness. They do not understand short/long-term goals as such. What they understand is the final classification and that it is important. More important are for them everyday activities presented in a form of games. They understand that there are task to be done, they do them and learn through them. These tasks represent short-term goals and attract children's concentration and attention through providing direct motivation (boring activity can attract children's attention only up to 40 minutes). Constant change of activities is beneficial and ensures fulfilling of the defined goals. Adolescents are in a very difficult condition as they often mean something completely different from what they actually feel and do. This 'disharmony' is caused by proceeding physiological change in an individual. They are competitive, they need to be seen in a good light by their peers and are very sensitive to criticism. They are extremely impatient and expect the success to come soon after setting the task. The morefast the cycle 'Task – Success – Appreciation – New task' is

the more motivating it is for them. They are not aware of long-term goals. Their inspiration is mere curiosity. It is necessary to explain why they should learn concrete language items or do concrete activities so that they are aware of their short-term goals the same as of their long-term goals. Moreover, the goals should be reminded to them regularly during the learning process as their interest in them can waver. Completely different situation occurs with adults. Since they usually choose themselves to be present in English lessons they are also usually highly motivated intrinsically. Their values have already been determined, they are well aware of their aims and they want to fulfil them. They are matured and responsible enough to realize that if they want to reach their aim(s) they must sacrifice something to that. They of course need to be encouraged from time to time to increase their motivation but generally they are easier to deal with than adolescents. None the less experience of success and praising are very important for them as well as they are for everyone else, including children and adolescents. Praising is a proof of success and success is always highly motivating. Therefore it is wise to increase students' interest and motivation by sensible use of praise.

One of the main objectives that adults have for learning English is to improve their vocabulary and improve it fast.

As we know, there is little worse for an English teacher than having frustrated adult students in a class who aren't either learning the vocabulary they want to or improving their English as quickly as they think they should be doing.

Most people don't learn English because they have a love of languages. Most adults are learning English for a purpose, whether it be to pass an exam, for business, their career or to go on holiday. So when deciding what vocabulary to teach them, you need to choose vocabulary which is useful or necessary for them.

The problem with adult classes in doing this is that they all have their own interests (e.g. football, technology, fashion etc...) and reasons for learning English (career, job hunting, business, travel etc...). If students aren't interested in the vocabulary they are learning, they'll just get bored and unmotivated. For a teacher choosing the right vocabulary to teach in class can be difficult.

The constant need to satisfy language (especially English) demands stipulated by potential employers affect everyone. Nowadays children usually start with English or some other languages in very young age. Sometimes they acquire a relatively high level before the end of their compulsory education. On the other hand older generations are in a huge language disadvantage. Learning English is not easy at all for them unless they dispose of at least basic knowledge of it (or some other Germanic language) or of general talent for languages. It is not easy at all to learn in mature age. Certain psychic barriers might negatively influence learning. To avoid that it is necessary to select the right and efficient learning strategy for adult students taking into consideration various important aspects arising out of their specific needs. The aim of this work is to discuss adult students' vocabulary teaching possibilities and outline suitable ways of effective and comfortable dealing with them.

In this section I would like to present some suggestions and possible ways of how to teach English vocabulary effectively through techniques which I use in my lessons and which can be further extended into other variations. They were mostly inspired by Craig Wealand's ideas presented on the Internet pages (http://www.mansioningles.com/profesores08.htm). They are based on the fact that students tend to group words and make associations and connections for better remembering. It is useful to find out the ways students learn new words, if they use particular techniques or systems and adjust them to be used in their lessons. The following techniques can be of good support to that.

FLASH CARDS

Flash cards are well known as a very useful tool for learning language. Yet the general opinion is that flash cards have a limited use and work well especially with young learners since they help them to visualize words. As cards can contain various things (words, pictures, phrases, functions, sentences, symbols etc.) their use is not limited at all and neither is the age of students they are suitable for. There is probably no reason to explain the principle of working with flash cards, as their use is more or less familiar to everyone. But it might be interesting to realize that cards with simple icons can help e.g. with revising when a simple pointing to a requested gender, tense or sentence form (positive, negative, question, imperative, statement) indicated on cards can represent a fast and non-disturbing way of instructing the student's production. Obviously, many other icons can be invented to indicate certain requests.

WORD WALLS

A word wall is a systematically organized collection of words, phrases, functions etc. displayed in larger letters on a wall or other well visible place in the classroom. It is a tool which highlights significant points and offers a visual reminder and an instant exposure of contained notes to students. They can refer to them as often as needed and they usually use them throughout the lesson whenever they are not sure about a certain language item or just for a simple checking of spelling, correctness of structures, etc. Some teachers have invented a system of big sheets of paper containing individual selections of various phrases and functions for students. Whenever we come across a new one, we add it to our word wall in

a form of a strip of paper glued to the corresponding group. E.g.: Saying god-bye: It was a pleasure to meet you. Take care and see you soon again. Disagreeing: I see it a different way. I see what you are saying but… I am sorry but I must disagree there. Expressing somebody's opinion completely absolutely entirely certainly

INSIGHT PICTURES

The characteristic of words can be represented the way they are written. Through this vocabulary gets personalized, which helps with remembering. Students can draw a word in any way they imagine it or associate it.

MEMORY PICTURES AND WORD ASSOCIATIONS

This technique is based on a principle of similarity of words from different languages. If the sound of a word reminds students of a word from their language it is worth to make an association, which would help them to remember it.

REPETITION

Learning of language items is primary but exercise and activities focused on repetition are very important too. It is supposed to be the third and last stage of so called PPP principle (Present – Practice – Produce). Repetition is a very useful way of not only bringing to mind and revising vocabulary items, which students has already learned, but it is also a great chance to find out what has already been well mastered by students and what needs more practice or possibly more explanation to be fixed. When we do exercises we concentrate on the parts that are not clear or make any kind of trouble (pronunciation, linking, tenses, collocations, meaning…). The problematic parts are marked to be easily found for later checking. Most students are asked not to write answers into their students' books for being able to work on the same exercise more times. Is it not a problem because the key for the exercises is available and if not we note the right answers into their exercise books. This way they can work and practice with the exercise at home. Doing the same exercise twice might seem to be boring but it is not and it is very effective indeed. Repetition of a certain exercise can help to improve the language enormously. Every time a problematic word or phrase is repeated either in the same or in different context is becomes more clear and familiar. The types of exercise we usually do are matching parts of collocations, expressions, lines of dialogues; gap-filling with supplied words/expressions; finishing sentences (I would like to……); true/false (correct/incorrect) exercises for reading comprehension or checking grammar used in supplied sentences.

CONVERSATION

Repetition is closely connected with conversation in communicative means. Students sometimes find it difficult to express themselves in particular situations or when they have particular communicative intentions. It has already been mentioned above that the aim of practice is to be able to modify and adjust the language to the actual knowledge and communicative ability of students. The improvement is possible only through practice. I never believed that re-learning the example conversations is a good idea for developing communicative ability. It may increase a negative feeling of dependence on the learned lines and inhibit the natural spontaneity of expressing the learner's own ideas and reactions. Therefore I make my students to speak as much and as free as possible and insist on their using English for any comments they make (which is unfortunately not always observed). For practicing conversation we use a very effective technique. We pick up words either accidentally or deliberately and talk about them. Another way to start conversation is working with pictures. Pictures showing social situations (a couple on a bench in a park, a girl on a bicycle, a group of people waiting for their bus…) interest students as they offer a possibility to imagine who the people are, what are they doing and why, what happened before and what might happen next. Pictures provide a good source of topics for speaking. Another useful way for practicing conversation is to work with texts. It is so-called learning for comprehension. The teacher firstly reads dialogues and stories so that a student should listen carefully to get an idea what the text is about and provide a short content of the story. Second listening is done over the text – students listen and read consequently. After this reading they should be able to provide more detailed information. According to the difficulty of the text we either discuss unknown words and phrases or continue with the final reading – by a student. This final reading should prepare students to be able enough to retell the story in their own words, to paraphrase it or summarize it. A role-play activity for further practice sometimes follows. The presented scheme is usually more or less successful but there are many aspects influencing the process like tiredness, health condition, level of the text, weather… The good thing is that every activity can be simply adjusted to the actual circumstances.

MAKING MISTAKES

Mastering a new language is not an easy task at all. It is a very complicated process which is unavoidably connected with making mistakes. There is a variety of mistakes: error, mistake, slip of the tongue, fossilised mistake etc. They all are made for various reasons but we will simply use the general term 'mistake', which will be sufficient for this matter. Whatever activity students do it is always

closely connected with making mistakes. That is a natural rule. The traditional way of looking at mistakes is that they are forbidden. Students should perform in a way of avoiding them otherwise they are most likely to be reproached and punished by a bad mark. But this attitude is completely wrong. It is the other way round. Students should not be afraid of making mistakes at all. Mistakes are extremely important for learning and making them during their learning process is the best way of a successful acquisition of the language. When my student makes a mistake we usually take advantage of it and discuss the particular piece of grammar and compare it possibly with other ones to see clearly the difference. It usually brings smiles to the face of my student and the sentence containing the wrong item is well remembered for a long time, which is highly effective. Teacher's strategy is to encourage students to speak as much as possible in our lessons and not to be afraid of making mistakes at all. This is agreed at the very beginning of our course. Students do not get reproaches for their mistakes. They are actually being 'praised' for making them by comments of a type: 'It is very good we have come across this mistake. Not making it we could have miss an important thing. Now we can look closely at that particular item and find out where the problem is…' It usually works. Students are not stressed by a negative reaction and take mistakes as a normal part of a learning process.

USING SINGING

Singing songs in English is a good activity for learning the word in class. If students sing one or two songs with appropriate gestures, a harmonious class atmosphere is encouraged, and students attention is easily focused. Singing songs with gestures, using them just as with poetry, increases student involvement in the learning process. Activities that are gestural, visual and physical can be used in learning new skills which include both learning physical concepts, as well as arriving at the goal of learning and knowing vocabulary words. [4;365]

In the class, teachers can divide the whole class into several groups; each group is required to participate in the chorus so that they can master more and more vocabulary words in the activity of collaborative learning for young and adult students. Students can connect certain vocabulary words with the music, hence raising students' interest in reviewing some English words. For example, when the students are reviewing vocabulary words about the different parts of one's body, the teacher can connect these words with the popular song titled "The Song of Health" whose words are as follows: "Please get up early, shaking hands, kicking legs, bending arms, clapping shoulders, so that you will be healthy." The brisk rhythm, melody, and different tones and cadence will attract the attention of primary pupils. They can dance together while singing this popular song. This series of activities will make students remember the vocabulary words automatically.

TOTAL PHYSICAL RESPONSE

Originally developed by James Asher, an American professor of psychology, in the 1960s, Total Physical Response (TPR) is based on the theory that the memory is enhanced through association with physical movement. [5;3] It is also closely associated with theories of mother tongue language acquisition in very young children, where they respond physically to parental commands, such as "Pick it up" and "Put it down". TPR as an approach to teaching a second language is based, first and foremost, on listening and this is linked to physical actions which are designed to reinforce comprehension of particular basic items.

A typical TPR activity might contain instructions such as "Walk to the door", "Open the door", "Sit down" and "Give Maria your dictionary". The students are required to carry out the instructions by physically performing the activities. Given a supportive classroom environment, there is little doubt that such activities can be both motivating and fun, and it is also likely that with even a fairly limited amount of repetition basic instructions such as these could be assimilated by the learners, even if they were unable to reproduce them accurately themselves.

This technique works great with kinesthetic learners, namely those who learn best by moving their bodies. Most teachers are aware of the advantages of Total Physical Response in the ESL classroom.

The main advantage of TPR is that teacher can get students physically engaged in the lesson. It gets them out of their seats and shakes things up.

REALIA

It is not secret that all group of learners has the more interest to the objects that one can touch, hold and feel, rather than picture of this objects. The use of realia or real-life objects in the ESL classroom can make a huge difference in student learning. It engages them and motivates them to learn. It's fun and sets a more natural learning environment

Realia-real things-represent the actual conditions with which the learner will live. As such, realia should be used whenever possible. Real things are available. The task is to locate them and put them to use in helping students learn. Examples of realia are: insects; coins; rocks; plants; pets; and stamps.

ROLE PLAYING

Teaching students vocabulary can also be based on dialogues. Teachers can introduce some of the words which provide both definitional and contextual information about the words to be learned by making up a dialogue for students so that students can understand a further meaning and usage of the words.[1;524] For example, in a class,

the teacher could ask a group to design how to begin the new lesson with an interesting dialogue between teacher and students:

T=teacher S=student

In this section have been described ideas that could be useful and very supportive for teaching English. As long as teachers dispose of a variety of diverse activities they have a good chance to find just the right one for any situation and increase students' interest and motivation. Some of the techniques are great for learning in general and it is very good to present them to students and make them familiar with such techniques as they make great teaching support and not only that. They can also be used in real life and become an everyday tool.

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Issue Article

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RESEARCH OF ASYMMETRICAL AND NONSINUSOIDAL CURRENTS OF ASYNCHRONOUS MOTOR REACTIVE POWER

Abstract: *In this article, the generation of asymmetric and non-sinusoidal currents affecting the reactive power of the asynchronous motor and their effects on the operation modes of the asynchronous motor are mentioned. Information on the types and descriptions of high harmonic currents that form non-sinusoidal currents occurring in an asynchronous motor is given. The results of the research were formed on the basis of practical and theoretical data.*

Key words: *asynchronous motor, asymmetrical current, non-sinusoidal current, magnetic flux, high harmonics, reactive power, power factor.*

Language: *English*

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Introduction

Asynchronous motors are the main consumers of electricity, they are designed to work under symmetrical and sinusoidal voltages, but due to the connection of various loads to the power supply system and several faults that occur in asynchronous motors, asymmetrical and non-sinusoidal currents appear in asynchronous motors and they have a negative effect on the operation modes of the asynchronous motor [1].

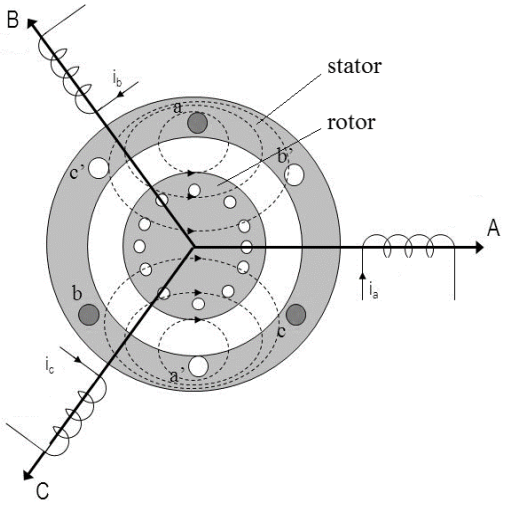

Figure 1. Schematic diagram of a three-phase asynchronous motor.

The formation, types and negative effects of asymmetric currents caused by various effects during the operation of an asynchronous motor are considered. In the stator of an asynchronous motor, symmetric windings are placed at an angle of 120° from each other, when voltage is applied to these windings, corresponding magnetic currents are generated in each phase according to the magnitude of the voltage (Fig. 1) [2].

Methods: Asynchronous motors have amplitude asymmetry and phase angle asymmetry. As a result of various effects, the asymmetric currents in the asynchronous motor lead to the asymmetry of the magnetic fluxes in the stator (1) and it is as follows [3].

$$\Phi_A(\theta,t)=\frac{1}{2}\Phi_m\{\sin(\theta-\omega t)+\sin(\theta+\omega t)\} \quad (1)$$

$$\Phi_B(\theta,t)=\frac{1}{2}\Phi_m\{\sin(\theta-\omega t)+\sin\left(\theta+\omega t-\frac{2\pi}{3}\right)\}$$

$$\Phi_C(\theta,t)=\frac{1}{2}\Phi_m\{\sin(\theta-\omega t)+\sin\left(\theta+\omega t)-\frac{4\pi}{3}\right)\}$$

where θ – the angle between the magnetic flux and the stator current, Φ_m – main magnetic flux.

Analysis of asymmetrical currents in asynchronous motors.

In three-phase asynchronous motors, asymmetrical currents occur when the amount of currents in each phase differs from each other. The causes of asymmetrical currents in asynchronous motors are as follows:

- Damage to the stator coil
- Bearing damage
- Damage to the magnetic circuit
- Operation in extreme load mode
- Asymmetrical supply voltage

Based on the above reasons, asymmetrical currents cause the following negative effects in asynchronous motors:

- Causes the power factor to decrease
- Causes an increase in the temperature of the asynchronous motor
- Leads to a decrease in stator torque
- Causes the stator current to increase
- Increases the amount of noise and vibration
- Asynchronous motor shortens the operating cycle

The asymmetrical currents that occur in asynchronous motors are as follows:

1. Amplitude asymmetry (if the currents in each phase differ in amplitude).
2. Phase asymmetry (if the currents in each phase do not form an angle of 120° from each other).

Amplitude-asymmetric currents occur when the amount of currents in each phase differs from each other in terms of amplitude, and the coefficient of asymmetry is different from one. (Fig. 2) Amplitude-asymmetrical currents create a magnetic flux in the opposite direction in the stator of the asynchronous motor, which causes a decrease in torque, mechanical power, and heating of the asynchronous motor [4].

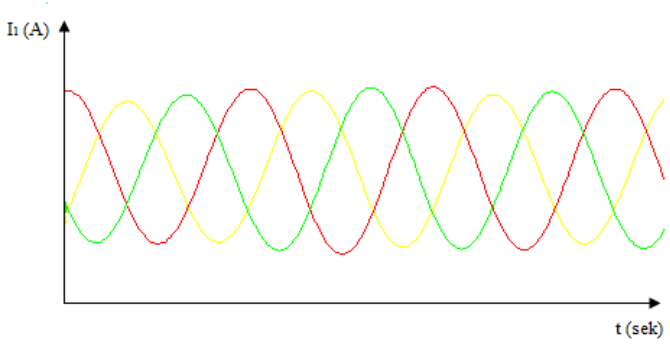

Figure 2. Time-dependent description of amplitude asymmetry currents.

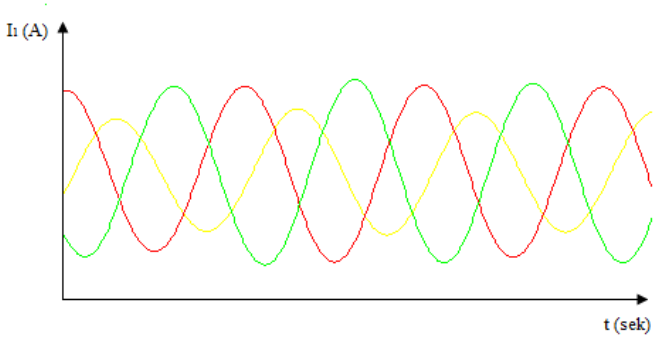

Figure 3. Time dependence description of phase asymmetry currents.

Phase-asymmetrical currents occur when the phase angles of the currents in each phase differ from each other, that is, the angle between the phase currents is not 120°. Phase asymmetry currents, like amplitude asymmetric currents, create a magnetic flux in the opposite direction in asynchronous motors, which leads to a decrease in the torque and mechanical power of the asynchronous motor, as well as its heating (Fig. 3). Phase asymmetry currents have a greater negative impact on the operation of an asynchronous motor compared to amplitude asymmetry currents [5].

The main negative effects of asymmetrical currents are overheating of asynchronous motors and generation of a torque opposite to the direction of the main electromagnetic torque, which has a negative effect on the insulation of the stator winding. Exceeding the specified amount of asymmetrical currents in an asynchronous motor leads to a shortening of its working life. If the amount of network voltage asymmetry is 4%, it causes the operation period of the asynchronous motor to be reduced by two times [6].

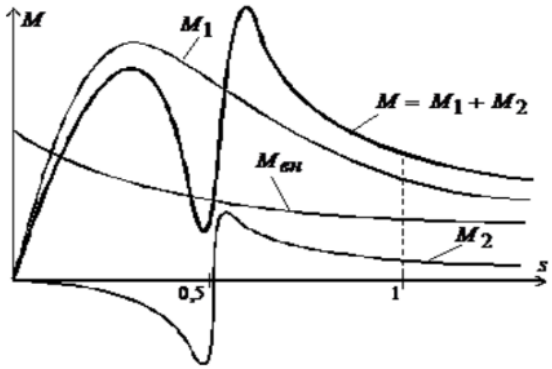

Figure 4. Mechanical description of a three-phase asynchronous motor under the influence of asymmetrical currents.

As a result of asymmetrical currents creating an electromagnetic moment of equal and opposite direction in the stator of an asynchronous motor, the slip coefficient of an asynchronous motor is also divided into two, and it is described in the following mechanical description (Fig. 4).

The slip coefficient of an asynchronous motor in the direction of the electromagnetic field is determined as follows:

$$s_m = \frac{\omega_s - \omega_r}{\omega_s} = 1 - \frac{\omega_r}{\omega_s} \qquad (2)$$

The slip coefficient of an asynchronous motor against the direction of the electromagnetic field is determined as follows:

$$s_q = \frac{-\omega_s - \omega_r}{-\omega_s} = 1 + \frac{\omega_r}{\omega_s} \qquad (3)$$

where ω_s – angular velocity of the magnetic flux in the stator, ω_r – angular velocity of rotor.

The power of an asynchronous motor is determined as follows:

$$P = P_m + P_q \qquad (4)$$

$$P_m = \frac{3R_r(U_{1m})^2}{s_m\left\{\left(\frac{R_r}{s_m}\right)^2 + X_r^2\right\}} \qquad (5)$$

$$P_q = \frac{3R_r(U_{1q})^2}{s_q\left\{\left(\frac{R_r}{s_q}\right)^2 + X_r^2\right\}} \qquad (6)$$

where P_m – active power in the appropriate direction (5), P_q – active power in the opposite direction (6).

The effect of asymmetrical currents on the electromagnetic torque of an asynchronous motor is determined as follows:

$$M = M_m + M_q \qquad (7)$$

$$M_m = \frac{P_m}{\omega_s} = \frac{3R_r(U_{1m})^2}{s_m\left\{\left(\frac{R_r}{s_m}\right)^2 + X_r^2\right\}}\frac{1}{\omega_s} \qquad (8)$$

$$M_q = \frac{P_q}{\omega_s} = \frac{3R_r(U_{1q})^2}{s_q\left\{\left(\frac{R_r}{s_q}\right)^2 + X_r^2\right\}}\left(-\frac{1}{\omega_s}\right) \qquad (9)$$

where M_m – electromagnetic torque in the appropriate direction (8), M_q – electromagnetic torque in the opposite direction (9).

The torque in the opposite direction due to the asymmetrical currents reduces the amount of the main electromagnetic torque and, as a result, reduces the electromagnetic torque of the induction motor and is defined as:

$$M = \frac{3R_r(U_{1m})^2}{s_m\left\{\left(\frac{R_r}{s_m}\right)^2 + X_r^2\right\}}\frac{1}{\omega_s} - \frac{3R_r(U_{1q})^2}{s_q\left\{\left(\frac{R_r}{s_q}\right)^2 + X_r^2\right\}}\frac{1}{\omega_s} \quad (10)$$

Power losses due to asymmetrical currents are determined as follows:

$$\Delta P = s\left(\frac{3R_r(U_{1m})^2}{s_m\left\{\left(\frac{R_r}{s_m}\right)^2 + X_r^2\right\}} + \frac{3R_r(U_{1q})^2}{s_q\left\{\left(\frac{R_r}{s_q}\right)^2 + X_r^2\right\}}\right) \quad (11)$$

Due to asymmetrical currents, the occurrence of a magnetic flux in the opposite direction in the stator of an asynchronous motor leads to an increase in reactive power, which leads to a decrease in the useful efficiency of the asynchronous motor, which is defined as follows:

$$\eta = \frac{P_2}{P_1} = \frac{(1-s_m)P_m}{P_m + P_q} \quad (12)$$

$$\eta = \frac{P_2}{P_1} = \frac{(1-s_m)}{1+\left(\frac{U_{1q}}{U_{1m}}\right)^2 \frac{s_m\left\{\left(\frac{R_r}{s_m}\right)^2 + X_r^2\right\}}{s_q\left\{\left(\frac{R_r}{s_q}\right)^2 + X_r^2\right\}}} \quad (13)$$

where U_m – appropriate direction voltage in the stator windings, U_q – opposite direction voltage in the stator windings.

The analysis of the asynchronous motor asymmetrical currents shows that by reducing the amount of electromagnetic torque in the opposite direction generated in the stator with the help of compensating devices, it is possible to increase the useful efficiency of the asynchronous motor.

Analysis of non-sinusoidal currents in asynchronous motors.

In three-phase asynchronous motors, non-sinusoidal currents occur due to high harmonic currents generated in the stator. The formation of high harmonic currents in electric energy consumers in enterprises is not desirable, which leads to the deterioration of the technical and economic indicators of electrical devices [7].

In asynchronous motors, high harmonic currents are formed due to the following effects:

- Increased asynchronous motor load
- Low power of the asynchronous motor supply transformer
- Length of asynchronous motor supply cable
- Control of asynchronous motors through devices consisting of semiconductor elements
- Faults in the electromagnetic system of the asynchronous motor
- Malfunctions in the mechanical system of the asynchronous motor
- Non-symmetry of rotating parts of an asynchronous motor
- Operation of asynchronous motors in a network with different non-symmetrical loads

Due to the above reasons, non-sinusoidal currents cause the following negative effects in asynchronous motors:

- Reduces active power factor
- Leads to reduction of asynchronous motor torque
- Asynchronous motor causes overheating
- Affects reactive power compensation and starting capacitors
- Affects the winding insulation of the asynchronous motor stator
- Increases the error in the counters for determining the active and reactive energies of asynchronous motors
- Causes a malfunction of the switching devices in the protection system of the asynchronous motor

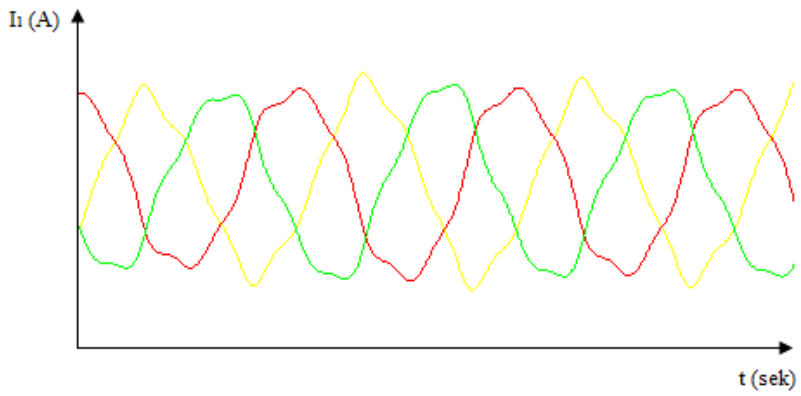

Figure 5. Time dependence description of asynchronous motor nonsinusoidal currents.

Higher harmonics are divided into the following types:

3, 6, 9, 12, 15, 18, 21, 24, 27, 30... zero-sequence (triple) harmonics, such harmonics are generated in asynchronous motors due to single-phase loads in the mains, three-phase loads connected to the mains are triple does not produce harmonics. This type of higher harmonics has a low current value, so this type of higher harmonics has almost no effect on the main magnetic flux.

4, 7, 10, 13, 16, 19, 22, 25, 28, 31... suitable sequence harmonics, such higher harmonics generate magnetic fluxes in the direction of the main magnetic flux of asynchronous motor, high frequency magnetic fluxes generated by higher harmonics are asynchronous causes the temperature of the motor to increase.

2, 5, 8, 11, 14, 17, 20, 23, 26, 29... reverse sequence harmonics, such type of super harmonics produce magnetic fluxes opposite to the main magnetic flux direction of induction motor, these higher harmonics high-frequency magnetic currents in the opposite direction caused by the asynchronous motor lead to a decrease in the electromagnetic moment and an increase in the temperature and reactive power [8].

Each higher odd harmonic current generates electromagnetic torques in the stator, respectively. These torques in turn have corresponding slip coefficients for each of the odd harmonics and is illustrated in the mechanical description below (Fig. 6).

Result: non-sinusoidal currents are generated due to high harmonic currents generated in the stator of an asynchronous motor depending on certain factors (Fig. 5). Negative effects of odd harmonics can be seen mainly in asynchronous motors. Double harmonics are compensated in the magnetic field, so their effect is absent. High harmonics mainly cause heating of asynchronous motors and reduction of active power factor [9, 10].

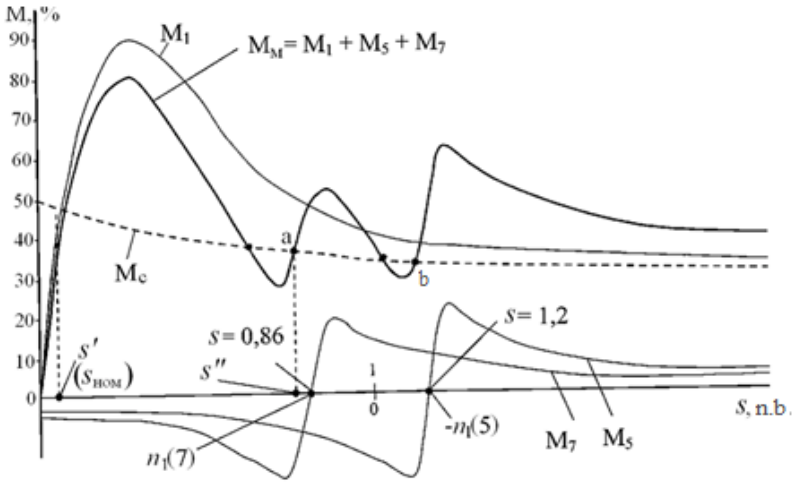

Figure 6. Mechanical description of a three-phase asynchronous motor under the influence of non-sinusoidal currents.

The effect of high harmonic currents generated in asynchronous motors on asynchronous motors is as follows:

The effect of zero-sequence and even harmonics on the main magnetic flux of a three-phase asynchronous motor is almost non-existent, mainly 5, 7, 11, 13, 17, 19, 23, 25, 29, 31... higher odd harmonics have a negative effect . Moments in the corresponding direction caused by non-sinusoidal currents were determined by the expression 6n+1, and moments in the opposite direction by the expression 6n-1 [11, 12].

The slip coefficient generated by high harmonics corresponding to the direction of the electromagnetic field of an asynchronous motor is determined as follows:

$$s_{6n+1} = \frac{\omega_{6n+1} - \omega_r}{\omega_{6n+1}} = 1 - \frac{\omega_r}{\omega_{6n+1}} \qquad (14)$$

The slip coefficient of the asynchronous motor generated by high harmonics opposite to the direction of the electromagnetic field is determined as follows:

$$s_{6n-1} = \frac{-\omega_{6n-1} - \omega_r}{-\omega_{6n-1}} = 1 + \frac{\omega_r}{\omega_{6n-1}} \qquad (15)$$

where S_{6n+1} – the slip coefficient generated by higher harmonics in the appropriate direction (14), S_{6n-1} – the slip coefficient generated by higher harmonics in the opposite direction (15).

Torques in the opposite direction lead to a decrease in the main electromagnetic torque and are given below:

$$\sum M = M_{main} + \sum_{n=1}^{N} M_{m.(6n+1)} - \sum_{n=1}^{N} M_{q.(6n-1)} \quad (16)$$

$$M_{m.(6n+1)} = \frac{3R_r (U_{1m.(6n+1)})^2}{s_{m.(6n+1)} \left\{ \left(\frac{R_r}{s_{m.(6n+1)}} \right)^2 + X_r^2 \right\}} \frac{1}{\omega_{(6n+1)}} \quad (17)$$

$$M_{q.(6n-1)} = \frac{3R_r (U_{1q.(6n-1)})^2}{s_{q.(6n-1)} \left\{ \left(\frac{R_r}{s_{q.(6n-1)}} \right)^2 + X_r^2 \right\}} \left(-\frac{1}{\omega_{(6n-1)}} \right) \quad (18)$$

where M_{main} – main electromagnetic torque of an induction motor, $M_{m.(6n+1)}$ – electromagnetic torque generated by higher harmonics in the appropriate sequence (17), $M_{m.(6n-1)}$ – is an electromagnetic moment generated by higher harmonics in the opposite sequence (18).

The value of the total harmonic distortion of non-sinusoidal currents generated in an asynchronous motor is determined as follows and its value is expressed in %:

$$THD_I = \sqrt{\sum_{n=2}^{N} \left(\frac{I_k}{I_1} \right)^2} \quad (19)$$

In three-phase asynchronous motors, high harmonic currents lead to a decrease in power factor, which is given below:

$$\cos\varphi_I = \frac{\cos\varphi}{\sqrt{1 + (THD_I)^2}} \quad (20)$$

In three-phase asynchronous motors, due to the effect of high harmonics, there is an increase in electrical and electromagnetic power losses and a decrease in mechanical power.

The active power resulting from higher harmonic currents is given below:

$$P_{out} = (1 - s_1)P_1 - \sum (1 - s_{6n-1})P_{6n-1} + \sum (1 - s_{6n+1})P_{6n+1} \quad (21)$$

The useful duty factor resulting from high harmonic currents is given below:

$$\eta = \frac{P_{out}}{P_{in}} = \frac{(1 - s_1)P_1 - \sum (1 - s_{6n-1})P_{6n-1} + \sum (1 - s_{6n+1})P_{6n+1}}{P_1 - \sum P_{6n-1} + \sum P_{6n+1}} \quad (22)$$

where P_{out} – is the active power generated by the asynchronous motor shaft (21), P_{in} – is the active power consumed by the asynchronous motor from the network.

Conclusion: Since the amount of asymmetrical and non-sinusoidal currents in an asynchronous motor directly depends on the amount of reactive power, it is important to determine and analyze the occurrence of asymmetrical and non-sinusoidal currents of reactive power in an asynchronous motor and their negative effects on the operation modes of the asynchronous motor.

The analysis shows that by reducing the amount of high harmonic currents generated in the stator of the asynchronous motor, it is possible to increase the active power factor, prevent overheating of the asynchronous motor, and ensure the efficient operation of electricity consumers in the electric network by filtering high harmonic currents.

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Issue **Article**

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VIBRATIONS OF A CYLINDRICAL BODY IN A VISCOELASTIC MEDIUM

Abstract: *This article considers the diffraction of harmonic waves on an elliptical cylindrical cavity made of an elastoplastic material. The problem of diffraction on elliptical cylindrical bodies with a concave shape, affected by an elastoplastic medium, and their specific features have not yet been sufficiently studied in terms of methodology, algorithm, and program creation. The aim of this research is to develop a methodology and algorithm for studying the dynamic deformation of an elliptical cylindrical body with a concave shape in an elastoplastic medium. The equations describing the diffraction process are formulated using the Mate function. It is established that the frequency of oscillations in an elliptical cavity depends not only on the Poisson's ratio but also on the aspect ratio of the ellipse.*

Key words: *elliptic cylindrical space, displacement wave diffraction, Mate equation, Puasson coefficient, specific fluctuations.*

Language: *English*

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Introduction

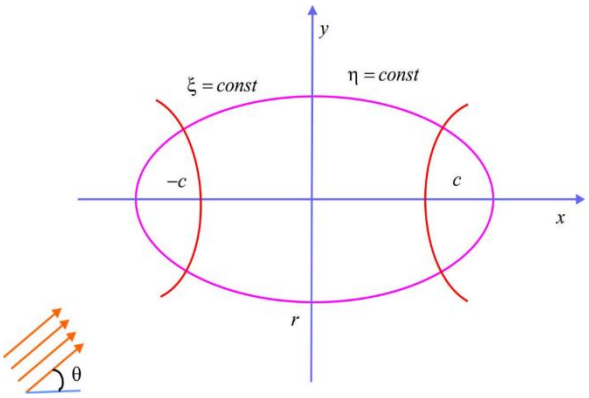
The problem of studying the mutual influence of underground structures with the ground is considered important. Different types of underground structures can be used to solve this problem. In recent years, the construction of underground communications has been actively carried out in seismic zones. Therefore, it is necessary to assess the reliability of such structures (tunnels, pipelines, underground roads, etc.) under the influence of seismic and landslide processes, and studies the state of deformation and strengthening [1-3]. To study the state of underground structures under seismic influence, there are two main methods: experimental research and theoretical analysis [4, 5]. The methodology, algorithm, and program for studying the diffraction and special properties of elastic materials in elliptical cylindrical bodies interacting with each other and a vibrating environment has not been sufficiently solved [6-9]. In addition, there is no established scientific basis for studying the special properties of non-dissipative cylindrical bodies. The methodology, algorithm, and program for studying the diffraction and special properties of non-dissipative cylindrical bodies has not been sufficiently resolved [10, 11]. Various theoretical concepts have been proposed to address these issues of non-dissipative cylindrical bodies with either a segmented or non-segmented design, with the results (approximate and precise) requiring further scrutinization and utilization.

2.Methods

2.1. Purpose of the study

The purpose of the research is to develop a methodology and algorithm for studying the dynamic deformation state of a cylindrical body consisting of an ellipsoidal neck section located in a rubber-elastic environment under the influence of harmonic vibrations, and to obtain and analyze quantitative results (Figure 1). This article discusses the problem of diffraction of harmonic waves on an elliptical cylindrical cavity in an elastic medium, and presents a method for solving this problem and the numerical

results. The connection between deformation and distortion is expressed by the Bolzmann-Volterra integral. The diffraction of harmonic waves in an elliptical cavity is related to the problem of the theory of elasticity in a purely deformed state. The problem of the relationship between elasticity and deformation in the elastic medium is solved by using the Lame equation for a deforming solid.



1- Figure. Schematic representation of an elliptical cavity.

The equations that express the processes of diffraction are derived using the wave equation and are solved using the Math function. Finite results are obtained and analyzed. The diffraction of elastic and acoustic waves on cylindrical bodies with a smooth profile has been widely studied by domestic and foreign scientists. The problem of the diffraction of elastic waves on isotropic elastic cylindrical bodies with a smooth profile has been investigated in works [12,13] where the mutual influence of the elastic waves is considered.

2.2. Method of laying and solving the issue

Let's suppose that an elliptical cavity is given in an elliptic coordinate system in an elastic medium (Figure 1). Let a harmonic pulse (SH pulse) propagate along the OX axis at an angle to the major axis of the elliptical cavity. The pulse front is parallel to the Z axis. The problem under consideration relates to the mechanics of deformable solid bodies and is a boundary value problem in the theory of elasticity. Under these conditions, the following relationships hold.

$$u = v = 0,\ w = w(x,y,t) = w(\xi,\eta,t) \quad . \qquad (1)$$

The connections between the strengthening and deformation in physics are described by the Boltzmann-Volterra integral and can be expressed as follows:

$$\sigma_{ij} = \tilde{\lambda}_c \varepsilon_{kk}\delta_{ij} + 2\tilde{\mu}_c \varepsilon_{ij}(i,j,k = 1,2,3)\ , \qquad (2)$$

Here $\sigma_{ij}, \varepsilon_{ij}$ – respectively, components of the tension and deformation Tensor, $\tilde{\lambda}_c$, $\tilde{\mu}_c$ -Volterra operator [14]:

$$\tilde{\lambda}_c\phi(t) = \lambda_{0c}\left[\phi(t) - \int_{-\infty}^{t} R_{c\lambda}(t-\tau)\phi(\tau)d\tau\right];$$

$$\tilde{\mu}_c\phi(t) = \mu_{0c}\left[\phi(t) - \int_{-\infty}^{t} R_{c\mu}(t-\tau)\phi(\tau)d\tau\right].$$

Here $\lambda_{0c}, \mu_{0c}, R_{c\lambda}, R_{c\mu}$ – Lame parameters and nuclear relaxation of the environment, $\phi(t)$ - time arbitrary function. Using the main equations of the dynamics of deformations, we derive the following w equation for the elastic medium in terms of the displacement dynamics.

$$\Delta w - \int_{-\infty}^{t} R_{c\lambda}(t-\tau)\Delta w(\tau)d\tau = \frac{1}{c_{cs}^2}\frac{\partial^2 w}{\partial t^2}. \qquad (3)$$

If we use the relationships (1) and (2) mentioned above, then we can identify the deformations that occur in the environment due to the impact of compression forces. They can be described as follows:

$$\sigma_{\xi z} = \frac{\mu_{0c}}{H}\frac{\partial w}{\partial \xi} - \frac{\mu_{0c}}{H}\int_{-\infty}^{t} R_{c\mu}(t-\tau)\frac{\partial w(\tau)}{\partial \xi}d\tau, \qquad (4)$$

$$\sigma_{\eta z} = \frac{\mu_{0c}}{H}\frac{\partial w}{\partial \eta} - \frac{\mu_{0c}}{H}\int_{-\infty}^{t} R_{c\mu}(t-\tau)\frac{\partial w(\tau)}{\partial \eta}d\tau.$$

Here $H = c\sqrt{ch^2\xi - \cos^2\eta}$, $2c$ – focal length; w-displacement of ambient points at displacement. Assuming conditions for being free of deformations caused by compression on an elliptical cross-sectional cylindrical cavity located in an elastic medium, the condition can be expressed as follows:

$$\sigma_{\xi z}\big|_{\Sigma_1} = 0,\ \Sigma_1 = \Sigma_1(\xi = \xi_0, 0 \le \eta \le 2\pi) \qquad (5)$$

The utilization condition of Somerfield's invariance in an elliptic vacuum is carried out infinitely. The shape of the SH *X*OY - surface that comes to the elliptical void from infinity due to the infinity is as follows:

$$w_0 = Ae^{i(k_1(x\cos\theta + y\sin\theta) - \omega t)}, \qquad (6)$$

Here A- descending wave amplitude, in the case of the set, this magnitude will be given by; $k_1 = \frac{\omega}{c_{s1}}$ wavenumber, θ – the angle at which the falling wave

is aligned with the axis of the Ox. The solution of the equation (3) presented above is sought as follows

$$w = W(\xi,\eta)e^{i\omega t}, \qquad (7)$$

Here $W(\xi,\eta)$ - is the displacement amplitude and satisfies the following complex parametric differential equation $\left[\frac{1}{c^2H^2}\left(\frac{\partial^2}{\partial\xi^2}+\frac{\partial^2}{\partial\eta^2}\right)+(\alpha_1\Gamma_1)^2\right]W(\xi,\eta)=0$, (8)

Here $\Gamma_1(\omega)=1-\Gamma_1^e(\omega)+i\Gamma_1^s(\omega), k_1^2=\omega^2\rho/\mu_{01}, \alpha_1^2=k_1^2/c_{s1}^2$

Under the influence of the SH wave, the expression for the displacement in the elliptic coordinate system, which can occur in a cavity-elastic medium, is given as follows [15]:

$$w_0 = A\sum_{n=0}^{\infty} i^n \begin{bmatrix} Ce_n(\xi,q)ce_n(\eta,q)Ce_n(\theta,q)+ \\ +iSe_{n+1}(\xi,q)se_{n+1}(\eta,q)se_{n+1}(\theta,q)\end{bmatrix} e^{i\omega t}. \qquad (9)$$

Here ce_n and se_n - Periodic (trigonometric) functions of Mate, Ce_n, Se_n - Radial or modulated functions of the Mate. The general solution of the equation (8) presented above is expressed through the Mate function and appears as follows

$$w = \sum_{n=0}^{\infty}\begin{bmatrix} C_n Me_n^{(1)}(\xi,q)ce_n(\eta,q)ce_n(\theta,q)+ \\ +S_{n+1}Ne_{n+1}^{(1)}(\xi,q)se_{n+1}(\eta,q)se_{n+1}(\theta,q)\end{bmatrix} e^{i\omega t}, q=\frac{1}{4}(\alpha_1\Gamma_1 c)^2 \quad (10)$$

Here $Me_n^{(1)}(\xi,q)$ and $Ne_{n+1}^{(1)}(\xi,q)$ - Mathieu - Hankel functions, C_n and S_{n+1} integral constants or arbitrary constants.

The general solution (10) mentioned above expresses the reflection or diffraction of incident waves on an elastic medium-medium interface [16,17]. By the reflected wave that returns from the surroundings of the elliptic cavity, the increase in displacement amplitude is obtained by the addition of the incident and reflected waves: $w = w_0 + w^{*}$.

These waves are quantified by the Sommerfeld's radiation condition, which is established by defining the Mathieu function. The arbitrary constant amplitudes in the last solution (5) are determined by the boundary condition. To find these arbitrary constants, we use the following relation.

$$\sum_{n=0}^{\infty}\begin{bmatrix} C_n Me_n^{(1)\prime}(\xi_0,q)ce_n(\eta,q)ce_n(\theta,q)+ \\ +S_{n+1}Ne_{n+1}^{(1)\prime}(\xi_0,q)se_{n+1}(\eta,q)se_{n+1}(\theta,q)\end{bmatrix}+$$

$$+A\sum_{n=0}^{\infty} i^n \begin{bmatrix} Ce_n^{(1)\prime}(\xi_0,q)ce_n(\eta,q)ce_n(\theta,q)+ \\ +iSe_{n+1}^{(1)\prime}(\xi_0,q)se_{n+1}(\eta,q)se_{n+1}(\theta,q)\end{bmatrix}=0 \qquad (11).$$

Multiplying the two sides of the last (11) equation in accordance with the mat'e function $ce_0(\eta,q), ce_1(\eta,q), \ldots..$ and $se_{n+1}(\eta,q)$ if we integral the ham over the length of the Ellipse, and using the orthogonality property of the mat'e function, then arbitrary invariant magnitudes can be found:

$$C_n = -i^n ACe_n'(\xi_0,q)/Me_n(\xi_0,q),$$

$$S_{n+1} = -i^{n+1} ASe_{n+1}'(\xi_0,q)/Ne_{n+1}(\xi_0,q). \qquad (12)$$

Putting the arbitrary constants found from (12) in (10), then we find the complete representation or expression of the displacement. This gives a private solution to the last expression (8) and takes the following view

$$w = A\sum_{n=0}^{\infty} i^n \begin{bmatrix} Ce_n(\xi,q)ce_n(\eta,q)Ce_n(\theta,q)+ \\ +iSe_{n+1}(\xi,q)se_{n+1}(\eta,q)se_{n+1}(\theta,q)\end{bmatrix} e^{i\omega t}+$$

$$+\sum_{n=0}^{\infty}\begin{bmatrix} (-i^n ACe_n'(\xi_0,q)/Me_n(\xi_0,q))Me_n^{(1)}(\xi,q)ce_n(\eta,q)ce_n(\theta,q)+ \\ +(-i^{n+1}ASe_{n+1}'(\xi_0,q)/Ne_{n+1}(\xi_0,q))Ne_{n+1}^{(1)}(\xi,q)se_{n+1}(\eta,q)se_{n+1}(\theta,q)\end{bmatrix} e^{i\omega t},$$

From this displacement expression, it becomes possible to find the concentricity ($\sigma_{\eta z}^{*} = \sigma_{\eta z}/2\mu_{0c}$) of the contour voltages produced in an ellipse transverse cross - sectional space in a Convex-elastic medium:

$$\sigma_{\eta z}^{*} = \frac{A}{H}\sum_{n=0}^{\infty} i^n \begin{Bmatrix} \left[Ce_n(\xi,q)-Me_n(\xi,q)Ce_n'(\xi_0,q)/Me_n'(\xi_0,q)\right]Ce_n'(\eta,q)ce_n(\theta,q)+ \\ +i\left[Se_{n+1}(\xi,q)-Ne_{n+1}(\xi,q)Se_{n+1}'(\xi_0,q)/Ne_n'(\xi_0,q)\right]se_{n+1}'(\eta,q)se_{n+1}(\theta,q)\end{Bmatrix} e^{i\omega t}. \quad (13)$$

When $\theta=0$ and $\xi=\xi_0=0$, the following condition on the displacement on the elliptic Σ_1 surface is satisfied:

$$w\big|_{\Sigma_1} = \sum_{n=0}^{\infty} i^n ce_n(\xi,\eta)ce_n(0,q)/ce_n(\pi/2,q)e^{i\omega t} \quad (14)$$

Numerical results were obtained based on equations (13) and (14) when calculating expansion and contraction, resulting in finite results of complex numbers. The main goal is to find the $|\sigma_{\max}| = |H\sigma_{\eta z\max}/2\mu_{01}A|$ constant that represents the concentration of maximum contraction related to b/a and θ. Due to the elongated environment of the elliptical conical cylindrical cube, the issue being studied can be approached using the theory of elasticity in the problem of single deformation. In this case, the differential equation of motion in elliptical coordinate systems (Figure1) leads to the Lame equation [19,20], and using the potentials of expansion and contraction along the elliptical boundary, it is expressed as follows:

$$u_{\xi\kappa} = \frac{1}{aJ}\left(\frac{\partial \phi_\kappa}{\partial \xi} + \frac{\partial \psi_\kappa}{\partial \eta} + e\frac{\partial^2 \chi_\kappa}{\partial \xi \partial z}\right);$$
$$u_{\eta\kappa} = \frac{1}{aJ}\left(\frac{\partial \phi_\kappa}{\partial \eta} - \frac{\partial \psi_\kappa}{\partial \xi} + e\frac{\partial^2 \chi_\kappa}{\partial \eta \partial z}\right); \qquad (15)$$
$$u_{z\kappa} = \frac{\partial \phi_\kappa}{\partial z} + e\left(\frac{\partial^2}{\partial z^2} - \frac{1}{c_{sk}^2}\frac{\partial^2}{\partial t^2}\right)\chi.$$

Here, $k = 1,2$ describes the equation of motion for the environment and elliptical body in the conventional way, c_{sk}^2 - the speed of the oscillations. The characteristics of an elliptical cavity located in a homogeneous and elastic environment are described by its equation of motion, using the Lame equation for a simple problem of elastic theory. The condition that the forces at the boundary are zero is imposed for the solution of the problem.

$$\left[\frac{(\lambda+2\mu)}{aJ}\frac{\partial u_\xi}{\partial \xi} + \frac{\lambda}{aJ}\frac{\partial u_\eta}{\partial \eta} + \frac{\lambda sh2\xi}{2aJ^3}u_\xi + \frac{(\lambda+2\mu)}{2aJ^3}\sin 2\eta u_\eta\right]_\Gamma = 0,$$
$$\left[\frac{\lambda}{aJ}\frac{\partial u_\xi}{\partial \xi} + \frac{\lambda}{aJ}\frac{\partial u_\eta}{\partial \eta} + \frac{\lambda sh2\xi}{2aJ^3}u_\xi + \frac{\lambda}{2aJ^3}\sin 2\eta u_\eta\right]_\Gamma = 0. \qquad (16)$$

Moving potentials amplitudes $\phi_n(r), \psi_n(r)$ satisfies Gel'mgol's equations:

№	n=0	n=I	n=2	n=3
1	0,31529D+00 -i0,24476D+00	0,07927D+01 -i0,27538D+00	0,11075D+01 -i0,49782D+00	0,12755D+01 -i0,39915D+00
2			0,128621D+00 -i0,07852D+00	0,47232D+01 -i0,13223D+01
3			0,404607D+00 -i0,078552D+00	0,08123D+00 -i0,13228D+00

$$\nabla^2 \phi_n + \alpha^2 \phi_n = 0 \quad , \quad \nabla^2 \psi_n + \beta^2 \psi_n = 0 \quad .$$

The solutions of Gelmgolds equations are expressed through the Mate function. If we use (16) linear conditions, we can obtain a system of algebraic equations with complex coefficients. In order for this system to have a solution, the main determinant composed of coefficients with unknown values must be equal to zero [18]. The elements of the main determinant are calculated as a function of the complex parameter ω . To determine the complex parameter ω , we obtain the frequency equation as follows:

$$(n^2-1)F_n(x)F_n(y) - (y^2/2)F_n(x) + F_n(y) + n^2 - (n^2 - y^2/2)^2 = 0 \quad (17)$$

Here $F_n(x) = xce_n(x)/se_n(x), \quad n = 1,2,3....$

3. Results and their analysis

The complex parametric frequency equation (17) is solved using the Müller method. This transcendental equation has two parts of roots: the real (Re Ω) and the imaginary (Im Ω) parts. The real part of the complex frequency expresses the oscillation frequency of the mechanical system, while the imaginary part expresses the damping coefficient (attenuation coefficient). The results of the calculations $n \geq 0$ $(\nu_1 = 0{,}25)$ are presented in Table 1. Analysis of the results from the table shows that the real and imaginary parts of the complex frequency increase with the increase of the order (n). The frequency equation (17) is dependent only on the Poisson coefficient (ν) .

It was found that when the value of the Puasson coefficient $0 \leq \nu \leq 0{,}4$ changes in the range, the actual and abstract parts of the frequency change to 27%. Table 1. Change of complex frequency with respect to n.

4. Conclusions

The results obtained for a cylindrical cavity when a=b were compared with the results obtained for an elliptical cavity located in an elastic environment (by Prof. Safarov I.I.). The results were found to have a difference of up to 3%. The frequency of oscillations of the elliptical cavity located in an elastic environment was found to be dependent not only on the Poisson coefficient (ν) , but also on the a/b parameter. When the value of the Poisson coefficient $0 \leq \nu \leq 0{,}4$ changed within a certain range, the real and imaginary parts of the frequency varied by up to 25%, and the dependence on a/b changed by up to 20%.

$$\frac{\partial^4 V}{\partial \eta^4} - 2\bar{r}^2\frac{\partial^2 V}{\partial \eta^2} - +\bar{S}^4 V = \frac{L^4}{D}q(x). \qquad (18)$$

Here $\bar{r}$, $\bar{S}$, L, D - constant parameters.

The problem was solved by the method of initial parameters. Taking into account the fact that the depth of the foundation changes when a concentrated load is applied to the elastic beam, a bending moment plot is constructed, as a result of which a decrease in the bending moment will occur.

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Issue Article

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THE TECHNIQUE OF PAINTING WITH OIL PAINTS ON CANVAS, HIGHLIGHTING WITH ONE COLOR, LIGHT, SHADOW, SHAPE OF THE OBJECT IN THE PICTURE

Abstract: *The article studies the technique of painting with oil paints on canvas.*
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Introduction

Oil Painting

Oil painting remains one of the most popular art forms today. By using oil paints on canvas, artists can capture the richness of color, texture and depth of an image. And one of the key techniques used in oil painting is to emphasize the shape of an object in an image using a single color, light, and shadow.

This technique allows the artist to create a three-dimensional and visually appealing effect. Light and shadow play an important role in creating the illusion of reality by adding depth and volume to objects on the canvas. However, by using a single color, the artist can achieve expressiveness and uniqueness, emphasize the basic shape of the object, and give character to the work.

In this research paper, we will focus on the study of oil painting technique in which the selected object in the picture is highlighted with a single color and emphasized by light and shadow. We will explore the influence of various factors such as color choice, lighting, and paint application technique in creating the desired effect and adding depth to the image.

The success of this technique requires not only a thorough understanding of the principles of oil painting, but also a keen perception of light and shadow. The result will be a unique, attractive and expressive work. I hope that my research will help artists improve their skills and take the quality of their art to the next level.

Explain the choice of techniques to emphasize the shape of an object in an image, using color, light, and shadow.

The choice of the technique of emphasizing the shape of the object in the picture using one color, light and shadow in oil painting on canvas is based on the artist's desire to convey the volumetric and realistic nature of the depicted object.

The use of a single color to emphasize the shape of the object makes it possible to create a harmonious and uniform impression. The absence of a variety of colors and shades helps to focus the viewer's attention on the shape of the object itself. A single color can also create a simple and minimalist effect, giving the work elegance and style.

Light and shadow are integral to creating volume and depth in an image. The use of light and shadow effects helps to convey the different levels and contours of an object. Highlights help to emphasize the protruding parts of an object and give it volume, while shadows create depth and the appearance of concave parts.

Oil paints are an excellent choice for this type of work. Their dense texture allows the artist to create different shading and light translation effects and to

explore different ways of applying the paint to achieve the desired result.

The choice of this technique can also be driven by artistic exploration or experimentation to create effects that can be achieved with only one color, light and shadow.

In general, using a single color, light and shadow to emphasize the shape of an object in an oil painting on canvas helps to convey dimensionality, depth and realism in the work, creating a harmonious and minimalist effect. This technique also offers the opportunity to experiment and explore new ways of conveying the effects of light and shadow, which can lead to interesting and innovative results.

A review of existing methods and researches related to the technique of painting with oil paints on canvas, highlighting with a color, light, shadow the shape of the object in the picture, is an important topic for art historians and artists.

In art with oil paints, there are many famous cultures and artists who have used this technique. One of the most famous artists using oil paints is Jan Vermeer, he is known for his realistic portraits where the focus was on the shape of the subject, creating a stunning light and shadow effect. His style has inspired many modern artists, for example the painting "Rest during the Flight to Egypt" by Antonis van Dyck, "Girl at the Window" by Louis-Leopold Boilly, where the artist develops his images by drawing shadows, highlights and details to achieve the desired contrast, or the painting "First Scout" by Norman Rockwell, the artist does not worry about how the different tones will be combined or what will result from their mixing.

Modern techniques and materials for painting with oil colors to emphasize the shape of an object are varied and constantly evolving. One such technique is the use of gradations of tone to create the illusion of volume and shape in an object. This is achieved by applying different shades of the same color and using light and shadow to emphasize certain parts of the object. Different brushes and tools are also used to create different textures and tones.

Research articles that explore the effects of using a single color, light, and shadow on the perception of an object in an image are important to artists and art historians. Research shows that the use of a single color, especially when combined with bright light and shadow, can create a strong effect of depth and volume. Studies also show that the use of light and shadow can create the illusion of movement and texture, making the painting more lively and interesting.

Overall, the technique of painting with oil paints on canvas, using a single color, light and shadow to emphasize the shape of an object in a picture, is unique and exciting. Research in this area helps artists and art historians to better understand and use these methods and techniques to create outstanding works of art.

Research Methodology Description.

This research paper explores the methodology of using oil paints when painting on canvas to highlight the shape of an object using a single color, light and shadow.

The first step of the research is to describe the chosen painting materials. In this case, oil paints are used, which offer a more flexible texture and allow the creation of rich colors. The canvas is chosen for its quality to allow better adhesion of the paints and also to achieve the desired texture.

The description of the working process includes the use of only one color, light and shadow to emphasize the shape of the object in the image. The researchers explain the technique of applying the colors with the lighting of the object to create a sense of volume and depth. While working on a research paper that involves using only one color, light, and shadow to highlight the shape of an object in an image, researchers use a specially designed technique to create a sense of volume and depth.

Before they begin, researchers analyze the lighting of an object and determine its key characteristics, such as light direction, intensity, and color temperature. This allows them to determine the locations of light and shadow on the object.

Next, researchers develop a methodology for applying color with the object's lighting in mind. They determine how colors will change depending on the angle of incidence of the light and create a hue scale for each area of the object. For example, they can use bright and saturated colors on areas of the object in direct light, and darker and less saturated colors on areas in the shade.

Researchers also describe paint application techniques that can create different effects to visually emphasize the shape of an object. They can use color blending techniques to create smooth transitions between light and shadow, and color application techniques along the contour of an object to emphasize its shape and volume.

The use of oil brushes is one of the key techniques in this process. Oil brushes allow researchers to create different textures and effects on paintings, adding detail and giving the object a more realistic look. In addition, the use of oil brushes allows for more precise application of color and control over its distribution on the surface of the object. Research Methodology Description.

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Before they begin, researchers analyze the lighting of an object and determine its key characteristics, such as light direction, intensity, and color temperature. This allows them to determine the locations of light and shadow on the object.

Next, researchers develop a methodology for applying color with the object's lighting in mind. They determine how colors will change depending on the angle of incidence of the light and create a hue scale for each area of the object. For example, they can use bright and saturated colors on areas of the object in direct light, and darker and less saturated colors on areas in the shade.

Researchers also describe paint application techniques that can create different effects to visually emphasize the shape of an object. They can use color blending techniques to create smooth transitions between light and shadow, and color application techniques along the contour of an object to emphasize its shape and volume.

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Oil brushes are one of the most important tools in oil painting and are widely used by artists of different styles and directions. By using them, you can achieve a variety of effects and create unique textures on the canvas. Here are some important ways to use oil brushes:

1. Create textures and effects: Oil brushes allow you to create different textures on a painting, from rough and brittle to soft and smooth. This can be especially useful when painting natural objects such as trees, rocks, waves, etc. The artist can use different types of brushes to achieve the desired texture and effects.

2. Add details: Oil brushes allow artists to add details and enhance the realism of the image. You can use a fine brush to paint fine details such as hair, small objects, or textures on fabric. It is also possible to use different brushes to create different types of textures to add depth and volume to an object in a painting.

3. Precise application of paint: Oil brushes have a certain stiffness and elasticity that allows the artist to have more control over the application of paint on the canvas. This allows the artist to easily change the width and depth of the reds, create different effects, and control the transitions between colors. This is especially important when creating smooth transitions and textures in a painting.

4. Control over color distribution: Oil brushes allow the artist to control the distribution and blending of color on the canvas. The artist can work with thin layers of paint, gradually adding or removing paint to create the desired effect. It is also possible to mix colors directly on the palette or on the canvas with a brush, which gives more freedom when working with complex shades and tones.

Overall, the use of oil brushes is an important and effective way to create artwork. They allow artists to express their creative concept in a more precise and detailed way, adding life and realism to their work.

The research work involves developing and describing a methodology for applying paint, taking into account the lighting of the subject, as well as describing techniques for applying paint and using oil brushes to create different effects. This will allow the researchers to emphasize the shape of the object in the image and create a sense of volume and depth.

To measure performance and test the effectiveness of the technique, researchers can use a color analyzer to evaluate the chosen color and its hue on the canvas. They can also survey artists or viewers to get feedback on the visual impact and credibility of the image.

All these research methods help to understand how the use of a single color, light and shadow can affect the extraction of the shape of an object on canvas when using oil paints. The results of the study will suggest a new approach to painting techniques and enable artists to more deeply and accurately convey the shape and volume of an object in their works.

Results of the study.

In this paper, a study was conducted to determine the effectiveness of this technique in creating three-dimensional images on the canvas plane.

The study produced several images that highlighted the shape of an object using only one color, light, and shadow. Each image was a realistic representation of some object or subject, such as an apple, a flower or a bowl.

The analysis of the resulting images allows us to draw the following conclusions. First, the use of a single color instead of the usual color spectrum allows to focus the viewer's attention on the shape of the object, facilitating its visual perception. This creates an effect of depth and three-dimensionality, making the viewer "see" the object on the canvas as if it were in the real space in front of him.

The use of light and shadow in combination with a single color can create deceptive lighting effects in

an image. This makes the object look more realistic and lifelike, enriching its texture and detail.

However, it is worth noting that the results of this study are not groundbreaking, as artists have previously explored and used the technique of highlighting the shape of an object using a single color, light and shadow. For example, some works by artists Georges Seurat and Claude Monet demonstrate similar effects. Nevertheless, this study plays with this technique and presents new applications of it.

Discussing the results of the study, it can be said that they confirm the effectiveness of the technique of painting with oil paints on canvas using a single color, light and shadow to highlight the shape of the object. This technique is capable of creating realistic and three-dimensional images that can capture the viewer's attention and evoke an emotional response.

However, more research needs to be done using a wider range of objects and different color combinations to more fully evaluate the capabilities of this technique and compare it to previous research and artwork. It is also worth considering the effect of different lighting options on the effect of highlighting the shape of an object using a single color, light and shadow.

Conclusions.

The detailed results and their significance in the context of the topic under study showed that the technique of oil painting, which uses a single color, light and shadow to highlight the shape of an object in an image, can be very effective. The use of a single color can create a harmonious and balanced image in which the shape of the object is clearly highlighted.

Research has proven that light and shadow play a key role in representing the volumetricity and shape of an object on canvas. The correct application of light and shadow can create a realistic and three-dimensional image. This emphasizes the importance of proper lighting in oil painting and visual communication.

The applicability of this technique in the practice of artistic creation and visual communication is enormous. It can be used to create expressive and emotional works and to convey a certain mood. Moreover, the use of a single color, light and shadow to highlight the shape of an object allows one to focus on the shape and structure of the object itself, making the image more convincing and vivid.

However, there are potential avenues for further research and improvement of oil painting techniques using a single color, light and shadow to highlight the shape of an object in an image. One possible avenue is to investigate the effect of different color schemes on the perception of object shape. Also, the research could delve into aspects of lighting to reveal how different light sources and different lighting angles affect the representation of the shape and volume of an object.

In addition, the possibility of using different materials other than oil paints in creating an image using a single color, light and shadow to highlight the shape of an object can also be further investigated. This will allow artists and designers to expand their creative toolkit and create unique and original works.

Thus, the technique of painting with oil paints using a single color, light and shadow to highlight the shape of an object in an image has significant potential and can be an effective way to convey shape and volume. Further research and improvement of this technique may lead to even better and more expressive images.

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Issue Article

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COGNITIVE MODEL OF THE TALE OF THE FISHERMAN AND THE GOLDFISH

Abstract: *A cognitive model of the fairy tale about the fisherman and the goldfish has been developed, in which conceptual and quantitative manifestations of immeasurable feelings, emotions, actions of the fisherman, goldfish, old woman, and the sea are modeled. Their formulaic, phraseological, visualized on graphs description of the behavior of the corresponding curves has been implemented and justified. They are as expected. A system of 4 semantic equations with 13=8+4 semantic variables has been developed: meaning (y_1), meaning (y_2), meaning (y_3), meaning(y_4), meaning(z_1),..., meaning(z_8), satisfying matrix semantic equality of the form meaning(Z_{m8})= meaning($Y_{m4}C^{\#}_{48}$), where meaning(Z_{m8})=meaning(z_1)⊕…⊕meaning(z_8), meaning($Y_{m4}C^{\#}_{48}$)=meaning($Y_{m4}c^{\#}_1$) ⊕meaning($Y_{m4}c^{\#}_2$)⊕meaning($Y_{m4}c^{\#}_3$)⊕meaning($Y_{m4}c^{\#}_4$). Matrix semantic equality corresponds to matrix equality with numerical z-, y-variables modeled as matrices: $Z_{m8}=Y_{m4}C^{T}_{84}$. Four semantic solutions-knowledge (new extracted knowledge) learn not only new meanings, but also paired connections, the forces of manifestations of 13 semantic variables. Visualization of the mutual dynamics of curves (variability values of z-, y-variables from matrices Z_{m8},Y_{m4}) knowledge about "weights" (from C_{88}) and z-, y-variabilities in a model with 8 z-variables, 4 y-variables showed the dynamics of the model values of unmeasured indicators of manifestations of feelings, emotions, actions of a fisherman, goldfish, old woman, sea. The variables introduced into the model are endowed with mathematical and statistical properties, and the parameters are constant. They are modeled in the Optimization Problem and depend on the numbers of variables and on the values of the indicators that form a mosaic within an 8-by-8 square. Both uncorrelated (y-) and correlated (z-) variability are multiplied by their "weights" - the strength of the factor manifestation. Interesting knowledge was gained after visualization. The model "justifies" its replacements of indicator values with both semantic (with semantic variables) and algebraic (with numerical variables) equalities. In the ending of the fairy tale, the goldfish (to a lesser extent than the sea) does not want (minus sign of strength c_{24}=(-0.0295)) factor z_2, to a lesser extent wants to promise the fisherman (with strength c_{34}=0.1528, z_3), but she does not promise (does not answer) to fulfill his desire", "after returning home, the fisherman sees his wife's result (with the strength (c_{44} = 0.9521, z_4) of her "non-promises - the previous broken trough. These 4 z-factors are more informative (in plot of the fairy tale) than the old woman's desire to have a new hut (c_{54} = 0.0418, z_5), and for the goldfish the old woman's former desire "to be a pillar noblewoman" is indifferent (the strength of the goldfish's desire is 0: c_{64} = 0.0000, z_6). The strengths of the manifestations of feelings, emotions, and actions of the goldfish at the end of the fairy tale clarify the meaning of factor y_4 and its z-variabilities of 4 factors z_2, z_3, z_4, z_5.*

Key words: *multisense equation with known and unknown semantic variables, Cognitive Model of the tale of the fisherman and the goldfish.*

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КОГНИТИВНАЯ МОДЕЛЬ СКАЗКИ О РЫБАКЕ И ЗОЛОТОЙ РЫБКЕ

Аннотация: *Разработана Когнитивная модель сказки о рыбаке и золотой рыбке, в которой моделируются смысловые и количественные проявления неизмеряемых чувств, эмоций, действий рыбака, золотой рыбки, старухи, моря. Реализована, обоснована их формульное, фразеологическое, визуализированное на графиках описания поведений соответствующих кривых. Они соответствуют ожидаемому. Разработана система из 4-х смысловых уравнений с 13=8+4 семантическими переменными: смысл(y_1),смысл(y_2),смысл(y_3),смысл(y_4),смысл(z_1),…,смысл(z_8), удовлетворяющих матричному смысловому равенству вида смысл(Z_{m8})=смысл($Y_{m4}C^{\#}_{48}$), где смысл(Z_{m8})=смысл(z_1)⊕…⊕смысл(z_8), смысл($Y_{m4}C^{\#}_{48}$)= смысл($Y_{m4}c^{\#}_1$)⊕смысл($Y_{m4}c^{\#}_2$)⊕смысл($Y_{m4}c^{\#}_3$)⊕смысл($Y_{m4}c^{\#}_4$). Этому матричному смысловому равенству соответствует матричное равенство с числовыми z-, y-переменными, смоделированных в виде матриц: $Z_{m8}=Y_{m4}C^{T}_{84}$. Четыре семантические решения–знания (новые извлеченные знания), познают не только новые смыслы, но и парные связи, силы проявлений 13 семантических переменных. Визуализация взаимных динамик кривых (значений изменчивостей z-, y-переменных из матриц Z_{m8},Y_{m4}) знаний о «весах» (из C_{88}) и z-, y-изменчивостях в модели с 8 z-переменными, 4 y-переменными показала динамики модельных значений неизмеряемых показателей проявлений чувств, эмоций, действий рыбака, золотой рыбки, старухи, моря. Введенные в модель переменные наделены математическими и статистическими свойствами, а параметры постоянны. Они смоделированы в Оптимизационной Задаче и зависят от количеств переменных и от значений индикаторов, образующих мозаику внутри квадрата 8-на-8. Как некоррелированные (y-), так коррелированные (z-) изменчивости умножаются на свои «веса» - силы проявления фактора. Получены интересные знания после визуализации. Свои замены значений индикаторов модель «обосновывает» как смысловыми (с семантическими переменными), так и алгебраическими (с числовыми переменными) равенствами. Пять событий сказки реализуются последовательно, каждому из которых зафиксированы 24 моментов времени i=1,…,24. В каждый момент времени отклонение от 0 значения z_{i2} (или других) показателя, измеряющего (смоделированного значения неизмеряемого показателя)) «желание старухи иметь новое корыто», образуют кривую «z_2», зависящую от кривой «z_3» (с силой c_{21}=1), от кривой «y_1» (по формуле $y_1=z_1*1{,}00+ z_2* (-1{,}00)+z_2*1{,}00+z_8*1{,}00$). Эти зависимости видны визуально и словесно описываются фразами, характеризующими их тренды: тренд кривой «z_2» медленно растущий и сопровождается прыгающим и убывающим трендом кривой «y_1», сопровождаемый сильными отклонениями кривой «z_3» от 0 – сильными сомнениями в сознании золотой рыбки. По мере возрастания номера фактора y_1,y_2,y_3,y_4. В финале сказки золотая рыбка (в меньшей степени, чем море) не хочет (знак минус силы c_{24}=(-0,0295)) фактора z_2, в меньшей степени хочет обещать рыбаку (с силой c_{34}=0.1528, z_3), а она не обещает (не отвечает) исполнить его желание», «после возвращения домой рыбак видит у жены результат (с силой (c_{44}=0,9521, z_4) ее «необещания – прежнее разбитое корыто. Эти 4 z-фактора являются более информативными (в сюжете сказки), чем желания старухи иметь новую избу (c_{54}=0,0418, z_5), и для золотой рыбки безразлично прежнее желание старухи «быть столбовой дворянкой» (сила желания золотой рыбки равна 0: c_{64}=0,0000, z_6). Приведены силы проявлений чувств, эмоций, действий золотой рыбки в финале сказки проясняют смысл фактора y_4 и его z-изменчивостей 4-х факторов z_2,z_3, z_4, z_5.*

Ключевые слова: *многосмысловое уравнение с известными и неизвестными семантическими переменными, Когнитивная модель сказки о рыбаке и золотой рыбке.*

Введение

В русскую культуру вошла поговорка «остаться у разбитого корыта» — то есть погнаться за бóльшим, а остаться ни с чем. Эта и другие фразы вложены в сознание многих, эффект от «работы» «сказки о рыбаке и золотой рыбке» бесконечен. По широко распространённой версии, сюжет сказки основан [1] на померанской сказке «О рыбаке и его жене», в индексе сказочных сюжетов Аарне-Томпсона №555) из сборника сказок братьев Гримм, с которой сказка имеет общую сюжетную линию, а также перекликается с русской народной сказкой «Жадная старуха». Более древняя версия сюжета — индийская сказка «Золотая рыба», с местным национальным колоритом, здесь Золотая рыба-могущественный златоликий подводный дух. Осмысление сказки проведено в разных жанрах. Театрально-музыкальные и экранизированные постановки реализованы в 1937 году на студии «Мосфильм» был снят цветной (по методу Павла Мершина) кукольный мультфильм «Сказка о рыбаке и рыбке». Автор сценария и режиссёр-постановщик — Александр Птушко. В 1950 году на киностудии «Союзмультфильм» по сценарию Михаила Вольпина выпустили рисованный мультипликационный фильм «Сказка о рыбаке и рыбке». Режиссёр-постановщик — Михаил Цехановский, композитор — Юрий Левитин. В мультфильме «Вовка в Тридевятом царстве» (1965) главный герой оказывается на последней странице сказки «Сказка о рыбаке и рыбке», говорит со старухой и не очень уважительно обращается к ней на «ты». Потом он вызывает Золотую Рыбку, но та отказывается исполнять его желание.

В фильме «После дождичка, в четверг...» (1986) Иван-царевич и Иван-подкидыш разыгрывают перед Кощеем кукольное представление этой сказки. В 1986 году чехословацким режиссёром Властой Янечковой был снят мультфильм «Сказка о рыбаке и рыбке»/O rybári a rybce. В 1997 году в Санкт-Петербургском драматическом театре «Патриот» РОСТО был поставлен музыкальный спектакль по мотивам сказки (постановка Геннадия Егорова). В 1998 году театром кукол Московского Городского Дворца детского (юношеского) творчества был поставлен спектакль-опера «Сказка о рыбаке и рыбке». Режиссёр-постановщик — Елена Плотникова, композитор - Елена Могилевская. В 2003 году на киностудии «Союзмультфильм» создан кукольный мультипликационный фильм «О рыбаке и рыбке». Режиссёр-постановщик — Наталья Дабижа, композитор — Геннадий Гладков. В 2017 году в Архангельском театре драмы имени М. В. Ломоносова был поставлен детский спектакль «Сказка о рыбаке и рыбке». Режиссёр — Анастас Кичик. Золотая рыбка (балет Минкуса) — балет на музыку Людвига Минкуса, Золотая рыбка (балет Черепнина) — балет на музыку Николая Черепнина, созданный в 1937 году. Ниже (в 2023 году) изложена когнитивная (познающая) модель сказки о рыбаке и золотой рыбке. В ней измеряются неизмеримые показатели проявлений желаний, чувств, эмоций, действий рыбака, золотой рыбки, старухи, моря. В финале сказки рыбак (в меньшей степени, чем в 1-ый раз) «зовет золотую рыбку и просит» (знак минус силы проявления $c^2_{24}=(-0{,}0295)^2$) фактора z_2, золотая рыбка в меньшей степени обещает рыбаку (с силой $c^2_{34}=0.1528^2$, смысл(z_3), она не обещает (сила проявления $c^2_{84}=0$, смысл(z_8, не отвечает) исполнить его желание», «после возвращения домой рыбак видит у жены результат (с большой силой проявления ($c^2_{44}=0.9521^2$, смысл(z_4) ее «необещания – прежнее (до нового корыта) разбитое корыто. Сказка актуальна в бизнесе. Для магистров бизнес-администрирования является примером метода «приманка и крючок», в который попадают рыбак и золотая рыбка, а жадная старуха использует их для обогащения (как при ЭКСПО-2017), но в конце у нее все конфискуют по статьям виртуального кодекса законов.

Исходные данные

Исходной информацией для модели являются смыслы 8 z-факторов, выражающих компетенции индивидов-обучаемых, z-факторы способствуют внедрению аналитических способностей и управляются смыслами 4-х y-факторов. Смыслы y-факторов взяты из текста сазки:

1) «состояние золотой рыбки при 1-ой встрече с рыбаком (смысл(y_1)): «она обещает любой выкуп и просит отпустить её в море, (либо в зависимости от просьбы золотая рыбка не отвечает рыбаку)»;

2) «золотая рыбка дарит новое корыто вместо разбитого, либо избу, либо статус столбовой дворянки, либо статус «вольная царица» (смысл(y_2));

3) «состояние моря, зависящее от желаний старухи (смысл(y_3));

4) «золотая рыбка не отвечает на последнюю просьбу рыбака» (смысл(y_4)).

Смыслы факторов из группы, состоящей из 8 z-факторов, влияют на смыслы 4-х y-факторов. Смыслы 8 z-факторов состоят из фраз, выражающих проявления чувств, эмоций, действий рыбака, золотой рыбки, старухи, поведений моря. В модели факторами, влияющими на независимые y-факторы, назначим коррелированную систему смыслов z-переменных. Их количество должно быть достаточно большим, они должны отображать важные эпизоды сказки, последовательность которых ведет к финальному эпизоду. Статусы золотой рыбки, старухи, поведений моря постоянны, у рыбака статус меняется: если он просит золотую рыбку у моря– он рыбак, если он стоит перед старухой – старик. Множество смыслов z–факторов состоит из 8 следующих смыслов 8 z-факторов :

1) «рыбак отпускает золотую рыбку, не прося награды» (смысл(z_1));

2) «позвать золотую рыбку и попроситьу нее хотя бы новое корыто вместо разбитого» (смысл(z_2)).

3) «рыбак зовёт золотую рыбку (смысл(z_3)), «которая появляется и обещает исполнить его просьбу»;

4) «после возвращения домой старик видит у жены новое корыто» (смысл(z_4)).

5) «старуха желает получить новую избу» (смысл(z_5));

6) «старуха желает быть столбовой дворянкой» (смысл(z_6));

7) «старуха желает быть «вольною царицей» (смысл(z_7));

8) «старуха желает быть владычицей морскою, сама золотая рыбка должна стать у неё в услужении» (смысл(z_8)).

Фразы, выражающие смыслы управленческих решений всего 4: смысл(y_1), смысл (y_2), смысл (y_3), смысл (y_4).

Важными исходными данными для модели являются назначенные экспертом исходные значения сил влияния $c_{kj}=corr(z_k,y_j)$, $k\in\{1,\ldots,9\}$, $j\in\{1,\ldots,4\}$ 13 индикаторов наличия знаний: $c_{11}=1$; $c_{21}=(-1)$; $c_{22}=1$; $c_{32}=1$; $c_{42}=1$; $c_{52}=1$; $c_{22}=1$; $c_{72}=1$; $c_{73}=(-1)$; $c_{83}=(-1)$; $c_{54}=1$; $c_{74}=1$; $c_{84}=(-1)$. Мозаика $\{c_{kj}\}$ из элементов будущей матрицы «весов» C_{88} задается экспертом в соответствии со смыслами и

силами парной связи $c_{kj}=corr(z_k,y_j)$ нижеперечисленных смыслов факторов из текста сказки. Словесная модель сказки имеет зависимые по смыслам показатели. Специфика управляющих параметров модели отлична от специфик моделей в других предметных оластях [1-8].

Задача: разработать систему из 4-х смысловых уравнений с 13=9+4 семантическими переменными смысл(y_1), смысл(y_2), смысл(y_3), смысл(y_4), смысл(z_1),…,смысл(z_9), удовлетворяющих матричному смысловому равенству вида смысл(Z_{m8})=смысл($Y_{m4}C^{\#}_{48}$), где смысл(Z_{m8})=смысл(z_1)⊕…⊕смысл(z_8), смысл($Y_{m4}\mathbf{C}^{\#}_{\mathbf{48}}$)=смысл($Y_{m4}\mathbf{c}^{\#}_{\mathbf{1}}$)⊕смысл($Y_{m4}\mathbf{c}^{\#}_{\mathbf{2}}$)⊕ смысл($Y_{m4}\mathbf{c}^{\#}_{\mathbf{3}}$)⊕смысл($Y_{m4}\mathbf{c}^{\#}_{\mathbf{4}}$). Элементы матрицы $C^{\#}_{48}$ равны 8 элементам первых 4-х строк $\mathbf{c}^{\#}_{\mathbf{1}}, \mathbf{c}^{\#}_{\mathbf{2}}, \mathbf{c}^{\#}_{\mathbf{3}}, \mathbf{c}^{\#}_{\mathbf{4}}$ матрицы индикаторов C_{88}, а ее i-ая строка $\mathbf{c}^{\#}_{\mathbf{j}}$ имеет компоненты, равные компонентам матрицы индикаторов C_{88}:$c^{\#}_j=(c_{j1},c_{j2},\ldots,c_{j8})$, i=1,…,4. Этому матричному смысловому равенству соответствует математическое матричное равенство для числовых переменных вида: $Z_{m8}=Y_{m4}C^{T}_{84}$. Таково правило соответствия матричного смыслового равенства своему матричному числовому равенству.

Применяемая система многосмысловых уравнений

Многосмысловое уравнение [9-10] конструируется из многомерной математической модели [8], где уже введены числовые параметры, переменные, функции связи, соответствующие реальным свойствам реальных многомерных объектов разных типов. Тип объектов, их свойств отражается в смыслах свойств объектов [2-11]. Суммы смыслов свойств (z-переменных) объекта могут образовать новый смысл y-переменной (взамен старому смыслу) или нет [7]. В многомерной математической модели (она является вторичной, первична матричная смысловая модель) переменные делятся на 2 вида: известные имена-смыслы z-переменных: смысл(z_1),…,смысл(z_8) и известные имена-смыслы y-переменных смысл(y_1),…,смысл(y_4). Количество 4 переменных равно количеству дисперсий $disp(y_1)=\lambda_1, disp(y_2)=\lambda_2,\ldots,disp(y_4)=\lambda_4$. В соответствии с значениями $\lambda_1, \lambda_2,\ldots,\lambda_4$, взятыми из пары смоделированных матриц (C_{88},Λ_{88}) проставляются числовые параметры $c_{11},\ldots, c_{88}$ в нижеприведенные 4 уравнения системы многосмысловых уравнений. Не проводим удаления слагаемых с «весами» c_{ij}, если даже их величины не удовлетворяют критерию быть индикатором скрытых знаний [11,14], поэтому количество слагаемых в уравнениях с неизвестными новыми смыслами смысл(y_1), смысл(y_2),…,смысл(y_4) не сокращаются. Более «короткие» суммы смыслов приведены для облегчения осмысливания читателем статьи. Для конструирования 6 фраз для 4 новых смыслов (новых семантических y-переменных) новый_смысл(y_1), новый_смысл(y_2), новый_смысл(y_3), новый_смысл(y_4), существенно дополняющих исходные смыслы смысл(y_1), смысл(y_2), смысл (y_3), смысл(y_4) применялись методы смыслового преобразования исходных семантических переменных в новые семантические переменные. Это – трудозатратная особенность когнитивного моделирования.

Требуемые фразы, отражающие смыслы неизвестных 4 новых смыслов y-переменных, можно сконструировать, если смоделировать:

а) пару матриц собственной структуры (Λ_{88},C_{88}), где C_{88} – матрица псевдособственных векторов, $C_{88}C^{T}_{88}=I_{88}$, $C^{T}_{88}C_{88}\neq I_{88}$, $\Lambda_{88}=diag(\lambda_1,\ldots\lambda_8)$, $tr(\Lambda_{88})=\lambda_1+\ldots+\lambda_8=8$, условие упорядоченности $\lambda_1\geq\ldots\geq\lambda_8\geq 0$ не требуется;

б) матрицы значений некоррелированных изменчивостей Y_{m4}, коррелированных изменчивостей (отклонений от 0) Z_{m8}, соответствуют своим системам многосмысловых уравнений с известными и неизвестными семантическими (смысловыми) переменными.

Иное название [11] элементов матрицы C_{88} введено в статьях [2-8], оно отражает смысл «весов», моделируемых в нашей модели, наш метод моделирования отличается от методов из [2-10].

Новые моделируемые 2 матрицы в нашей модели должны обладать свойствами: ортогональная (не ортонормированная) матрица C_{88} собственных векторов $\mathbf{c_j}=(c_{1j},c_{2j}\ldots c_{8j})^T$, расположенных по столбцам матрицы $C_{88}=[c_1|c_2|\ldots|c_8]$ согласована со своим спектром Λ_{88} неиспользуемой нами ковариационной матрицы $W_{88}=(1/m)Z^{T}_{m8}Z_{m8}$, $\Lambda_{88}=diag(\lambda_1,\ldots\lambda_8)$ В решаемой ниже Оптимизационной Задаче: $(I_{88},I_{88})=>(C_{88}, \Lambda_{88})$ (другие методы смотрите в [10-12]) целевая функция отличается от ранее применявшейся функции: $\lambda_1+\ldots+\lambda_8=8$, теперь это равенство является функцией ограничений при изменяемых значениях 8*8+8 элементов 2-х матриц C_{88}, Λ_{88}, $C^{T}_{88}C_{88}\neq I_{88}$, $C_{88}C^{T}_{88}=I_{88}$. Моделируемые ниже случайные матрицы U_{m8} и Y_{m8} такие, что подчиняются соотношениям Обратной Модели Анализа Главных Компонент [14]: $(1/m)U^{T}_{m8}U_{m8}=I_{88}$, $Y_{m8}=U_{m8}\Lambda^{1/2}_{88}$, $Z_{m8}=Y_{m8}C^{T}_{88}$, в матрице Y_{m8} элементы j–го столбца $y_{1j},y_{2j},\ldots,y_{mj}$ (j-ая y-переменная, j=1,…,8) имеют среднее арифметическое, равное нулю: $(1/m)(y_{1j}+y_{2j}+\ldots+y_{mj})=0$ и дисперсию равную λ_j: $(1/m)(y^2_{1j}+y^2_{2j}+\ldots+y^2_{mj})=\lambda_j$, сумма дисперсий равна 8: $\lambda_1+\ldots+\lambda_8=8$. Матрицы $Y_{m8}=U_{m8}\Lambda^{1/2}_{88}$, $Z_{m8}=Y_{m8}C^{T}_{88}$ в таком порядке моделируются и интерпретируются как многомерные выборки

[14]. В нашей модели мы моделируем нестандартизованные ($C^{T}_{88}C_{88}\neq I_{88}$) коррелированные z-переменные являются многомерными данными, объединенных в матрицу Z_{m8}, в которой элементы j–го столбца $z_{1j},z_{2j},\ldots,z_{mj}$ (j-ая переменная, j=1,…,8) имеют среднее арифметическое равное нулю: $(1/m)(z_{1j}+z_{2j}+\ldots+z_{mj})=0$, и дисперсию не равную 1: $(1/m)(^{z2}{}_{1j}+z^2_{2j}+\ldots+z^2_{mj})\neq 1$, сумма дисперсий не равна 8. Элементы матрицы C_{88} интерпретируются как индикаторы знаний [13,14]. Матрица Y_{m8}, в которой элементы j–го столбца y_{1j}, $y_{2j},\ldots,y_{mj}$ (j-ая y-переменная, j=1,…,8) имеют среднее арифметическое равное нулю: $(1/m)(y_{1j}+y_{2j}+\ldots+y_{mj})=0$, и дисперсию равную λ_j: $(1/m)(y^2{}_{1j}+y^2{}_{2j}+\ldots+y^2{}_{mj})=\lambda_j$, сумма дисперсий равна 8: $\lambda_1+\ldots+\lambda_8=8$. Матрица Y_{m8}, интерпретируется как многомерная выборка. Нестандартизованные коррелированные z-переменные - данные, объединенные в матрицу Z_{m8}, в которой элементы j–го столбца $z_{1j},z_{2j},\ldots,z_{mj}$ (j-ая z-переменная, j=1,…,8) имеют среднее арифметическое равное нулю: $(1/m)(z_{1j}+z_{2j}+\ldots+z_{mj})=0$ и дисперсию, не равную 1: $(1/m)(z^2{}_{1j}+z^2{}_{2j}+\ldots+z^2{}_{mj})\neq 1$, сумма дисперсий не равна 8. Матрица Z_{m8} интерпретируется как многомерная нестандартизованная выборка.

Применяемая система многосмысловых уравнений состоит из 4-х смысловых уравнений с 12=8+4 семантическими переменными $смысл(y_1)$,$смысл(y_2)$,$смысл(y_3)$,$смысл(y_4)$, удовлетворяющих матричному смысловому равенству вида $смысл(Z_{m8})=смысл(Y_{m4}C^{\#}_{48})$, где $смысл(Z_{m8})=смысл(z_1)\oplus\ldots\oplus смысл(z_8)$, $смысл(Y_{m4}\mathbf{C}^{\#}_{\mathbf{48}})=смысл(Y_{m4}\mathbf{c}^{\#}_{\mathbf{1}})\oplus смысл(Y_{m4}\mathbf{c}^{\#}_{\mathbf{2}})\oplus смысл(Y_{m4}\mathbf{c}^{\#}_{\mathbf{3}})\oplus смысл(Y_{m4}\mathbf{c}^{\#}_{\mathbf{4}})$.

Когнитивная модель сказки о рыбаке и золотой рыбке

Информационными компонентами когнитивной модели «компетенций, внедряющин аналитические способности» являются:

1. Модельная пара матриц (C_{88},Λ_{88}): матрица собственных чисел Λ_{88}, матрица псевдособственных векторов C_{88} таких, что выполняются условия: $C_{88}C^{T}=I_{88}$, $C^{T}_{88}C_{88}=\neq I_{88}$, $\Lambda_{88}=diag(\lambda_1,\ldots\lambda_8)$, $tr(\Lambda_{88})=\lambda_1+\ldots+\lambda_8=8$, Λ_{88}=diag(2.5000,2.5000,2.5000,1.5000,0.0000, 0.0000,0.0000,0.0000,0.0000).

2. Матрицы C_{88} и Λ_{88} моделируются при решении Оптимизационной задачи. Вид таблицы-программы Оптимизационной задачи: $(I_{88},I_{88})=>(C_{88}\Lambda_{88})$ приведен в Таблице 2.

3. Известные смысловые переменные $смысл(z_1),\ldots,$ $смысл(z_8)$ в модели используются для нахождения новых смыслов для модельных y-переменных y_1,y_2,y_3,y_4, которые управляют соответствующими числовыми 8 z-переменными $(z_1,z_2,\ldots,z_8)$.

4. Четыре смысловые уравнения:
$смысл(y_1)=смысл(z_1)*1.00\oplus смысл(z_2)*(-1.00)\oplus смысл(z_3)*1.00\oplus смысл(z_8)*1.00;$
$смысл(y_2)=смысл(z_1)*0.00\oplus смысл(z2)*1.00+ смысл(z_3)*1.00\oplus смысл(z_4)*1.00\oplus смысл(z_5)*1.00\oplus смысл(z_6)*1.00;$
$смысл(y_3)=смысл(z_1)*0.00\oplus смысл(z_2)*(-0.4334)\oplus смысл(z_3)*0.7284\oplus смысл(z4)*(-0.1269)\oplus смысл(z_5)*(-0.1681);$
$смысл(y_4)=смысл(z_1)*0.00\oplus смысл(z_2)*(-0.0295)\oplus смысл(z_3)*0.1528\oplus смысл(z_4)*0.9521+ смысл(z_5)*0.0418.$

Системе смысловые равенств соответствует система числовых алгебраических равенств:

$y_1=z_1*1{,}00\oplus z_2*(-1{,}00)+z_3*1{,}00+z_8*1{,}00;$
$y_2=z_2*1{,}00+z_3*1{,}00+z_4*1{,}00+z_5*1{,}00+z_6*1{,}00;$
$y_3=z_2*(-0{,}4334)+z_3*0{,}7284+z_4*(-0{,}1269\oplus z_5*(-0{,}1681);$
$y_4=z_2*(-0{,}0295)+z_3*0{,}1528+z_4*0{,}9521+z_5*0{,}0418.$

5. Ненулевые дисперсии $\lambda_1=0.0250$, $\lambda_2=0.02500$, $\lambda_3=0.02500$, $\lambda_4=0{,}1.5000$ из модельного спектра Λ_{88}=diag(2.5000,2.5000, 2.5000,1.5000,0.0000,0.0000, 0.0000,0.0000,0.0000) равны значениям алгебраических формул y–изменчивостей $y_{i2},y_{i1},y_{i3},y_{i4}$, i=1,…,24, имеют развные значения. Других значений не удалось получить при решении Оптимизационной Задачи с 13 индикаторами (управляющие параметры, соответствующие смыслам y-переменных $y_1,\ldots,y_4$) присутствия знаний.

6. Из вычисленных в рамках модели 8*8=64 индикаторов в смысловой модели используются все (в том числе 13 назначенных экспетом) индикаторов наличия модельных знаний, как показано на Рисунках 1-8, адекватных ожидаемым знаниям.

7. Каждая из четырех смысловых формул из пункта 3 когнитивно сконструирована из смыслов 8 неизмеряемых и зависимых друг от друга z-показателей. Четыре смысловые функции реализованы в когнитивной модели сказки о рыбаке и золотой рыбке: «старик отпускает рыбку, не прося награды», «золотая рыбка выполняет (после просьб рыбака) все 6 желаний старухи, начиная с нового корыта, кончая «быть столбовой дворянкой», «проявления тревожного состояния моря», «золотая рыбка не отвечает на последнюю просьбу рыбака потому, что она измерила ценности всего произошедшего и убедилась в безграничной жадности старухи». Четыре не y–изменчивости не коррелируют друг с другом: $(y_1,y_2)=corr(y_2,y_3)=corr(y_1,y_3)=\ldots=corr(y_1,y_4)=0$, так как $\lambda_{12}=\lambda_{23}=\ldots=\lambda_{14}=0$. Эти равенства – следствие исходной гипотезы модели: они по смыслам друг на друга не влияют.

8. Смыслы z-показателей являются входными

данными модели, они сформулированы в пункте «Исходные данные» статьи.

9. Состав исходных индикаторов (13 штук, Таблица 2) не отличен по значениям от смоделированных индикаторов, формально найденных при решении Оптимизационной Задачи.

10. Модельные матрицы Y_{m4}, Z_{m8} (Таблицах 5 и 6) (полученные путем вычисления по алгоритму и путем компьютерного моделирования случайных матриц V^0_{m8}, U_{m8} удовлетворяют равенствам алгебраической системы уравнений, соответствуют найденным выше 4 многосмысловым уравнениям.

Таблица 1. Модельная матрица C_{88} псевдособственных векторов с 13 исходными или модельными индикаторами Λ_{88}=diag()

1	2	3	4	5	6	7	8
1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-1.0000	1.0000	-0.4334	-0.0295	-0.1256	-0.2409	0.0000	0.0000
1.0000	1.0000	0.7285	0.1528	-0.1544	-0.3156	0.0000	0.0000
0.0000	1.0000	-0.1269	0.9221	-0.0114	-0.1733	0.0000	0.0000
0.0000	1.0000	-0.1681	0.0418	0.7262	-0.1115	0.0000	0.0000
0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.0000	5.0000	0.7629	0.8762	0.5671	0.2001	1.0000	0.0000

Оптимизационная Задача

Для моделирования матрицы C_{88} индикаторов наличия скрытых знаний сформируем для пары матриц (C_{88}, Λ_{88}) 2 диагональные единичные матрицы (I_{88},I_{88}). Они являются начальными значениями (C_{88},Λ_{88}). Процедура GRD2 после последовательных приближений преобразует матрицы (I_{88},I_{88}) в матрицы (C_{88},Λ_{88}). Для процедуры GRD2, необходимы функции ограничений, помогающие процедуре GRD2 уменьшить работу при поиске решения (матрицы C_{88},Λ_{88}). Простыми ограничениями, не вызывающих возражений, являются индикаторы, назначенные экспертом: c_{11}=1;c_{21}=(-1);c_{22}=1;c_{32}=1;c_{42}=1;c_{52}=1; c_{22}=1;c_{72}=1;c_{73}=(-1);c_{83}=(-1);c_{54}=1;c_{74}=1;c_{84}=(-1). Формула c_{11}=1 обозначает другую формулу corr(z_1,y_1)=c_{11}=1. Если значения 2-х переменных (z_{i1},…, z_{im}), (y_{i1},…,y_{im}) стандартизированы, то z_{i1}=1*y_{i1}, i=1,…,24. Последняя формула проясняет смысл формулы, но у нас переменные не стандартизированы. Эти значения выражают условия сказки: идеальная парная связь (как в сказке, в жизни такой связи не бывает) в парах показателей действующих субъектов сказки. Отклонение одного показателя равно отклонению другого. Идеальная связь.

Решается Оптимизационная Задача: (I_{88},I_{88})=>(C_{88},Λ_{88}) целевая функция имеет вид c_{54}+c_{64}+c_{74}+c_{84}), ее значение должно минимизироваться, согласно сюжету сказки. старуха желает: получить новую избу (смысл(z_5)), быть столбовой дворянкой (смысл(z_6)), быть «вольною царицей» (смысл(z_7)), быть владычицей морскою. Модель должна знать будущий результат желаний старухи, поэтому мы вводим нестрогое ограничение на сумму ее желаний: минимизируем эту сумму. Мы могли потребовать обнуления желаний старухи, но желаем в модели сохранить единичные значения индикаторов. Есть опасение, что процедура GRD2 откажется искать решение (C_{88},Λ_{88}). Используем ограничения: λ_1+…+λ_8 =8 при изменяемых значениях 8*8+8 элементов 2-х матриц C_{88}, Λ_{88}. Ограничения на элементы матриц: $C^TC \neq I_{88}$, $C_{88}C^T_{88}=I_{88}$, Λ_{88}=*diag*(λ_1,…λ_8), tr(Λ_{88})=λ_1+…+λ_8=8, без ограничений на монотонность: $\lambda_1 \geq \ldots \geq \lambda_n \geq 0$.

Мы проведем моделирование матрицы псвдособственных векторов C_{88}:(I_{88},I_{88})=> (C_{88},Λ_{88}), $C^T_{88}C_{88} \neq I_{88}$, $C_{88}C^T_{88}=I_{88}$ и моделирование для нее диагональной матрицы Λ_{88}. Особенность матрицы псевдособственных векторов C_{88} состоит в том, что и позволяют моделировать коррелированные z-переменные с дисперсиями, большими 1. Такая z-переменная более изменчива, чем y-переменная y_4, это

соответствует свойствам показателей из текста сказки. Сильно изменчивые z-переменные (z_2, z_3, z_3, z_5, z_6) через формулы передают заметные ненулевые дисперсии y-переменным y_1, y_2, y_3. Значения z-переменных (z_1, z_2, z_3, z_4, z_5,…, z_8) являются многомерными данными, объединенных в матрицу Z_{m8}, в которой элементы j–го столбца z_{1j},z_{2j},…,z_{mj} (j-ая переменная, j=1,…,8) имеют среднее арифметическое равное нулю: $(1/m)(z_{1j}+z_{2j}+\ldots+z_{mj})=0$, и дисперсию не равную 1: $(1/m)(^{z^2}{}_{1j}+z^2{}_{2j}+\ldots+z^2{}_{mj}) \neq 1$, сумма дисперсий не равна 8.

Решая Оптимизационную Задачу: $(I_{88},I_{88})=>(C_{88},\Lambda_{88})$, мы надеемся получить другие значения элементов матрицы Λ_{88}, отличающиеся от диагональной матрицы Λ_{88} из статей [2-8]. Основным вычислительным регулятором является мозаика исходных индикаторов и назначенные экспертом значения 13 индикаторов. Вид таблицы-программы Оптимизационной задачи с 13 исходными индикаторами приведен в Таблицах 9,10.

Конструирование смыслов y-факторов с 13 исходными индикаторами

Смысловое равенство смысл(Z_{m8})= смысл($Y_{m8}C^T{}_{88}$) можно записать по-другому: смысл(z_1)⊕…⊕смысл(z_8)=смысл(y_1*$\mathbf{c^T_1}$)⊕…⊕ смысл(y_8*$\mathbf{c^T_8}$). Так как не существует 8 y-смыслов, а имеем только 4 y-смысла (смыслы смысл(y_5*$\mathbf{c^T_5}$), …, смысл(y_8*$\mathbf{c^T_8}$ отсутствуют), то сокращается количество смыслов из правой части смыслового равенства. Смысловые равенства не обладают свойствами числовых и функциональных равенств. Имеем смысловое равенство смысл(z_1)⊕…⊕смысл(z_8)=смысл(y_1*$\mathbf{c^T_1}$)⊕….⊕ смысл(y_4*$\mathbf{c^T_4}$). Это равенство должно воплотиться в фразы. Смысл фразы из правой части должен равняться смыслу фразы из левой части равенства. В матричном виде данное смысловое равенство имеет вид: смысл(Z_{m8})=смысл($Y_{m4}C^{\#}{}_{48}$). Так как в когнитивном компьютинге смысловые равенства более значимы, чем числовые, функциональные равенства, то смысловому равенству смысл(Z_{m8})=смысл($Y_{m4}C^{\#}{}_{48}$) соответствует математическая модель вида: $Z_{m8}=Y_{m4}C^T{}_{84}$. В правой части участвуют 4 1-ые компоненты 8-ти псевдособственных векторов $\mathbf{c_1,\ldots,c_8}$. Четверка «весов» из каждого (из 8) псевдособственного вектора, умножается почленно на значения 4-х y–изменчивостей, получаются 4 результата дают 4 произведения вида y*c, а сумма их равна значению одной (из 8-и) z–изменчивости.

Почему используются 1-ые 4 компоненты псевдособственного вектора? Это зависит от местонахождения ненулевых собственных чисел λ_1=2.5000, λ_2=2.5000, λ_3=2.5000, λ_4=1.5000 из матрицы Λ_{88}=diag(2.5000,2.5000, 2.5000, 1.5000, 0.0000, 0.0000, 0.0000,0.0000,0.0000). Λ_{88}. Первые 4 компоненты каждого псевдособственного вектора (из 8) соответствуют 1-ым 4-м элементам матрицы собсвенных чисел Λ_{88}=diag(2.5000, 2.5000, 2.5000, 1.5000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000). Модельная матрица C_{88} используется неполностью из-за меньшего количества y-изменчивостей. Количество z–изменчивостей равно 8, а их смыслы являются заданными в исходных данных. Если бы количество z–изменчивостей совпало бы с количеством y–изменчивостей, то мы бы решали смысловое уравнение смысл(Z_{m8})=смысл($Y_{m8}C^T{}_{88}$) со своей математической моделью вида: $Z_{m8}=Y_{m8}C^T{}_{88}$. Но мы по постановке задачи рассматриваем матричное смысловое равенство вида смысл(Z_{m8})=смысл($Y_{m4}C^{\#}{}_{48}$), поэтому формула $Z_{m8}= Y_{m8}C^T{}_{88}$ в данной когнитивной модели не применима.

Займемся интеллектуальным анализом смыслового равенства смысл(Z_{m8})= смысл($Y_{m4}C^{\#}{}_{48}$). Рассмотрим матричное равенство смысл(Z_{m8})=смысл($Y_{m4}C^{\#}{}_{48}$), Оно разлагается в систему многосмысловых уравнений вида:

смысл(y_1)=смысл(z_1)*1.00⊕смысл(z_2)*(-1.00) ⊕смысл(z_3)*1.00⊕смысл(z_8)*1.00;

смысл(y_2)=смысл(z_1)*0.00⊕смысл(z_2)*1.00⊕ смысл(z_3)*1.00⊕смысл(z_4)*1.00⊕смысл(z_5)*1.00⊕ смысл(z_6)*1.00;

смысл(y_3)=смысл(z_1)*0.00⊕смысл(z_2)*(-0.4334) ⊕ смысл(z_3)*0.7284⊕смысл(z_4)*(-0.1269)⊕ смысл(z_5)*(-0.1681);

смысл(y_4)=смысл(z_1)*0.00+смысл(z_2)*(-0.0295)⊕ смысл(z_3)*0.1528⊕смысл(z_4)*0.9521⊕смысл(z_5)* 0.0418.

Рассмотрим 1-ую смысловую неизвестную переменную смысл(y_1)=«состояние золотой рыбки при 1-ой встрече с рыбаком: она обещает любой выкуп и просит отпустить её в море, (либо в зависимости от просьбы рыбака не отвечает рыбаку)» (смысл(y_1)), являющуюся неизвестной семантической переменной из уравнения смысл(y_1)=смысл(z_1)*1.00⊕смысл(z_2)*(-1.00)⊕ смысл(z_3)*1.00⊕ смысл(z_8)*1.00. Для неизвестной переменной смысл(y_1) из левой части сконструируем сумму смыслов (новый_смысл(y_1)) слагаемых из правой части равнства. Проверим фразу из вновь сконструированного ниже смысла новый_смысл(y_1) и фразу «» из смысл(y_1)=« состояние золотой рыбки при 1-ой встрече с рыбаком: она обещает любой выкуп и просит отпустить её в море» на отсутствие противоречия по их смыслам. Если отсутствует противоречие по их смыслам, то считаем, что смысловое уравнение

смысл(y_1)=смысл(z_1)*1.00⊕смысл(z_2)*(-1.00)⊕ ⊕смысл(z_3)*1.00⊕смысл(z_8)*1.00 имеет семантическое решение, равное новый_смысл(y_1).

Проводим конструирование суммарной фразы для неизвестной семантической переменной новый_смысл(y_1). Дисперсия переменной равна disp(λ1)=2.5000, мы ожидаем большего объема информации, сможем ли мы преобразовать ее в знания? В анализируемом уравнении присутствуют 4 смысла 4-х z–переменных: «старик отпускает рыбку, не прося награды» (с силой $c^2_{11}=1^2$, смысл(z_1)), «позвать золотую рыбку и не попросить новое корыто вместо разбитого» (с силой $c^2_{21}=(-1)^2$, смысл(z_2)), «старик зовёт рыбку (с силой $c^2_{31}=1^2$, смысл(z_3)). Но, вопреки сюжету сказки на начальный эпизод, «старуха желает быть владычицей морскою, сама золотая рыбка должна стать у неё в услужении» (с силой $c^2_{81}=1^2$, смысл(z_8))). Здесь в новый смысл(y_1) входят фразы, отрицающие желания старухи, они видны из смысл(z_4), смысл(z_5), смысл(z_6), смысл(z_7). Эти отрицания выявляются из фактов: «после возвращения домой рыбак видит у жены новое корыто» (с силой $c^2_{41}=0^2$, смысл(z_4)), что означает: не видит нового корыта; далее «старуха желает получить новую избу (с силой $c_{51}{}^2=0^2$, смысл(z_5)): у старухи нет желания иметь избу; «старуха желает быть столбовой дворянкой» (с силой $c_{61}{}^2=0$, смысл(z_6)): у старухи нет желания быть столбовой дворянкой; «старуха желает быть «вольною царицей» (с силой $c_{71}{}^2=0^2$, смысл(z_7)): она не хочет быть «вольною царицей». Теперь учет исходного смысла переменной смысл(y_1)= «состояние золотой рыбки при 1-ой встрече с рыбаком» и сравнение его с новым смыслом позволяет нам утверждать: новый смысл не дополняет смысл(y_1), а предугадывает будущие эпизоды сказки. Смысловое уравнение вида смысл(y_1)=смысл(z_1)*1.00⊕смысл(z_2)*(-1.00)⊕ смысл(z_3)*1.00⊕смысл(z_8)*1.00 предугадывает будущие желания старухи и точно видит: «старуха желает быть владычицей морскою, сама золотая рыбка должна стать у неё в услужении» (с силой $c_{81}=1$, смысл(z_8)). С этой оговоркой новый смысл смыслового уравнения смысл(y_1)= смысл(z_1)*1.00⊕смысл(z_2)*(-1.00)⊕смысл(z_3)* 1.00⊕смысл(z_8)*1.00 может быть включено в модель. В других предметных областях [2-7] такого не было. Вышеприведенная фраза «новое корыто вместо разбитого» (с силой $c^2_{21}=1^2$, смысл(z_2))» подчиняется правилу функциональных преобразований свойств корыта: *новое* (старое)=новое, *новое*(новое)=старое. Одна функция – *новое,* 2 аргумента - старое и новое (в скобках). В сказке упомянуты 2 корыта: старое и новое, поэтому функция обновления вида новое(новое)=старое действует с силой $c^2_{81}=1^2$, функция обновления вида *новое*(старое)=новое действует с силой $c^2_{21}=(-1)^2$. Функция имеет только 2 значения, 2-ое значение есть действие новое(старое)=новое происходит раньше, чем действие новое(новое)=старое. Так формализовалась одна из кратких фраз «новое вместо нового корыта=прежнее разбитое корыто» из теории смысловых уравнений. В формулах других y-переменных y_1,y_2,y_3 ,y_4 силы проявлений z-факторов имеют разные знаки плюс или минус, влияющие на конструируемые фразы.

Рассмотрим 2-ую смысловую неизвестную переменную смысл(y_2)= «золотая рыбка дарит новое корыто вместо разбитого, либо избу, либо статус столбовой дворянки, либо статус «вольная царица». Ее смысловая формула смысл(y_2)= смысл(z_1)*0.00⊕смысл(z_2)*1.00⊕смысл(z_3)*1.00⊕ смысл(z_4)*1.00⊕смысл(z_5)*1.00⊕смысл(z_6)*1.00. Смысл правой части должен быть равен сумме смыслов 6 z–переменных z_1,z_2, …,z_6. «Золотая рыбка выполняет (после просьб рыбака) все желания старухи, начиная с нового корыта, кончая желанием «быть столбовой дворянкой» смысл(z_6). Выполнены идеально с весами $c^2_{22}=corr^2$ (z_2,y_2)=1^2; $c^2_{32}=corr^2(z_3,y_2)=1$;$c^2_{42}=corr^2(z_4,y_2)=1$; $c^2_{52}=corr^2(z_5,y_2)=1$;$c^2_{62}=corr^2(z_6,y_2)=1$ равными 1. Вновь назначенный моделью «вес» $c_{12}=1$. Модель добавляет к 5-ти желаниям старухи, ее исходное 1-ое желание – новое корыто (спусковой механизм разогрева жадности старухи). Новый_смысл(y_2)= «золотая рыбка выполняет (после просьб рыбака) все 6 желаний старухи, начиная с нового корыта, кончая «быть столбовой дворянкой». Эта фраза кратко передает смысл неизвестной смысловой переменной новый_смысл(y_2).

Рассмотрим 3-ю смысловую неизвестную переменную смысл(y_3)=«состояние моря, зависящее от желаний старухи», (смысл(y_3)). Смысл правой части смыслового уравнения смысл(y_3)=смысл(z_2)*(-0.4334)⊕смысл(z_3)* 0.7284⊕смысл(z_4)*(-0.1269)⊕смысл(z_5)*(-0.1681) равен сумме смыслов 4 z–переменных z_2, …,z_5. Знаки сил проявлений состояний моря постоянно меняются: то плюс (1 раз), то минус (3 штуки). Плохое состояние моря зависит не только от желаний старухи, оно зависит от действий золотой рыбки, от просьб рыбака. Плохое (тревожное) состояние моря проявлось: а) при «просьбе рыбака дать новое корыто» (с заметной силой $c_{23}=(-0.4334)$, смысл(z_2)); б) когда появляется золотая рыбка на зов старика и исполнила его желание (с силой $c^2_{33}=0.1528^2$, смысл(z_3)); в) когда рыбак видит у жены новое корыто», (с меньшей силой $c^2_{43}=(-0.1269)^2$, смысл(z_4)); г) когда старуха желает получить новую избу (с малой силой $c^2_{53}=(-0.1681)^2$, смысл(z_5)). Как видим, модель оценивает состояние моря по-разному – наибольшая степень ухудшения моделируется когда старуха просит новое корыто (с заметной силой $c^2_{23}=(-0.4334)^2$,

смысл(z_2)), с меньшей степенью - когда рыбак видит у жены новое корыто, когда старуха желает получить новую избу. Природа (море) заранее измеримо реагирует на эпизоды, чувствует плохой финал, порицает старуху.

Рассмотрим 4-ю смысловую неизвестную переменную смысл(y_3)=«золотая рыбка не отвечает на последнюю просьбу рыбака». Смысл правой части уравнения смысл(y_4)=смысл(z_2)*(-0.0295)⊕смысл(z_3)*0.1528⊕смысл(z_4)*0.9521⊕ смысл(z_5)*0.0418 равен сумме смыслов 4-х z–переменных z_2,z_3,z_4,z_5. «Золотая рыбка не отвечает на последнюю просьбу рыбака потому, что: а) она была вынуждена спасти свою жизнь и выполнила просьбу рыбака дать новое корыто» (с заметной силой $c^2_{24}=(-0.0295^2)$, смысл(z_2)), б) она появлялась на каждый зов рыбака и исполняла его желание (с силой $c^2_{34}=0.1528^2$, смысл(z_3)), в) впервые после возвращения домой рыбак видит у жены новое корыто», (с меньшей силой $c^2_{44}=(-0.1269)^2$, смысл(z_4)), г) она выполнила желание «старухи получить новую избу» (с малой силой $c^2_{54}=0.0418^2$, (z_5)». Короткий новый_смысл(y_4)= «Золотая рыбка не отвечает на последнюю просьбу рыбака потому, что она измерила ценности всего произошедшего и убедилась в безграничной жадности старухи».

Четыре функции требуются реализовать в когнитивной модели сказки о рыбаке и золотой рыбке: «старик отпускает рыбку, не прося награды», «золотая рыбка выполняет (после просьб рыбака) все 6 желаний старухи, начиная с нового корыта, кончая «быть столбовой дворянкой», «проявления тревожного состояния моря», «золотая рыбка не отвечает на последнюю просьбу рыбака потому, что она измерила ценности всего произошедшего и убедилась в безграничной жадности старухи».

Моделирование числовых матриц Y_{m4}. Z_{m8} y- и z–отклонений для 4-х многосмысловых уравнений

по математической модели, где отдельно моделировались матрицы U_{m8} и Y_{m8} [21] такие, что $(1/m)U^T_{m8}U_{m8}=I_{88}$, $Y_{m8}=U_{m8}\Lambda^{1/2}_{nn}$, затем моделировалась матрица $Z_{m8}=Y_{m4}C^{\#}_{48}$. Матрица значений z-переменных $z_1,z_2,z_3,\ldots,z_8$ $Z_{m8}=Y_{m4}C^{\#}_{48}$. ($C_{88}C^T_{88}\neq I_{44}$, при этом $C_{88}C^T_{88}=I_{88}$). Легко вычисляется в ЭТ Excel. Матрицы Z_{m8} и Y_{m4} содержат модельные значения неизмеряемых изменчивостей (отклонений от 0), соответствующих неизмеряемым факторам.

Матрица $Y^{(t)}_{m8}$ t=1,…,∝, обеспечивает случайность будущих значений y- и z–отклонений из матриц ($Y^{(t)}_{m8}$, ($Y^{(t)}_{m4}$. $Z^{(t)}_{m8}$). В матрице Y_{m4} элементы j–го столбца $y_{1j},y_{2j},\ldots,y_{mj}$ (j-ая y-переменная, j=1,…,4) имеют среднее арифметическое, равное нулю: $(1/m)(y_{1j}+y_{2j}+\ldots+y_{mj})=0$, дисперсию равную λ_j: $(1/m)(y^2_{1j}+y^2_{2j}+\ldots+y^2_{mj})=\lambda_j$, j=1,…,4, при этом сумма дисперсий равна 8: $\lambda_1+\ldots+\lambda_8=8$. Матрицы Z_{m8}, Y_{m4} приведены в Таблицах 5 и 6.

Таблица 2. Вид таблицы-программы Оптимизационной задачи: ($I_{88}I_{88}$)=>(C_{88} Λ_{88}) в модели с 8 z-переменными, 4 y-переменными

	1	2	3	4	5	6	7	8	
z1	1,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	1,0000
z2	-1,0000	1,0000	-0,4334	-0,0295	-0,1256	-0,2409	0,0000	0,0000	1,0000
z3	1,0000	1,0000	0,7285	0,1528	-0,1544	-0,3156	0,0000	0,0000	1,0000
z4	0,0000	1,0000	-0,1269	0,9221	-0,0114	-0,1733	0,0000	0,0000	1,0000
z5	0,0000	1,0000	-0,1681	0,0418	0,7262	-0,1115	0,0000	0,0000	1,0000
z6	0,0000	1,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	1,0000
z7	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	1,0000	0,0000	1,0000
z8	1,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	1,0000
	4,0000	5,0000	0,7629	0,8762	0,5671	0,2001	1,0000	0,0000	8,0000
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
lam	2,2000	2,2000	2,2000	1,4000	0,0000	0,0000	0,0000	0,0000	8,0000
c11=	1		1,00000						
c21=	-1					0,01000	0,8889		0,0418

c32=	1								
c 42	1								
c52=	1								
c62=	1								
c72=	1								
c73=	-1								
c83=	-1								
c54=	1								
c74=	1								
c84=	-1								
c22=	1								

Таблица 3. Матрица V^0_{m8} значений равномерно распределенных в интервале [-1;1] случайных чисел

	1	2	3	4	5	6	7	8
1	-0,0526	0,2325	0,1472	0,2836	0,4510	0,1750	-0,4181	0,4119
2	0,2491	0,2025	0,3691	0,1119	-0,0937	-0,4153	0,3616	0,3006
3	0,4804	-0,1537	-0,1748	-0,3778	0,2711	-0,4207	0,3584	-0,3557
4	-0,3396	-0,1483	-0,1056	-0,2194	0,3334	-0,1585	-0,1537	-0,4411
5	0,2506	0,2913	0,0429	0,4258	0,0636	-0,4439	0,0428	-0,218
6	-0,3220	-0,0171	0,0081	-0,2066	0,4277	0,4112	-0,3246	0,3169
7	0,1498	0,0732	-0,3036	-0,2938	0,0365	0,2262	0,4715	0,1633
8	-0,0365	0,0022	-0,2170	-0,0953	-0,2983	0,2472	-0,1444	-0,4108
9	-0,1159	0,0598	0,4960	-0,0091	-0,4771	-0,4942	0,0984	0,3699
10	-0,0890	0,4267	-0,2604	0,0959	0,4344	0,3072	-0,0811	0,4152
11	0,0524	-0,2548	-0,2290	0,4417	0,1496	0,2894	-0,2359	0,2202
12	-0,2712	0,1883	0,2892	-0,3829	0,2302	0,1233	0,3226	-0,0219
13	-0,169	0,1326	0,3656	-0,2619	0,0969	-0,0347	-0,0969	-0,2931
14	0,3837	0,2969	0,3366	0,2169	0,0056	-0,5400	-0,3927	0,2508
15	-0,3847	-0,1853	-0,3437	0,2376	0,0837	0,1218	-0,4063	0,3548
16	**-0,1107**	-0,0035	0,2945	0,3531	-0,0615	0,2229	0,3361	0,0425
17	**-0,2165**	0,2396	0,226	-0,3821	-0,4993	-0,4196	0,0233	-0,4245
18	**0,4099**	-0,2633	-0,2912	0,0071	-0,35	0,3413	0,1077	0,4082
19	0,4624	-0,4753	-0,4591	0,2163	-0,115	0,1077	0,0494	-0,2835
20	**-0,3494**	-0,0523	-0,4393	0,4715	-0,1760	0,3021	-0,3766	-0,5348
21	-0,0445	0,0407	0,2313	-0,3828	0,0520	-0,1864	0,4132	0,1939
22	**0,5209**	-0,0220	-0,0650	-0,1270	-0,5044	0,2160	-0,3278	-0,1449
23	**-0,3813**	-0,1751	0,3810	-0,4338	0,3967	-0,1858	-0,1223	0,1286
24	-0,0763	-0,4358	-0,2987	0,3110	-0,4572	0,2077	0,4952	-0,4481
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Таблица 4. Матрица U_{m8} u–изменчивостей

	u 1	**u 2**	**u 3**	**u 4**	**u 5**	**u 6**	**u 7**	**u 8**
1	-0,1817	1,0248	0,5007	0,9556	1,4810	0,5737	-1,4066	1,2640206
2	0,8607	0,8926	1,2555	0,3771	-0,3077	-1,3615	1,2166	0,9224543
3	1,6599	-0,6774	-0,5946	-1,2730	0,8903	-1,3792	1,2058	-1,091652
4	-1,17343	-0,6536	-0,3592	-0,7393	1,0949	-0,5196	-0,5171	-1,353734
5	**0,8659**	1,2840	0,1459	1,4348	0,2089	-1,4553	0,144	-0,669067
6	-1,112612	-0,0753	0,0275	-0,6962	1,4045	1,3481	-1,092	0,972477

7	0,5176063	0,3227	-1,0327	-0,9900	0,1199	0,7416	1,5863	0,501097
8	-0,126119	0,0097	-0,7381	-0,3211	-0,9796	0,8104	-0,4858	-1,260747
9	-0,400471	0,2636	1,6872	-0,0306	-1,5667	-1,6202	0,3311	1,1351277
10	-0,307523	1,880756	-0,8858	0,323164	1,42653	1,007142	-0,2728	1,274148
11	0,1810586	-1,1230	-0,7790	1,4884	0,4913	0,9488	-0,7936	0,6757163
12	-0,937082	0,82998633	0,983712	-1,2902261	0,7559614	0,4042419	1,0854	-0,06726
13	-0,583948	0,58448345	1,24359	-0,8824981	0,318221	-0,1137472	-0,326	-0,89954
14	1,3258047	1,30865084	1,144946	0,7308918	0,0184034	-1,7703288	-1,3211	0,769624
15	-1,32926	-0,8166901	-1,16912	0,8006436	0,2748739	0,3993242	-1,3669	1,0887876
16	-0,382503	-0,0153898	1,001741	1,1898385	-0,201945	0,7307717	1,1308	0,1303763
17	-0,748076	1,05609581	0,768735	-1,2875304	-1,639624	-1,375608	0,0784	-1,302791
18	1,416334	-1,1604823	-0,99054	0,0239386	-1,149342	1,1189357	0,3624	1,2526658
19	1,5977381	-2,0948918	-1,56166	0,72887	-0,377632	0,3530986	0,166225	-0,870079
20	-1,207287	-0,2304803	-1,49431	1,5888054	-0,577948	0,9904219	-1,26697	-1,641288
21	-0,153762	0,17942573	0,786763	-1,2898891	0,1707751	-0,6110823	1,390163	0,5950047
22	1,799874	-0,0969303	-0,22111	-0,4279319	-1,656372	0,7081506	-1,10279	-0,444732
23	-1,317512	-0,7717327	1,295974	-1,4617414	1,3027263	-0,6091153	-0,41143	0,3946069
24	-0,263641	-1,9207919	-1,01606	1,0479761	-1,501373	0,6809398	1,666037	-1,375216
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
	1,0000	**1,0000**	**1,0000**	**1,0000**	**1,0000**	**1,0000**	**1,0000**	**1,0000**

Таблица 5. Матрица Y_{m4} y–изменчивостей

№	y 1	y 2	y 3	y 4
1	-0,26958	1,520027	0,7426	1,130738
2	1,27665	1,323901	1,8622	0,446165
3	2,46208	-1,00476	-0,8819	-1,50628
4	-1,74047	-0,96946	-0,5328	-0,87474
5	1,28434	1,904433	0,2164	1,697693
6	-1,65027	-0,11174	0,0408	-0,8237
7	0,76773	0,478601	-1,5318	-1,17137
8	-0,18706	0,014437	-1,0949	-0,37995
9	-0,59399	0,390998	2,5025	-0,03627
10	-0,45613	2,789612	-1,3138	0,382373
11	0,26855	-1,6657	-1,1554	1,761087
12	-1,38992	1,231069	1,4591	-1,52662
13	-0,86614	0,866929	1,8445	-1,04419
14	1,96649	1,941043	1,6982	0,864803
15	-1,97161	-1,21135	-1,7341	0,947334
16	-0,56734	-0,02283	1,4858	1,407836
17	-1,10958	1,566443	1,1402	-1,52343
18	2,10076	-1,72127	-1,4692	0,028325
19	2,36983	-3,10723	-2,3163	0,862411
20	-1,7907	-0,34186	-2,2164	1,8799
21	-0,22807	0,266131	1,167	-1,52622
22	2,66964	-0,14377	-0,328	-0,50634
23	-1,95419	-1,14466	1,9222	-1,72956
24	-0,39104	-2,84899	-1,5071	1,239982
	0,0000	0,0000	0,0000	0,0000
	2,2000	**2,2000**	**2,2000**	**1,4000**

Таблица 6. Матрица Z_{m8} z–изменчивостей

№	z1	z2	z3	z4	z5	z6	z7	z8
1	-0,2696	1,4344	1,9641	2,5024	1,4424	1,5200	-1,43E-08	-0,2696
2	1,2767	-0,7730	4,0252	1,5124	1,0295	1,3239	-2,73E-08	1,2767
3	2,4621	-3,0402	0,5848	-2,3270	-0,9194	-1,0048	-1,51E-11	2,4621
4	-1,7405	1,0277	-3,2317	-1,7347	-0,9164	-0,9694	2,11E-08	-1,7405
5	1,2844	0,4763	3,6057	3,4933	1,9390	1,9044	-2,39E-08	1,2843
6	-1,6503	1,5451	-1,8581	-0,9012	-0,1530	-0,1117	1,20E-08	-1,6503
7	0,7677	0,4093	-0,0484	-0,4423	0,6872	0,4786	4,30E-09	0,7677
8	-0,1871	0,6872	-1,0282	-0,2084	0,1826	0,0144	8,32E-09	-0,1871
9	-0,5940	-0,0986	1,6143	0,0389	-0,0313	0,3910	-1,35E-08	-0,5940
10	-0,4561	3,8039	1,4349	3,3204	3,0265	2,7896	-6,87E-09	-0,4561
11	0,2685	-1,4854	-1,9698	0,1577	-1,3978	-1,6657	1,11E-08	0,2686
12	-1,3899	2,0336	0,6708	-0,4076	0,9219	1,2311	-4,26E-09	-1,3899
13	-0,8661	0,9644	1,1849	-0,3613	0,5132	0,8669	-8,54E-09	-0,8661
14	1,9665	-0,7870	5,2767	2,5489	1,6917	1,9410	-3,50E-08	1,9665
15	-1,9716	1,4839	-4,3014	-0,0893	-0,8802	-1,2113	2,69E-08	-1,9716
16	-0,5673	-0,1410	0,7072	1,1290	-0,2138	-0,0228	-8,42E-09	-0,5673
17	-1,1096	2,2267	1,0547	-0,0287	1,3111	1,5665	-6,01E-09	-1,1096
18	2,1007	-3,1861	-0,6864	-1,5079	-1,4731	-1,7213	6,37E-09	2,1008
19	2,3698	-4,4985	-2,2929	-1,9922	-2,6817	-3,1072	1,61E-08	2,3698
20	-1,7907	2,3541	-3,4599	1,7293	0,1094	-0,3418	2,14E-08	-1,7907
21	-0,2281	0,0334	0,6550	-1,3351	0,0061	0,2661	-3,69E-09	-0,2281
22	2,6696	-2,6563	2,2096	-0,5842	-0,1098	-0,1438	-1,18E-08	2,6696
23	-1,9542	0,0273	-1,9628	-3,0353	-1,5401	-1,1447	1,08E-08	-1,9542
24	-0,3911	-1,8413	-4,1484	-1,4772	-2,5438	-2,8490	2,52E-08	-0,3910
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
	2,2000	**3,8390**	**6,2828**	**3,0045**	**1,8738**	**2,2000**	**0,0000**	**2,2000**

Визуализация знаний о «весах» и z-, y-изменчивостях в модели с 8 z-переменными, 4 y-переменными

Точки на Рисунках 1-3 показывают взаимные динамики “скачки-падения» точек переменных (z_1,z_2,z_3,z_8,y_1). Визуализация динамик факторов поведений, компетенций отличается от визуализаций динамик факторов из других предметных областей [16-22]. Рисунок 1 показывает возрастающую динамику y – изменчивость фактора y1 со смыслом «состояние золотой рыбки при 1-ой встрече с рыбаком: она обещает любой выкуп и просит отпустить её в море». После желания старухи он вынужден «позвать рыбку и попросить хотя бы новое корыто (с силой c_{21}=1, смысл(z_2)), золотая рыбка выполняет просьбу (с силой c_{31}=1, смысл(z_3)) и свободно уходит в море (с силой c_{21}=1, с дисперсией, измеряющей степень свободы ее поведения λ_1=2.4, y_1). Событие реализуется в течение моментов времени i=1,…,24. В каждый момент времени отклонение от 0 значения z_{i2} показателя, измеряющего «желание иметь новое корыто», образуют кривую «z_2», зависящую от кривой «смысл(z_3)» (с силой c_{21}=1), от кривой «y_1» (по формуле y_1=z_1*1,00+z_2*(-1,00)+ z_2*1,00+z_8*1,00). Эти зависимости видны визуально и словесно описываются фразами, характеризующими их тренды: тренд кривой «z_2» медленно растущий и сопровождается прыгающим и убывающим трендом кривой «y_1», сопровождаемый сильными отклонениями кривой «z_3» от 0 – сильными сомнениями в сознании золотой рыбки. Числовой факт –

визуализированное равенство (z_{i1}*1≅y_{i1}*1, i=1,…,24, означает: *изменчивость просьбы* (y_{i1}, с силой 1 *отпустить ее)* золотой рыбки при 1-ой встрече с рыбаком равна *изменчивости ответной реакции* (z_{i1}*)* рыбака: 1-ая сильно просит, 2 -ой адекватно сильно отвечает. Изменчивость просьбы (дать новое корыто) рыбака (с силой c_{31}=1, z_3) при 2-ой встрече с золотой рыбкой равна изменчивости «просьбы золотой рыбки при 1-ой встрече». Эти идентичности ответных *изменчивостей* золотой рыбки свидетельствует: она твердо выполняет свое 1-ое обещание, последующие откупы исполняет одинаково правильно.

Приведенные примечания прилагаются ко всем интеллектуальным исследованиям кривых из Рисунков 2-8.

Значения z_{i1},i=1,…,24, y_{i1}=z_{i1}*1.00+z_{i2}*(-1.00) +z_{i3}*1.00+z_8*1.00 очень близки друг к другу, их точки на графике не различимы, т.е. значения чисел (z_{i1}*1.00+z_{i3}*1.00+z_{i8}*1.00) равны значениям чисел z_{i2}*(-1.00). Изменчивость фактора z_2 «позвать рыбку и попросить новое корыто вместо разбитого» равна сумме изменчивостей факторов z_1, z_3, z_8 (Рисунок 2).

На рисунке 3 на возрастающую динамику y–изменчивости фактора y_2 со смыслом «изменчивость» влияют по формуле y_2=z_2*1,00+z_3*1,00+z_4*1,00+z_5*1,00+z_6*1,00) динамики 5 (а не 3-х) z–изменчивостей: z_2 (с силой c_{22}=1), z_3 (с силой c_{32}=1), z_4 (с силой c^{42}=1), z_5 (с силой c_{52}=1), z_6 (с силой c_{62}=1). Среди 5 z–кривых 3 z–кривые имеют малые отклонения, поэтому их влияние на y_2–изменчивость сильнее (их дисперсии равны s^2_2=3,8390, s^2_3=6,2828, s^2_4=3,0045) и 2 z-кривые имеют большие отклонения, поэтому их влияние на y–изменчивость слабее (их дисперсии равны s^2_5=1,87382^2, s^2_6=2000^2). Факторы «позвать рыбку и попросить новое корыто» (смысл(z_2), «старик зовёт рыбку и обещает исполнить его желание», «после возвращения домой рыбак видит у жены новое корыто» (смысл(z_4) являются более информативными (в сюжете сказки), чем желания старухи иметь новую избу (смысл(z_5), «быть столбовой дворянкой» (смысл(z_6). Перечисленные выявленные скрытые знания проясняют смысл сказки. Совпадающие динамики 2-х изменчивостей y_2 («золотая рыбка дарит новое корыто вместо разбитого») и «быть столбовой дворянкой» (смысл(z_6), (обе влияют на возрастающую динамику z-изменчивости фактора y_2 со смыслом «золотая рыбка дарит … » показывает его большую силу фактора y_2, присущего золотой рыбке, чем сила влияния фактора z_6, присущего старухе («быть столбовой дворянкой» (z_6)).

Взаимная динамика y-изменчивость фактора y_3 и 4-х z-изменчивостей факторов z_2,z_3, z_4, z_5. Динамика y-изменчивости фактора y_3 (изменчивость «состояния моря, зависящее от желаний старухи») и 3-х z-изменчивостей факторов z_2,z_3, z_4 влияют на возрастающую динамику z-изменчивости фактора z_5 со смыслом «2-ое желание старухи получить новую избу». Среди 4 z–кривых 3 z–кривые имеют большие отклонения, поэтому их влияние на y_3–изменчивость сильнее (их дисперсии равны s^2_2=3,8390, s^2_3=6,2828, s^2_4=3,0045) и 1 z-кривая имеет большие отклонения, поэтому его влияние на y–изменчивость слабее (его дисперсия равна s^2_5=1,87382^2). Море не хочет (знак минус силы c_{23}==(-0.4334)) фактора z_2, чтобы рыбак «позвал золотую рыбку и попросил у нее новое корыто» (с силой c_{23}=(-0.4334), смысл(z_2)), но зависимый от старухи старик как «рыбак зовёт золотую рыбку, а она обещает исполнить его желание», «после возвращения домой рыбак видит у жены новое корыто» с силой (c_{43}=0.1269, смысл(z_4)). Эти 4 z-фактора являются более информативными (в сюжете сказки), чем желания старухи иметь новую избу (c_{53}=0.1681, смысл(z_5)), а для моря безразлично желание старухи «быть столбовой дворянкой» (сила желания моря равна 0: c_{63}=0.0000, смысл(z_6). Эти слова, проясняющие смысл фактора y_3 и его 4-х z-изменчивостей факторов z_2,z_3, z_4, z_5, отсутствуют в тексте сказки. Слова из текста сказки «Море, к которому приходит старик, постепенно меняется от спокойного и синего к чёрному и бурному, а под конец — к штормящему» мы дополнили проясняющими, содержащими числа, силы связей, цифровые знания словами. Природа (море) осуждает жадность старухи, модель провела измерение ее проявлений. Дисперсии z-факторов превышают дисперсии y-факторов: λ_3=disp(y_3)=2.2000, disp(z_2)=3.8390, disp(z_3)=6.2828, disp(z_4)=3.0045, disp(y_5)=1.8738, влияющих на возрастающую динамику z-изменчивости фактора z_5 со смыслом «старуха желает получить новую избу».

Мы провели интеллектуальное осмысление смыслового уравнения, измеряющего показатели поведения моря – высшей природной силы в сказке. Измерителем проявлений моря является формула y_3=z_2*(-0,4334)+z_3*0,7284+z_4*(-0,1269)+ z_5*(-0,1681), измеряющая другие неизмеримые факторы.

Фактор y_4 (менее изменчивый, чем другие y-факторы, ее дисперсия λ_4=disp(y_4)=1.4000) с смыслом «золотая рыбка не отвечает на последнюю просьбу рыбака» приобретает проясняющие детали в контексте «причина-следствие». Это связано с появлением функциональной связи y-изменчивости фактора y_4 вида y_4=z_2*(-0,0295)+z_3*0,1528+z_4*0,9521+ z_5*0,0418, обусловленной смысловым равенством смысл(Z_{m8})= смысл($Y_{m4}C^{\#}_{48}$) от z-изменчивостей

4-х z-факторов z_2,z_3, z_4,z_5 (воздействия 4-х z-кривых на Рисунке 7). Взаимная динамика 4-х z–изменчивостей (проявлений z-факторов, влияющих на возрастающую динамику y-изменчивости фактора y_4 с новым смыслом «золотая рыбка не отвечает…» на Рисунке 7 позволяет дополнительно узнать интересные проявления чувств, эмоций, действий золотой рыбки, рыбака, жадной старухи. Знания извлекаются из смыслового равенства вида новый_смысл(y_4)=смысл(z_1)*0.00⊕смысл(z_2)*(-0.0295)⊕смысл(z_3)*0.1528⊕смысл(z_4)*0.9521⊕ смысл(z_5)*0.0418 и из соответствующего ему числового равенства $y_4=z_2*(-0,0295)+z_3*0,1528+ z_4*0,9521+ z_5*0,0418$. Они обоснованы выше.

Среди 4 z–кривых 3 z–кривые имеют большие уклонения, поэтому их влияние на y4–изменчивость сильнее (их дисперсии равны $s^2_2=3,8390$, $s^2_3=6,2828$, $s^2_4=3,0045$) и 1 z-кривая имеет меньшие отклонения, поэтому его влияние на y_4–изменчивость слабее (его дисперсия равна $s^2_5=1,87382^2$). Золотая рыбка (в меньшей степени, чем море) не хочет (знак минус силы $c_{24}=(-0,0295)$) фактора z_2, в меньшей степени хочет обещать рыбаку (с силой $c^2_{34}=0.1528^2$,смысл(z_3)), а она не обещает (не отвечает) исполнить его желание», «осле возвращения домой рыбак видит у жены результат (с силой ($c^2_{44}=0,9521^2$,смысл(z_4)) ее «необещания – прежнее разбитое корыто. Эти 4 z-фактора являются более информативными (в сюжете сказки), чем желания старухи иметь новую избу ($c^2_{54}=0,0418^2$,смысл(z_5)), и для золотой рыбки безразлично прежнее желание старухи «быть столбовой дворянкой» (сила желания золотой рыбки равна 0: $c^2_{64}=0.0000$, смысл(z_6)). Приведены силы проявлений чувств, эмоций, действий золотой рыбки в финале сказки проясняют смысл фактора y4 и его z-изменчивостей 4-х факторов z_2,z_3, z_4,z_5. Море под конец становится штормящим, предупреждающим нас.

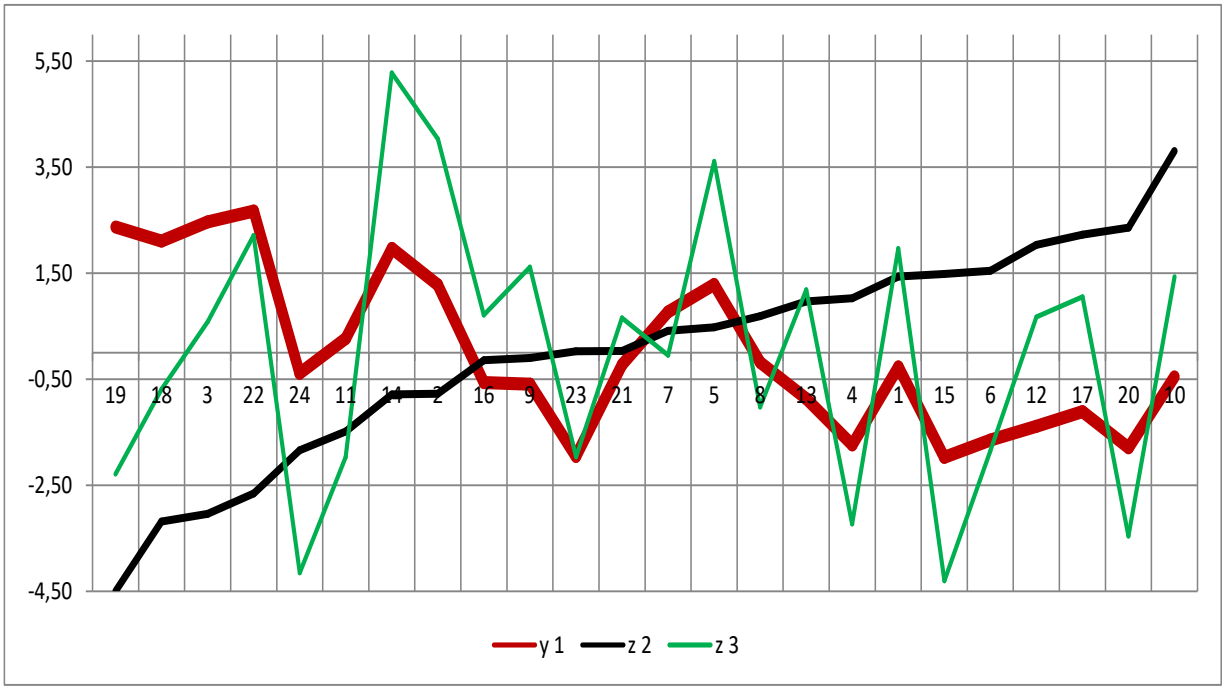

Рисунок 1. Взаимная динамика 2-х изменчивостей z_2, z_3, влияющих на на возрастающую динамику изменчивость на y –изменчивость фактора y_1 со смыслом «состояние золотой рыбки при 1-ой встрече с рыбаком: она обещает любой выкуп и просит отпустить её в море»

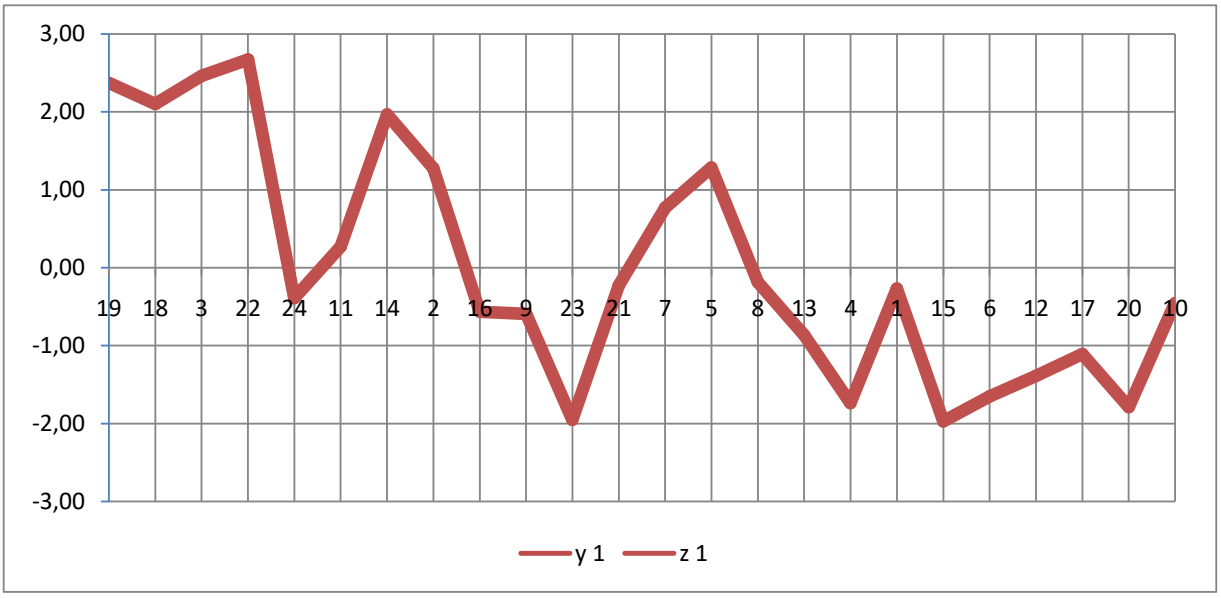

Рисунок 2. Совпадающая динамика 2-х изменчивостей y_1, z_1 влияющих на на возрастающую динамику z-изменчивости фактора z_2 со смыслом «позвать рыбку и попросить хотя бы новое корыто вместо разбитого»

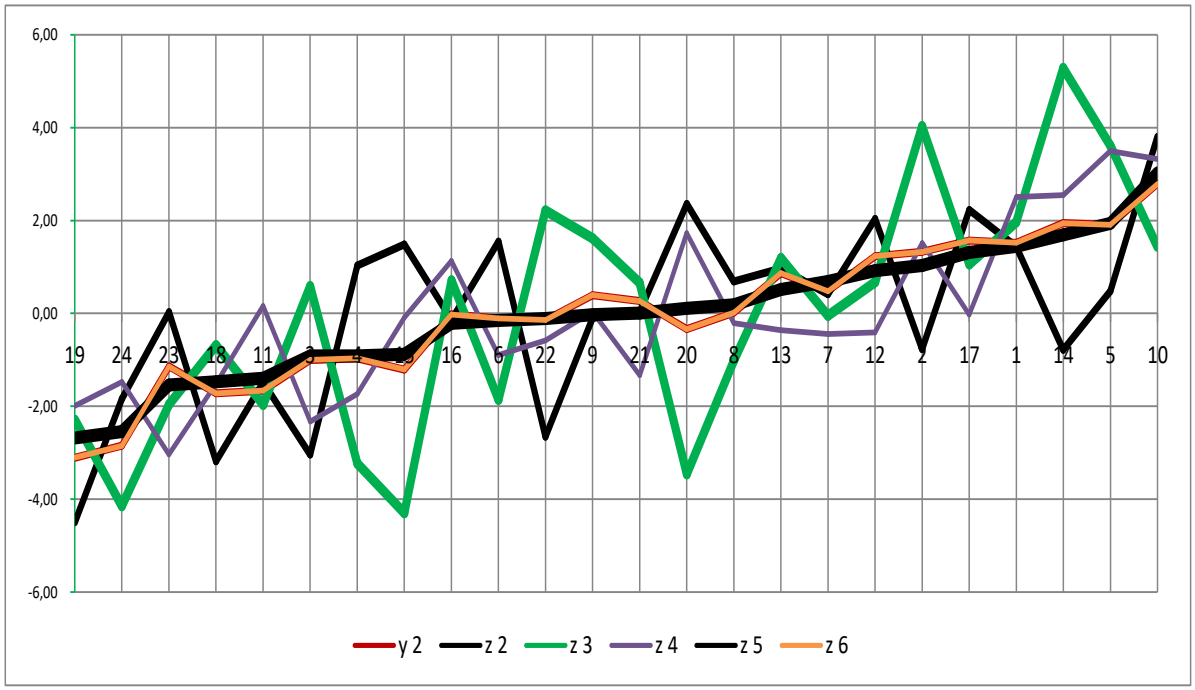

Рисунок 3. Взаимная динамика 3-х z -изменчивостей z_2, z_3, z_4, z_5, z_6, влияющих на на возрастающую динамику y –изменчивости фактора y_2 со смыслом «золотая рыбка дарит новое корыто, либо избу, либо статус столбовой дворянки, либо статус «вольная царица»

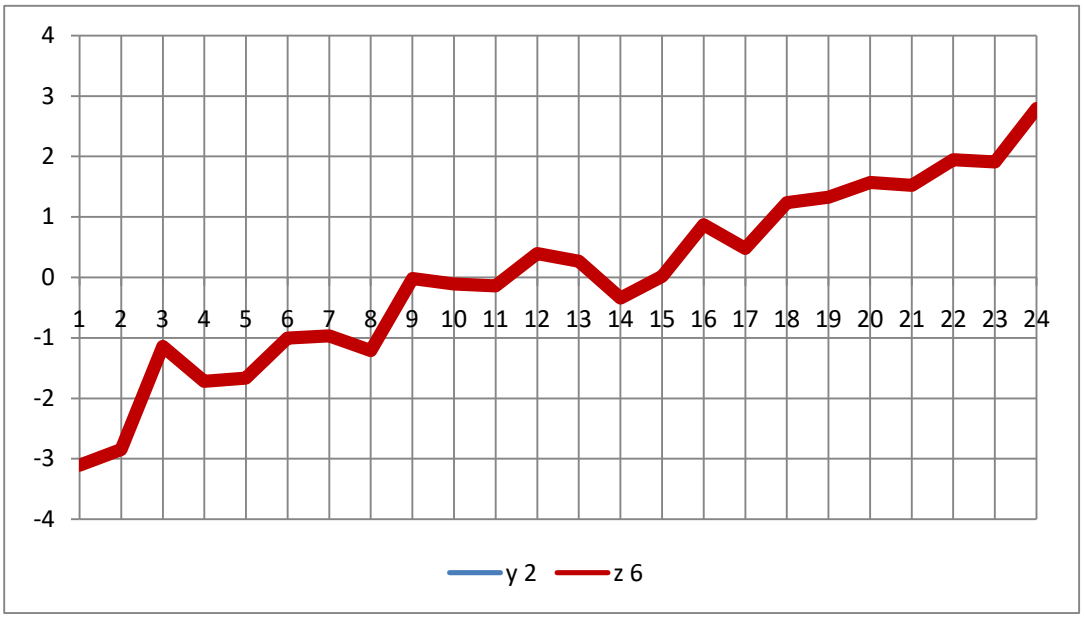

Рисунок 4. Совпадающая динамика 2-х изменчивостей y_2 (золотая рыбка дарит новое корыто вместо разбитого), z_6 влияющих на возрастающую динамику z-изменчивости фактора z_2 со смыслом «позвать рыбку и попросить хотя бы новое корыто вместо разбитого»

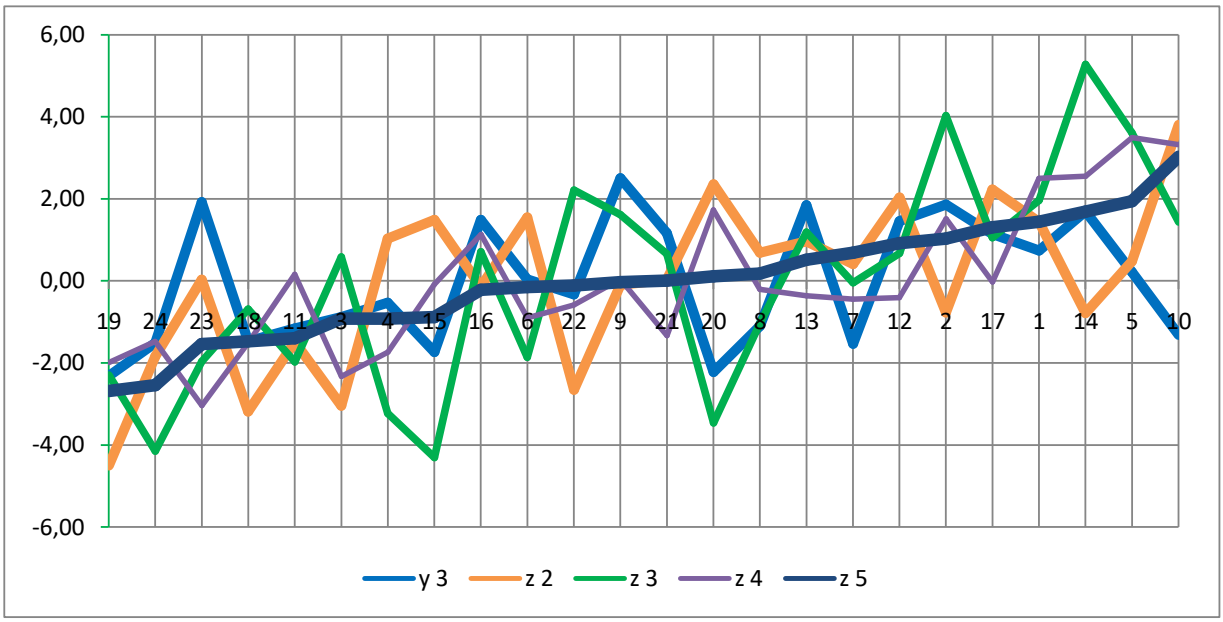

Рисунок 5. Взаимная динамика y-изменчивость фактора y_3 («состояние моря, зависящая от желаний старухи») и 3-х z-изменчивостей факторов z_2,z_3, z_4 влияющих на возрастающую динамику z-изменчивости фактора z_5 со смыслом «старуха желает получить новую избу»

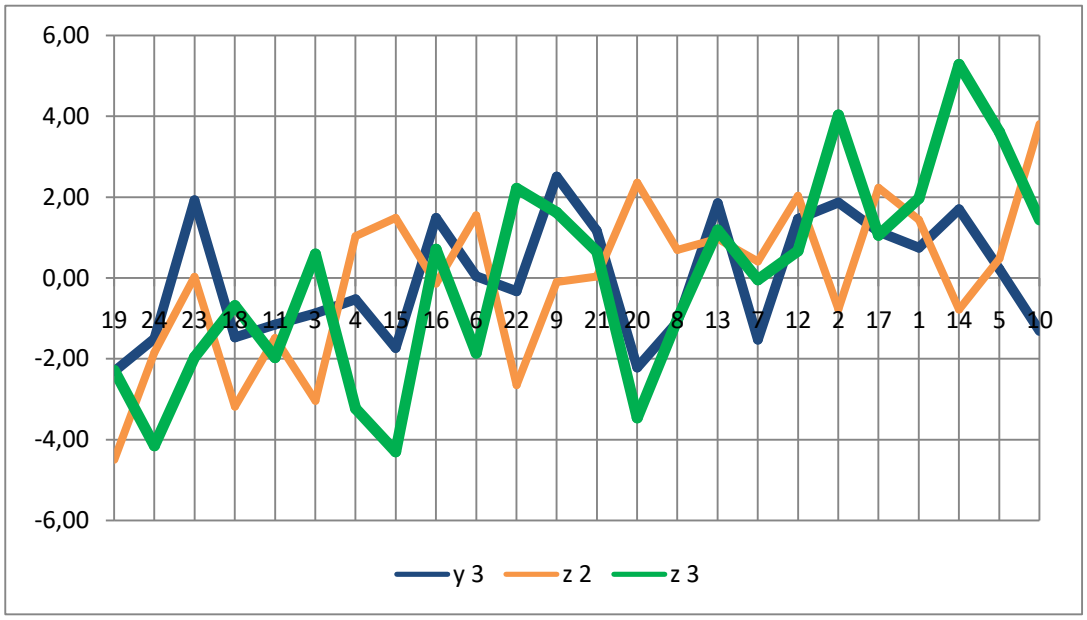

Рисунок 6. Взаимная динамика y-изменчивост фактора y_3 и 2-х z-изменчивостей факторов z_2,z_3, влияющих на возрастающую динамику z-изменчивости фактора z_5 со смыслом «старуха желает получить новую избу»

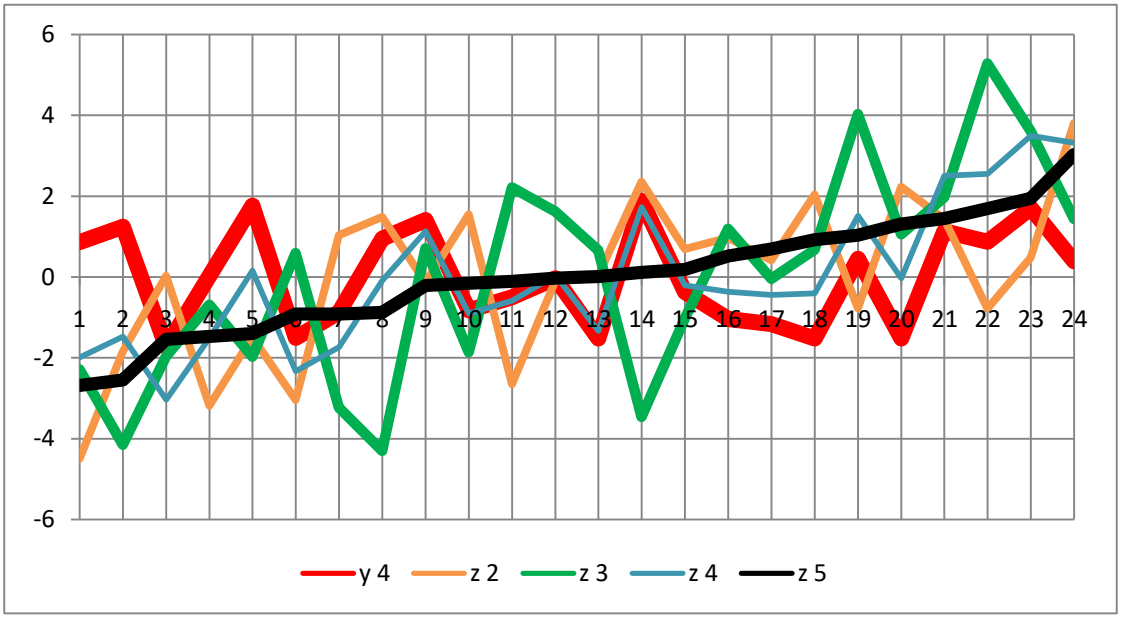

Рисунок 7. Взаимная динамика 4 z –изменчивостей факторов, влияющих на на возрастающую динамику y-изменчивости фактора y_4 с новым смыслом «золотая рыбка не отвечает … , потому что»

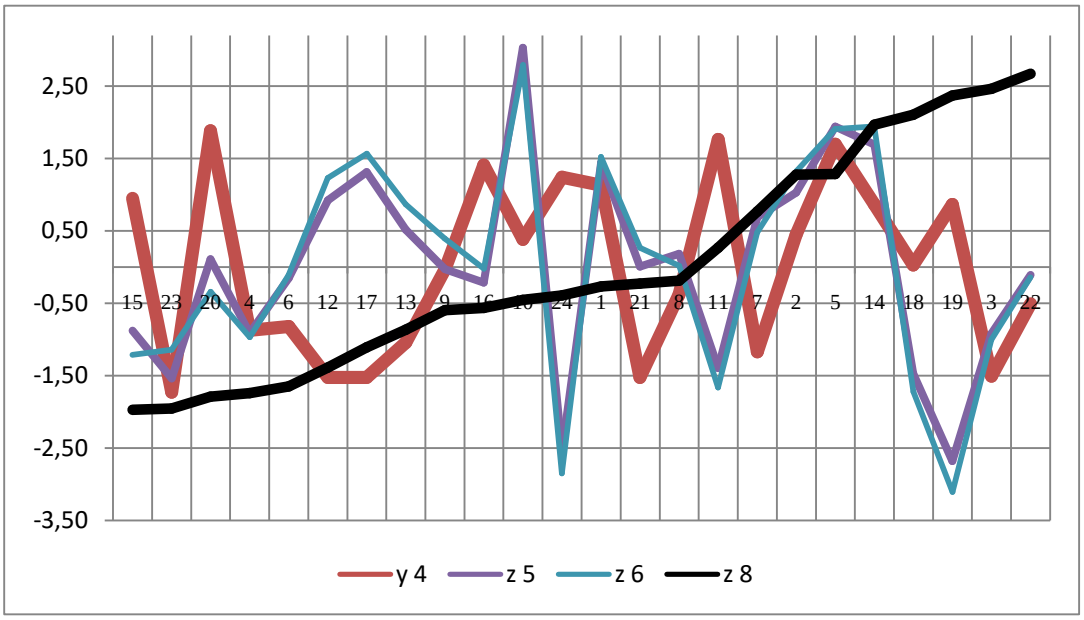

Рисунок 8. Взаимная динамика y-изменчивост фактора y_4 и z –изменчивостей 3-х факторов, влияющих на возрастающую динамику z-изменчивости фактора z_8 с смыслом «старуха желает быть владычицей морскою, сама золотая рыбка должна стать у неё в услужении»

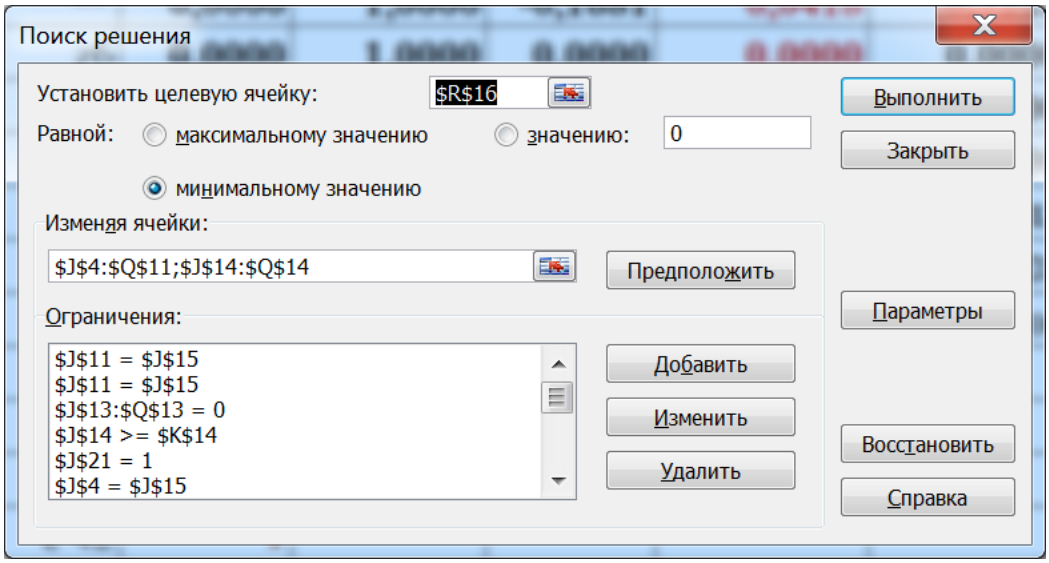

Рисунок 9. Окно надстройки «Поиск решения» с операторами таблицы-программы решения оптимизационной Задачи: $(I_{88},I_{88})=>(C_{88}, \Lambda_{88})$

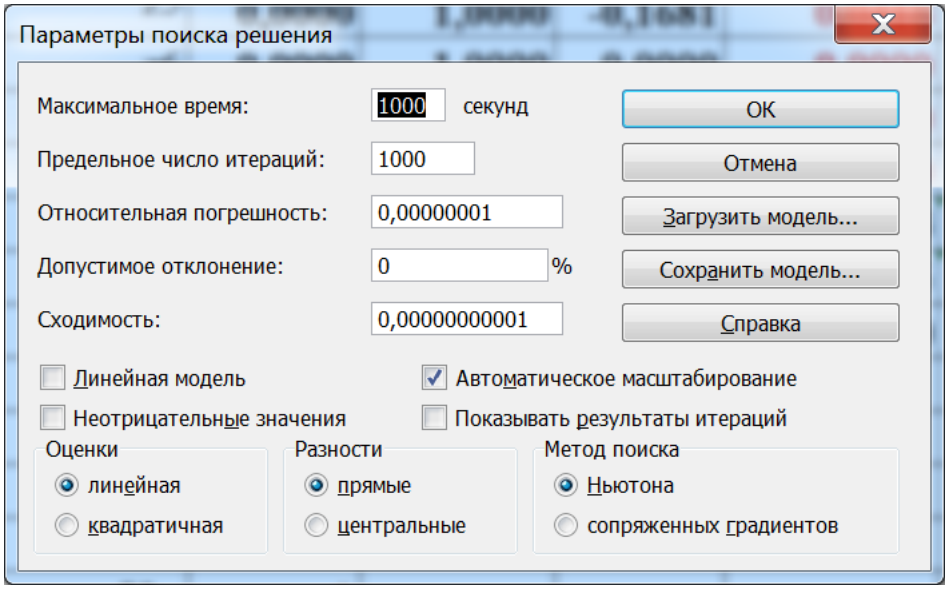

Рисунок 10. параметры поиска решения (C_{88}, Λ_{88}) в таблице-программе решения оптимизационной Задачи: (I_{88},I_{88})=>(C_{88}, Λ_{88})

Заключение

Выше разработана Когнитивная модель сказки о рыбаке и золотой рыбке об смысловых и количественных проявлениях реализовать, обосновать их формульное, фразеологическое, визуализированное на графиках описания поведений кривых соответствует ожидаемому. Разработана система из 4-х смысловых уравнений с 13=8+4 семантическими переменными: смысл(y_1),смысл(y_2),смысл(y_3),смысл(y_4), смысл(z_1), …, смысл(z_8), удовлетворяющих матричному смысловому равенству вида смысл(Z_{m8})=смысл($Y_{m4}C^{\#}_{48}$), где смысл(Z_{m8})= смысл(z_1)⊕…⊕смысл(z_8),смысл($Y_{m4}\mathbf{C}^{\#}_{48}$)= смысл($Y_{m4}\mathbf{c}^{\#}_{1}$)⊕смысл($Y_{m4}\mathbf{c}^{\#}_{2}$)⊕смысл($Y_{m4}\mathbf{c}^{\#}_{3}$)⊕ смысл($Y_{m4}\mathbf{c}^{\#}_{4}$). Этому матричному смысловому равенству соответствует матричное равенство для числовых z-, y-переменных, смоделированных в виде матриц: $Z_{m8}=Y_{m4}C^{T}_{84}$. Четыре семантические решения–знания (новые извлеченные знания), познают смыслы, парные связи, силы проявлений 13 семантических переменных. Визуализация взаимных динамик кривых (значений изменчивостей z-, y-переменных из матриц Z_{m8},Y_{m4}) знаний о «весах» (из C_{88}) и z-, y-изменчивостях в модели с 8 z-переменными, 4 y-переменными показала динамики модельных значений неизмеряемых показателей [15-19] проявлений чувств, эмоций, действий рыбака, золотой рыбки, старухи, моря. Введенные в модель переменные наделены математическими и статистическими свойствами, а параметры постоянны. Они смоделированы в Оптимизационной Задаче и зависят от количеств переменных и от значений индикаторов, образующих мозаику внутри квадрата 8-на-8. Как некоррелированные (y-), так коррелированные (z-) изменчивости умножаются на свои «веса» - силы проявления фактора. Получены интересные знания после визуализации. Модель извлекла новые знания и адекватны реальным представлениям людей о субъектах сказки. Модель исправляет неправильно назначенные экспертом значения индикаторов. Свои замены значений индикаторов модель «обосновывает» как смысловыми (с семантическими переменными), так и алгебраическими (с числовыми переменными) равенствами.

Пять событий сказки реализуются последовательно, каждому из которых зафиксированы 24 моментов времени i=1,…,24. В каждый момент времени отклонение от 0 значения z_{i2} (или других) показателя, измеряющего (смоделированного значения неизмеряемого показателя)) «желание старухи иметь новое корыто», образуют кривую «z_2», зависящую от кривой «z_3» (с силой c^2_{21}=1), от кривой «y_1» (по формуле $y_1=z_1*1{,}00+z_2*(-1{,}00)+z_3*1{,}00+z_8*1{,}00$). Эти зависимости видны визуально и словесно описываются фразами, характеризующими их тренды: тренд кривой «z_2» медленно растущий и сопровождается прыгающеим и убывающим трендом кривой «y_1», сопровождаемый сильными отклонениями кривой «z_3» от 0 – сильными сомнениями в сознании золотой рыбки. По мере возрастания номера фактора y_1,y_2,y_3,y_4 .

В финале сказки рыбак (в меньшей степени, чем в 1-ый раз) «зовет золотую рыбку и просит» (знак минус силы $c^2_{24}=(-0{,}0295)^2$) фактора z_2, золотая рыбка в меньшей степени обещает рыбаку (с силой $c^2_{34}=0.1528^2$, смысл(z_3)), она не обещает (сила c^2_{84}=0, смысл(z_8)), не отвечает) исполнить

его желание», «после возвращения домой рыбак видит у жены результат (с силой (c^2_{44}=0,9521^2, смысл(z_4)) ее «необещания –новое вместо нового корыта= прежнее разбитое корыто. В сказке упомянуты 2 корыта: старое и новое, поэтому обновленное (функция вида новое(новое)=старое имеет только 2 значения, 2-ое значение новое(старое)= новое было раньше) новое корыто есть старое корыто. Эти 5 z-факторов являются более информативными (в сюжете сказки), чем желания старухи иметь новую избу (c^2_{54}=0,0418^2, смысл(z_5)), и для золотой рыбки безразлично прежнее желание старухи «быть столбовой дворянкой» (сила желания золотой рыбки равна 0: c^2_{64}=0,0000, z_6). Приведены силы проявлений чувств, эмоций, действий золотой рыбки в финале сказки проясняют смысл фактора y_4 и зависимых от него z-изменчивостей 4-х факторов z_2,z_3, z_4, z_5, z_8. Море под конец становится штормящим, предупреждающим нас. Если из текста статьи удалить формулы, это повествование является сказкой о жадной старухе.

Изложенную структуру, познающей сюжет литературного произведения, модели можно применить и для современных «сказок», их фио-данных со смыслами, зависимостями, целями (завуалированными или придуманными), с критериями из статей виртуального кодекса законов, как альтернавную к большой модели GPT-3 (Generative Pre-trained Transformer 3). Я (автор) придумал более важное, чем «заголовок и первые предложения, а остальное допишет алгоритм». Уверен: для человека умственная работа является естественной потребностью, заGPTировать эту потребность индивидам, делающих сказку былью, не получится.

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Issue Article

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MOTIVES, PLOTS IN TATAR, KYRGYZ AND KARAKALPAK FOLK TALES

Abstract: *Very similar motifs and plots can be found in the oral works of the Turkic-Mongolian peoples. For example, the tales of the Kazakh, Kyrgyz, Nogai, Karakalpak, Tatar, Karachay, Kumyk, Bashkurd peoples have common episodes, motifs and plots. Some motifs, plots, episodes in these examples of oral art are very similar to each other. In the tales of these kindred peoples, motifs such as "Three boys", "Three friends", "Three brothers", "Three roads", "Three conditions", "Orphan", "People or animals expelled from their homes", there are stories. The study of the causes and features of these similarities is one of the issues that need to be dealt with in modern folklore. Especially in the Kyrgyz and Karakalpak folk tales, there are common similarities, similar events, and this makes every scientist think. This article talks about the general formulas, motifs, plots in the Tatar, Kyrgyz and Karakalpak folk tales.*

Key words: *Folklore, myth, fairy tale, motif, plot, hero, character, Turkic-Mongolian peoples, oral art, similar motifs, plots, common episodes, kindred peoples, folklore, fairy tales, events, general formulas in fairy tales.*

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Introduction

Folklore, literature, the art of Turkic peoples are very close and similar to each other. The reason is that these peoples together have passed several historical stages. From ancient times to the present day they lived a unified association, a single community. These historical events have been preserved in folk oral works. Myths, legends, stories and fairy tales express the difficult life and life experience of people.

In fairy tales, the difficulties and struggle of people for achieving their goals are preserved. There are several examples of such problems in fairy tales.

The Tatar folk fairy tale "Golden Feather" [1] tells about the difficult life of the orphan Timur. His mare is an animal speaking human language. The mare understands Timur's concerns. The stepmother Timur is very angry and cruel. The stepmother adds poison to bread and gives it an orphan. The mare warns the orphan that poison has been added to bread. With the help of mare Timur survives. Then her stepmother gets sick of lies. She orders her husband to cut the mare. Upon learning of this, Timur and his mare run away to a distant country. They find a golden feather and a magnificent bird. Thanks to his courage and help, the mare Timur marries the beautiful fairy.

Such motives and plots are also present in the Karakalpak folk tale “Dark Kyz (the girl of an orphan)” [2, p. 246-248]. For his reasons: in ancient times, there were a husband and wife. They had the only daughter. Once the wife of this man dies. A man marries another woman. The stepmother oppresses an orphan girl. The cow helps the orphan girl. The stepmother orders her husband to cut a cow. The orphan girl buried the cow's bones into the ground. Wonderful clothes come out of the bone burial ground. This clothing is a kind of orphan. As a result, the people chosen an orphan girl as a ruler.

There are common features in the tales of these two peoples. These tales also have their own national characteristics. The Tatar folk tale mentions the name of the hero (Timur). This name is very common

among the Tatar people. In the Karakalpak folk tale, the main character is represented by an orphan girl.

The name of the hero is also mentioned in the Tatar folk tale “The Verce Son Ahmet” [1]. It mentions a bold, brave Ahmet and ten of his brave brothers. Ahmet is looking for his ten brothers. He leaves his house and goes to distant countries. They (brothers) marry the eleven daughters of the king and reach their goal.

There are such motives and plots in the Karakalpak folk tales “Three heroes” [3, p. 219-220], “Eshmurat Batyr” [3, p. 221-223], “Batyr screamed” [3, p. 272-277]. Three brothers save their people from enemies. Eshmurat Batyr is a brave and strong young man, like his thirty -nine brothers. The brothers save people from terrible giants. Forty guys are trying to marry forty girls. This fairy tale is very similar to the fairy tale "The Violent Son Ahmet." In fairy tales, plots, some episodes are very similar, very close in content. There are similar motives in the Karakalpak folk tale “Asan Genzhe” [3, p. 119-125]. The main character, Asan Genzhe (Asan Jr.), saves his brothers from death. He kills an evil old woman and saves people who are in danger. Asan marries a beautiful fairy named. This episode is also found in the Tatar folk tale "The Violent Son Ahmet."

The Tatar folk tale "Kamyr Batyr" is also very interesting. The old man and the old woman have no children. The old woman sculpts the shape of the baby from the dough. The old man and the old woman return home, having finished their household chores. The baby sits at home and plays with a goat. “We made it from the dough, even if it is called Kamyr!” - says the old man. The Kamyr began to grow by the day, but by the clock. In one month it grew like the other and will not grow in a whole year. And Kamyr arrives at Kamyr every day. ” Kamyr Batyr shows great courage, does good deeds with his friends.

There is a similar motive and the plot in the Karakalpak folk fairy tale “Kuryk” (tail). The old man and the old woman want to have children. The old woman finishes a goat and receives milk. Then the goat kicks the old woman. The old woman falls to the ground. Then the tail of the goat turns into a boy. This boy will help the old man and the old woman. The child takes the salary of an old man and an old woman from a rich man.

The forest genie is mentioned in the Tatar folk fairy tale “Shurale” and the work of the Tatar People’s Poet Gabdulla Tukai of the same name (1886-1913). The young man goes into the forest and chopped firewood. At this moment, Shurala, a forest demon appears. The young man deceives a forest demon and squeezes his hand between the logs. Shurale asked the young man: "What is your name?" The guy says "Iltyr" (last year). The next day, forest demons ask Shurale: “Who made you like that?” He says "Tier" (last year). Forest demons said: “If he hurt you last year, where will we find him this year?” They laugh and leave.

In the Karakalpak folk tale "Aryk Mergen" [2, p. 102-105] (thin shooter) there are the same motives as in the fairy tale "Shurale". There are several versions of this fairy tale. In some versions, the character threatening the hero is a bear. In other versions, a dangerous character for the hero is a nursery or albasla (forest demons). Aryk Mergen seems to these characters as “Tier” (last year). Friends of the Antagonists laugh: “If he hurt you last year, where will we find him this year?”

There are a lot of similar motives and plots in the above -mentioned fairy tales. It should be noted that the Tatar and Karakalpak folk tales have common features. In particular, the names of fairy tales, the names of the heroes and words are very similar to each other: Timur, Kesh, Kish (evening), tyn, warm (night), “tan” (dawn), Kamir (dough), Saran (mean), Yumart (Zhomart, generous), lobby (flower), pelvis (bald), Altynshesh, Altynshash (golden hair), Bai (rich), Kobyz (ancient Karakalpak musical instrument), Cubes, Shynkobyz (ancient metal province musical instrument), chapan, chapan, chapan, chapan. Chapan (rich outerwear of mullah), jigit, jigit (guy), kalpak, kalfak (small velvet cap, embroidered with beads or gold and silver thread) and others.

Some epics, dastans and fairy tales of these peoples have mutual similarities and originality. For example, the Karakalpak folk epic "Alpamy" is similar to the Tatar folk tale "Alpamsha and a brave Sandugach." Horse Alpamsha Batyr - Akbuzat (Akbosat). The horse of Alpamys in the Karakalpak epos is Bayshubar. This (Akbuzat, Ak Boz AT) is also called in the Karakalpak language. In language, the Tatar and Karakalpak languages are very close and have common family ties. That is, the Tatar and Karakalpak languages take place among the Turkic - speaking peoples. These issues were analyzed by the Karakalpak scientist K. Mambetnazarov in a number of his scientific works [4]. Tatar and Karakalpak folk art, language, culture and art are very similar to each other. The reason is that these peoples lived together and created together from ancient times.

We tried to analyze these issues with the above examples. The folklore of these peoples has much in common in terms of the plot and motive. There are a lot of examples of fairy tales. It is impossible to make out all these tales in one article. Therefore, we strive to analyze these issues in our next articles. A comprehensive study and analysis of the Turkic - speaking and world folk tales are relevant in modern folklore science.

There are general similarities, motives, plots in the folklore of the Turkic-Mongol peoples. In particular, there is a similarity between Kyrgyz and Karakalpak oral works. As you know, the Kyrgyz and Karakalpaks since ancient times lived together and have passed several historical stages. Kyrgyz and

Karakalpaki - Turkic peoples. Their language, culture, folklore, literature, traditions are very similar. This is confirmed by the fact that the epics "Manas" and "Alpamy" are very close in content. In addition, there are literary ties between these peoples in written literature. For example, the works of great writers as Genghis Aitmatov and Tulepbergen Kaypbergenov are known and famous in the world.

Tales of these peoples are very similar in content. Tales of these two peoples have traditional formulas, motives, plots.

The motive of the dream is mentioned in the Kyrgyz folk tale “Minbai, Zhuzbai” [5] and the Karakalpak folk tale “Shepherd”. Minbai sees the sun, moon, star in a dream. A shepherd boy is also mentioned in the fairy tale "Chopon Bala" [6, p. 9-13]. He also sees the moon and a falling star in a dream. We know that there is such a thing as "if someone sees the sun, moon and stars in a dream, that person will be happy." Indeed, it is very interesting and relevant to study the motive and plot of “dreams”.

In the Kyrgyz folk tale “Asan” [5] and the Karakalpak folk tale “Asan Genzhe” [2, p. 137-147] there is a “three brothers” motive. In the Kyrgyz folk tale, two older brothers rudely treat their younger brother Asan. In the Karakalpak folk tale, Asan has good relations with his older brothers. He helps his older brothers. In both fairy tales, the father of the three brothers is the king. In the Kyrgyz fairy tale, the brothers' father is known as a khan. In the Karakalpak folk tales of the ruler, the “Patsha” (Padishah) is called.

The Kyrgyz folk tale “Golden Ring” [5] is similar to the Karakalpak folk tale “Boy and Snake” [2, p. 77-80]. In the Kyrgyz fairy tale, the old man gives money (Tyyn) to his son and sends him to the bazaar. The boy buys a puppy, a cat and a snake. The old man drives his son out of the house. The snake helps the child. The king of snakes gives the boy a gold ring. The golden ring is magical. The boy marries the king's daughter. Massten Kempir (Baba Yaga) steals a gold ring and princess. Puppy and cat help the child. The gold ring falls into the water. Fishermen catch this fish. The boy buys fish. A golden ring comes out of the fish. Such episodes are in the Karakalpak folk tale "Boy and Snake".

Fairy tales about animals also have their own characteristics among folklore works.

The Kyrgyz folk tale “Fox and the Wolf” [5] has a resemblance to the Karakalpak folk fairy tale “Fox and Shakal” [2, p. 184]. These tales talk about the cunning of the fox. In the Kyrgyz fairy tale, the fox deceives a wolf. That is, he says to the wolf: "You can eat sheep meat." The wolf falls into the trap when he wants to eat meat. The fox eats meat and leaves. The same events will occur in the Karakalpak fairy tale. The heroes of Kyrgyz fairy tales are a fox and a wolf. The heroes of the Karakalpak fairy tale are a fox and a jackal. The motive and plot of two fairy tales are the same.

The Kyrgyz folk tale “Man is the strongest” [5] is similar to the Karakalpak folk tale “The Greatest in the World” [7, p. 421-422]. In the Kyrgyz folk tale, the question is asked: "Who or what is stronger, the red pheasant (Kyzyl Kyrgyz), ice, rain, earth, forest, fire, grass, sheep, wolf?" They say that a person is stronger than anyone. A similar question is asked in the Karakalpak folk tale: which of them is the strongest? Magpie (xəkke), ice, sun, cloud, rain, earth, mouse, cat? In the fairy tale, the cat (pyushyk) is considered the strongest. Both peoples have a fairy tale called “Leo and Hare” [5] and “Aryzlan Menen Koyan” [7, p. 421-422]. The content of fairy tales is the same. Leo wants to eat a hare. The hare acts reasonably. He says to Leo: "There is a lion stronger than you in the well." Leo sees his reflection in the well. He jumps into the well. Hares get rid of the evil beast. The fairy tale "Hungry Wolf" is also present in the folklore of both peoples. In the Kyrgyz folk tale, the wolf wants to eat a hawk, a goat, a horse. But the horse scores the wolf. After a while, the wolf dies. There are such episodes in the Karakalpak fairy tale. The wolf wants to eat a goat, a sheep, a horse. The horse scores the wolf. After that, the wolf dies. In both fairy tales, the wolf speaks poetic poems [3, p. 226-227].

Tatar, Kyrgyz and Karakalpak folk tales have many similar episodes, motives, plots. If you pay attention, dialogs in Kyrgyz folk tales are described by poetic verses. In Karakalpak folk tales, poetry is less common. The study of the language, style, poetics, genesis and typology of fairy tales of these two related peoples is one of the most pressing issues.

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Issue Article

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KEY PERFORMANCE INDICATORS OF EMPLOYEES OF UZBEKISTAN'S CHAMBER OF ACCOUNTS

Abstract: *This article addresses such issues, as priority measures for improvement of the personnel policy and the state civil service in Uzbekistan, the legislation, the contents of the KPI, types of KPI used in world practice, important indicators of efficiency, the urgency of its introduction as well as the KPI practice in foreign countries and their effects on organizational performance. Also, the paper highlights the need to introduce KPI in Uzbekistan, the results expected from its introduction, the advantages and ensuing problems.*

The main stages of audit activities of Uzbekistan Chamber of Accounts (COA), the implementation of measures based on the results of the audit, monitoring and analysis of the operational discipline, as well as the KPI-related work carried out in the COA are covered in this research.

It is scientifically based that the author achieves positive results as a result of the implementation of the efficiency system for the improvement of the state financial control and internal audit system.

The achievement of positive results due to the implementation of the efficiency system for the improvement of the public financial control and internal audit system is scientifically justified by the author.

Key words: *Public financial control, Chamber of Accounts, COA, KPI, public audit, state budget, efficiency.*

Language: *English*

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Introduction

Intensive social and economic reforms carried out in 'New Uzbekistan' depend to a large extent on the proper formation of public finances and their effective use.

The program of priority measures related to fundamental improvement of personnel policy and state civil service system in Uzbekistan has been already approved.

This program envisages the development of a strategy for the development of the State Civil Service until 2030 and the implementation of modern methods of management and performance evaluation of employees based on integrated **key performance indicators** (KPI).

The Law of the Republic of Uzbekistan "On the Public Civil Service" also specifies a number of requirements, namely:

- implementation of the system for assessing the performance of the public civil service in Uzbekistan;
- determining the level of achievement of the main efficiency indicator of civil servants as a subject of performance evaluation;
- promoting or demoting a civil servant, assigning a qualification level, rewarding and applying disciplinary punishment based on the achieved results;
- formulating the activity plan of the public civil servant based on the main indicators of his activity.

It is envisaged to take into account the main indicators of the employee's performance when conducting the qualification exam.

In his speech to the Parliament on January 22, 2020, the President of Uzbekistan emphasized the feasibility of introducing a KPI system to assess the activities of heads and employees at all levels of

executive authorities, starting with the Prime Minister and members of the Government.

As the above-mentioned tasks and the mechanisms of their implementation show, improving the functioning of the public financial control system and increasing the effectiveness of their activities in our country is of critical importance.

Scientific research aimed at studying the economic content of "Key Performance Indicators" (KPI) shows that this concept itself covers a wide range of processes.

The concept of 'Key performance indicators' (KPI)

The notion "KPI" is an abbreviation of the English expression of "Key Performance Indicators", translated into Russian as "Klyuchevye pokazateli effektivnosti" ("Ключевые показатели эффективности"), and into Uzbek as "Samaradorlikning muhim ko'rsatkichlari".

'Key performance indicators' are conceptual tools that:

- measure the degree of realization of the goals set for the organization;
- assess the performance of the organization, its departments and employees expressed in numbers;
- that the organization makes it possible to assess the situation and implement its strategy;
- ensures employees' desire to increase their work activity.

The relevance of introducing KPI:

- The experience of foreign countries demonstrates that KPI is an effective and fair system;
- KPI is currently introduced in enterprises and banking institutions of Uzbekistan;
- The President of Uzbekistan has set the goal of introducing this system for all state institutions;

The draft Law of the Republic of Uzbekistan **"On Public Civil Service"** envisages the introduction of a system for evaluating the performance of public civil servants.

The KPI experience of foreign countries

Let's tackle types of KPIs used in international practice.

- **Indicators of achieved results** that evaluate the results achieved in terms of quality and quantity;
- **Cost indicators** that evaluate the amount of the resources spent;
- **Activity indicators** that assess the performance of production processes (compliance with the performance algorithm);
- **Productivity indicators** that evaluate the ratio of the results achieved and the time spent;
- **Efficiency indicators** that evaluate the ratio of the results achieved and the resources spent.

The peculiarity of the KPI system used for civil servants, especially for the employees of the **COA of Uzbekistan**, is that most of the results cannot be expressed only in terms of financial indicators, such as the reduction of expenses and the increase of profit, which are considered important for business entities.

As for international standards, such as **ISO 9000:2008**, the KPI system is interpreted as follows.

- **Effectiveness** – the level of achievement of the intended results or the ability of the organization to focus on results.
- **Efficiency** – the mutual ratio of resources spent with the achieved results, or the organization's ability to implement its goals and plans through certain quality indicators expressed by certain requirements (time, price).

That is, to understand the functioning of the KPI system, one needs to operate with these two important tools, 'Effectiveness' and 'Efficiency'.

The KPI system in Uzbekistan: experience, advantages and problems

The necessity to introduce the KPI system in Uzbekistan is justified by the following factors.

➨ The peculiarity of the COA activities. The result of the efficiency of the employees in charge of many tasks that require a large amount of labour remain not visible or measurable and thus neglected.

➨ Although the number of employees, assigned functions and tasks within the COA structure are increasing, there is an imbalance in the distribution of labour among employees.

➨ Due to the high competence of the COA employees, they should not be busy only with the execution of current tasks, and the need to encourage them to engage in personal initiatives and activities when the volume of work is low, as well as to engage in additional activities that can bring a high impact on the COA.

➨ There is a need to increase the quality of performance of tasks and functions by proportional distribution of labour among employees and increasing work efficiency.

➨ Since a mechanism for objective assessment of the employee's activity is created, his/her personal motivation, self-confidence, loyalty and operational approach as well as creativity will is expected to increase.

Expected results

➨ Due to healthy competition among employees, work efficiency and productivity will increase.

➨ In addition to direct audit events, the effectiveness of control measures will improve due to the fact that employees will be highly valued for identifying problems. preventing and taking measures to eliminate them.

➨ The focus is set on the full identification and elimination of violations, additional income, optimized costs, and existing problems at the control object.

Achieved results

In its yet-not-so-long period of operation, the COA of Uzbekistan has done a lot of positive work in implementing the KPI. An *ad interim charter* was developed to regulate the procedure for evaluating the effectiveness of the COA.

The procedure for determining the effectiveness of the COA management staff, i.e. the assessment of labour discipline, volume of work performed and operational discipline, as well as indicators of initiative, was established.

To ensure that the KPI of employee activity should be clear, measurable and result-aimed, the following approach was applied by the COA recently (*See Table 1*).

Approaches used in the assessment of critical performance indicators *(Table 1)*

N	Work to be done	Example	Approach
1.	Daily tasks that do not require special skills or experience	Preparation of draft business trip order, study program, business trip certificates, letters to ministries, issuance of travel tickets	Minimal assessment
2.	Performance of current tasks and functions	Participation in the audit event	Minimal assessment
3.	Achieving efficiency while performing assigned tasks	Identification of deficiencies, additional income, optimized costs during the audit event	Applying encouraging coefficients
4.	Implementation of the results of the audit event	Elimination of identified deficiencies, restoration of deficits to the budget, acceptance of given proposals	High level assessment
5.	Activities that are not directly related to work, but improve its quality through self-improvement	Be engaged in academic activities outside of working hours and gaining international certificates and scholarly degrees	High level assessment

Also, with the appropriate order of the COA Chairman, an Evaluation Commission was established to re-check the performance indicators of the employees.

The following sources of information are mainly used to determine the KPI of the COA employees:

The single e-system of the operational discipline – www.app.ijro.uz;

The e-system of the COA operational discipline – www.hp.ijro.uz;

The "State Audit" software of the COA – www.davlatauditi.uz;

The unified automated information system of the COA;

The e-program on the daily activity, location and attendance of the COA employees – davomat_bot

The official website of the COA – www.ach.gov.uz is set to collect indicators through e-programs.

Key performance indicators (Table 2)

Key performance indicators (based on the functions and tasks of the COA divisions)			
Total number of indicators – 66			
	1. Key indicators of performance ***(per control event)***	**2. Additional indicators of performance** ***(per expert analysis)***	**3. Other indicators and affecting factors**
Total number	39	22	5

Key performance indicators (Table 2.1)

Key indicators of performance			
Total number of key indicators – 39			
	1. Engagement in audit events	**2. Taking measures following audit events**	**3. Analysis and monitoring of COA documents execution**

Total number	21	13	5

Four stages in determining KPI of the COA employees

The following indicators related to the KPI of COA employees have been elaborated and are currently applied by the COA.

At the same time, the following **four stages** in determining employee performance indicators have been determined.

1. The main stages of participation in audit events;

- Development of the COA annual program;
- Participation in the organizational stage of the audit event;
- Participation in the initial study phase of the audit event and remote examination;
- Involvement into the control event;
- Forming the results of the audit event;

2. The main stages of implementation of measures following the audit event

- Review of objections expressed by the control object;
- Preparation of proposals for elimination of identified errors, prevention of future occurrences, and improvement of the control object performance;
- Making proposals to the Administration of the President and the Cabinet of Ministers regarding bringing to responsibility the heads of ministries, state committees, agencies, local state authorities and other public organizations;
- Preparation of presentations, instructions, conclusions, and analytical data;
- Submission of the materials following the audit event to the law enforcement bodies;
- Participation in the process of reviewing materials in law enforcement bodies or courts.

3. Stage of monitoring and analyzing the execution of COA documents

- Acceptance of proposals and instructions, summary, analytical information, measures and road maps;
- Criminal or administrative proceedings initiated by law enforcement bodies;
- Checking that measures have been taken against the responsible employees of the control object;
- Bringing to administrative responsibility those who have violated the budget discipline, obstructed the COA legal activities or did not fulfill their legal requirements.

4. The stage of forming additional KPI

- Preparation of the COA annual report;
- Preparation of information for the meetings of the President of Uzbekistan, the Administration of President, Chambers of the Parliament, the Cabinet of Ministers and the COA itself;
- Participation in the development of normative-legal and departmental documents;
- Release of analytical data to mass media;
- Addressing appeals of individuals and legal entities;
- Providing practical assistance to legal entities and individuals;
- Execution of direct assignments of the COA Chairman and Deputies Chairman;
- Working with candidates for recruitment to the COA

The results of the introducing KPI into the COA activities

Today, the KPI of the COA employees are automatically evaluated. Currently, the performance of the COA employees is evaluated at the end of each quarter and translated into the KPI rating system based on **234 indicators** in **17 areas of activities**.

This process serves to improve the work efficiency of the concerned employees, to increase their work and initiative, moral and material stimulation.

In particular, employees with consistently high KPI are encouraged, and on the contrary, measures are taken to impact the performance of those with low indicators.

Proposals to improve the KPI system in the COA

The following measures are proposed to be taken to improve performance evaluation indicators of the COA employees.

All COA divisions should study in depth the aggregated indicators of the KPI system and research the possibility of using them.

The special targeted guidelines for the use of these new indicators should be developed and each employee should be brought to it.

Approbation of the work by 2-3 employees of a COA division in the past period of 2023 should be done.

Upon the results of the approbation, the optimal amounts of evaluation indicators should be determined.

To systematically assess the performance of the COA employees, a special e-program should be developed in the nearest future.

Conclusion

Today, the implementation of the KPI system in the activities of financial control bodies employees is considered one of the urgent requirements. It is aimed at achieving performance and efficiency indicators of the area.

The introduction of performance indicators produces healthy competition among employees. Due to that, work efficiency and the effectiveness of aduit events increase.

This new system enables to identify and eliminate ongoing problems in control objects. Special focus is made on preventing violations as fully as possible.

By its means, a mechanism for objective assessment of the employee's activity is created. That gives stimulus for the employee's personal motivation, self-confidence, corporate loyalty, work discipline as well as the desire for new things.

Then, a mechanism for evaluating auditor performance will be improved. A system for monitoring and evaluating personal activity indicators will be developed in terms of achieving the strategic tasks. Compliance with financial culture will be promoted. Ultimately, COA of Uzbekistan will need to introduce the practice of determining control measures based on the “risk and control” principle.

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Issue Article

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PREPARATION AND PHOTO LUMINESCENT PROPERTIES OF LAYERED GES SINGLE CRYSTALS

Abstract: *One of the most interesting phenomena that has provided a lot of information about defects in single crystals is photoluminescence (PL). This paper presents data on edge and near-infrared (IR) luminescence of layered GeS single crystals. In the layered high-resistivity semiconductor compound GeS, local centers have been studied using both photoelectric and optical methods. Comprehensive studies of photoelectric and optical properties indicate that the recombination scheme of GeS is quite complex and contains a number of local levels.*

Key words: *photoluminescence, luminescence, PL spectra, single crystals, rare earth elements, semiconductor compounds.*

Language: *English*

Citation: Mammadov, I. M., Huseinov, R. K., Imanov, R.M.A., Zarbalieva, V. S., & Usubova, L. E. (2023). Preparation and photo luminescent properties of layered GeS single crystals. *ISJ Theoretical & Applied Science, 10 (126),* 391-394.

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Introduction

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Semiconductor compounds of the AIVBVI type are considered promising materials for use in various fields of electronics, such as thermionic elements, solar cells, memory elements and others, or have already found their application. The fundamental characteristics of these compounds, such as a narrow band gap, high dielectric constant, relatively high radiation resistance, high carrier mobility, and the predominance of ionic bonding, increase the possibility of their use. To study the energy spectrum of the bottom of the conduction band and the top of the valence band, the dispersion law, and the mechanism of charge carrier scattering in

semiconductor compounds and their hard alloys, doping with donor and acceptor impurities is widely used. By doping, filling electron or hole states, one can change the location of the Fermi level, and this significantly simplifies the calculation of band parameters.

From this point of view, doping the AIVBVI type GeS binary compound with rare earth elements or obtaining solid solutions of low concentrations and a comprehensive study of their physical properties is of interest. The resulting substances containing rare earth elements (REE) are widely used in the manufacture of energy converters and photoresistors that are resistant to radiation, pressure and humidity. The resulting materials with the participation of rare earth elements, in which the 4f-5d-6s transition occurs, due to the ease of complete filling of the 4f level of the electronic structure, and the appearance of variable valence due to the movement of electrons at the 4f level in atoms, are interesting objects of research. From this point of view, melts and compounds based on the participation of rare earth elements make it possible to obtain new promising materials with the required physical properties, which is important for their research. Alloys of the GeS and Ge0.995Nd0.005S system were synthesized from the starting elements in quartz ampoules evacuated to 0.1333 Pa. The synthesis was carried out in two stages: initially, ampoules with the substance were heated at a rate of 4-5 degrees/min. to the melting point of selenium and kept at this temperature for 3-4 hours, after which the temperature was raised to 950-10000C, depending on the composition, and kept for 8-9 hours. When synthesizing ternary alloys of the Ge0.995Nd0.005S system, elements of special purity were used as starting components.

The synthesized samples for complex physicochemical analysis and electrophysical studies were annealed for 100-140 hours. Homogenizing annealing of the resulting single-phase samples was carried out in an environment of spectrally pure argon at 800 K. After annealing, samples with dimensions of 2 4 18 mm were cut from the crystal ingots in an electric spark installation. The interaction in the Ge0.995Nd0.005S system was studied using differential thermal analysis (DTA), X-ray diffraction (XRD), microstructural analysis (MSA), as well as microhardness measurements and density determination. XRF was carried out on a model D-2 PHSER X-ray device using CuKα radiation and a Ni filter.

The PL spectra excited by laser radiation (λ=6328Å, maximum intensity L=1020kV/(〖cm〗^2 s)) were measured in the temperature range T=77-300K using an MDR-2 and DFS-13 monochromator. Registration was carried out according to a standard scheme using synchronous detection. FEU-62 and photoresistor PvS served as radiation detectors. A preamplifier assembled on the basis of a low-noise microcircuit was included as a matching element between the receiver and the U2-8 amplifier.

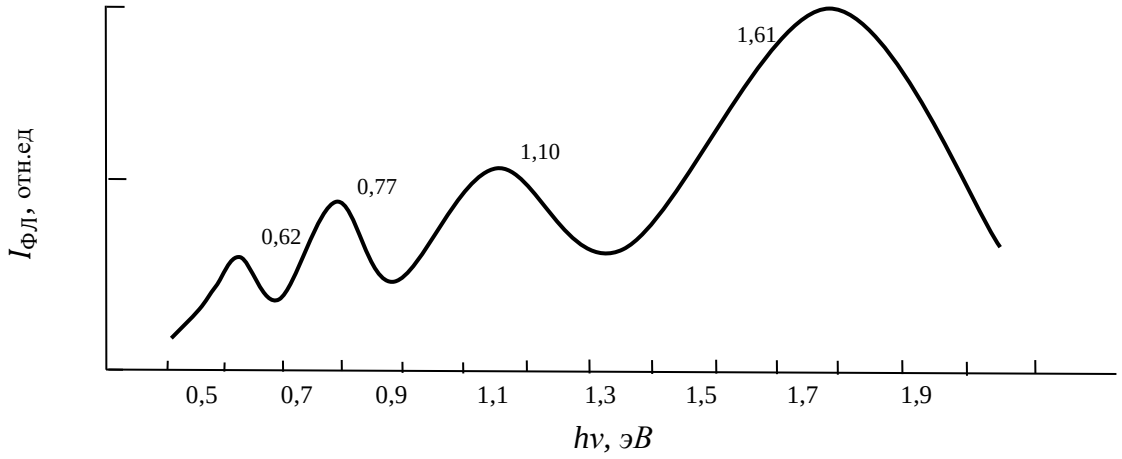

Fig.1. PL spectrum of a GeS single crystal at 77K.

The interaction in the Ge0.995Nd0.005S system was studied using differential thermal analysis (DTA), X-ray diffraction (XRD), microstructural analysis (MSA), as well as microhardness measurements and density determination. XRF was carried out on a model D-2 PHSER X-ray device using CuKα radiation and a Ni filter.

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microcircuit was included as a matching element between the receiver and the U2-8 amplifier.

In the PL spectra at temperatures 77K≤T≤300K three bands with maxima of 0.62, 0.77 and 1.1 eV are observed (Fig. 1). The ratio between the intensities of the bands varies from sample to sample, however, in the same sample, the intensity of these bands remains practically unchanged when the temperature changes from nitrogen to room temperature.

REE atoms (in the particular case Nd atoms), introduced as impurities into GeS, form energy levels inside the band gap. Luminescence of rare earth elements is intracenter. The radiation from these centers is a set of characteristic lines. REEs have an incomplete 4f electron shell, which is shielded by more outer shells. Each rare earth element has its own characteristic spectrum, which depends on the degree of filling of this shell. Under the influence of an external field, splitting of energy levels appears. Optical, including luminescent spectra of rare earth elements are determined by transitions of f-electrons, which are well screened by 5d electrons. The position and number of excited states depend on the number of electrons in the 4d shells.

As can be seen from Fig. 2, the spectrum of a layered GeS single crystal activated by Nd3+ atoms consists of separate groups of lines. Analysis of the luminescence spectrum allows one to obtain information about the structure of the optical rare-earth center, in particular, to determine its symmetry

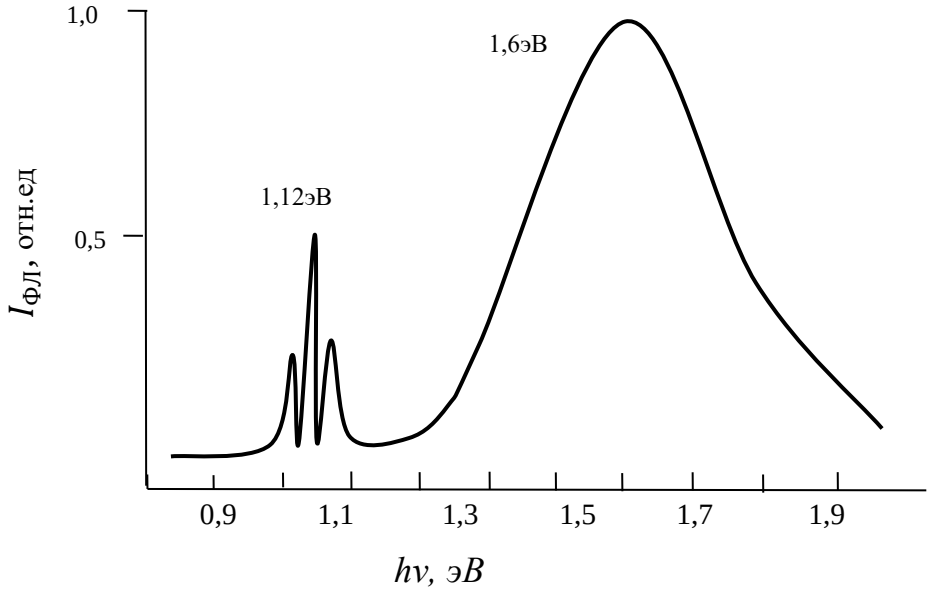

Fig. 2. The FL spectrum of a $Ge_{0,995}Nd_{0,005}S$ single crystal at 77K.

Optical, including luminescent spectra of rare earth elements are determined by transitions of f-electrons, which are well screened by 5d electrons. The position and number of excited states depend on the number of electrons in the 4d shells.

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In contrast to ordered systems, in disordered systems, including “soft” crystals, instead of a group of narrow lines, a blurred band with more or less pronounced maxima is observed. They look as if the lines of the crystal spectrum have increased in width, remaining in the same place, partially superimposed on each other.

The tendency of rare earth elements to oxidize promotes glass formation during cooling of a Ge1-xNdxS single crystal (x=0.005). The most common glass former is SiO2, from which quartz ampoules are made, where single crystals are grown.

Thus, in the “soft” GeS matrix, the optical centers - Nd3+ impurity atoms are in their own specific field, and this position manifests itself in the form of elimination of spectral lines. Unlike other rare earth elements, it is possible to obtain high radiation powers on neodymium ions due to a four-level scheme; in rare earth elements, in addition to 4f → 4f transitions, allowed electric dipole transitions 5d → 4f are observed [4]. Due to the fact that these transitions are resolvable, the intensity of the corresponding bands in comparison with the 4f→4f lines will be high, and the emission time will be short. But since the crystal field has a greater influence on the 5d shell

(than on the 4f shell), the bands will be wide, and their position will depend on the matrix.

As can be seen from Fig. 2, at a low concentration (x=0.005) of Nd3+, REE can be considered as an independent set of emitting centers. Obviously, in this case, the luminescence intensity will be linearly related to the REE concentration. When a certain concentration of rare earth elements increases, the interaction of ions and resonant energy transfer between Nd3+ ions begins. During resonant transmission, the probability of non-radiative energy loss increases. Therefore, the intensity of REE luminescence decreases with increasing concentration. At low concentrations of Nd3+, we can assume that spontaneous radiative transitions determine the dynamics of luminescence decay. At high Nd3+ concentrations, non-radiative transitions make an additional contribution to the luminescence decay.

Thus, a study of the PL spectrum of single crystals shows that

1. The recombination scheme of a GeS single crystal is quite complex and contains local levels.

2. The luminescence of rare earth elements is intracenter and the emission of these centers is a set of characteristic lines.

3. With increasing REE concentration, the probability of non-radiative energy loss increases and the intensity of luminescence associated with REE decreases.

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Issue Article

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RESEARCH PROGRESS, HOT SPOTS AND TRENDS OF TEA CULTURE COMMUNICATION IN CHINA: VISUALIZATION ANALYSIS BASED ON CITE SPACE

Abstract: *The article dwells on the issue of the research progress, hot spots and trends of tea culture communication in china: visualization analysis based on cite space. The given article presents a time distribution map of literature on domestic Chinese tea culture communication research from 1984 to 2023. The map is based on the number of literature publications per year (as shown in Figure 1). It can be observed that the number of literature publications in this field exhibits a fluctuating increase followed by a decreasing trend over the years. The change in publication patterns can be categorized into three phases. The author co-occurrence knowledge graph can reflect the publication collaboration cooperation of scholars in specific certain field. In this paper, the author analyzed the co-occurrence of authors in the field of Chinese tea culture communication. The resulting knowledge graph of author co-occurrence is shown in Figure 2. The map consists of 272 nodes, with only 87 lines connecting them. The network density is calculated to be 0.0024, indicating a low level of connections between scholars in the field. This suggests that most publications are independent or involve collaboration between a small number of scholars, and there is a lack of large-scale academic cooperation. It is concluded that Cite Space visualization software to conduct a bibliometric analysis, systematically organizing the publications in the field of Chinese tea culture dissemination research in China from 1984 to 2023. The analysis reveals that, firstly, the research on the dissemination of Chinese tea culture in China has experienced the stages of "budding," "exploding," "exploding," and "explosive," indicating progress in the field. First, in terms of research progress, domestic research on Chinese tea culture communication has gone through three phases: the "emerging period", the "boom period", and the "decline period".*

Key words: *Cite Space, visualization software, hot spots and trends of tea culture communication, home Chinese tea culture communication, low level of connections between scholars.*

Language: *English*

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Introduction

UDC – 81.822.08

On November 29, 2022, during the 17th Ordinary Session of the Intergovernmental Committee for the Safeguarding of the Intangible Cultural Heritage of the United Nations Educational, Scientific and Cultural Organization (UNESCO) in Rabat, Morocco, China's nomination of "Traditional Chinese Tea-Making Techniques and Related Practices" successfully passed the evaluation and was officially inscribed on the Representative List of the Intangible Cultural Heritage of Humanity by UNESCO. As the birthplace of tea, China not only boasts a diverse range of tea varieties, but also possesses an exceptional tea culture, complete with tea rituals and customs.

Chinese tea culture is prevalent worldwide. General Secretary Xi Jinping attaches great importance to the protection and preservation of tea culture development. He has also emphasized the significance of "tea on the road" on multiple occasions, highlighting the cultural significance embedded in tea. This serves as a metaphor for the harmonious relationship between humans and nature, as well as advocating for international relations based on values such as "diversity" and "win-win cooperation". "Win-win cooperation" in international relations. General Secretary Xi Jinping has provided significant guidance on the preservation of intangible cultural heritage. He emphasized the importance of effectively safeguarding intangible cultural heritage to meet the increasing spiritual and cultural needs of the people, and to promote cultural self-confidence and self-improvement. The dissemination of research on Chinese tea culture is an important aspect of contemporary Chinese tea studies [5].

At present, scholars have conducted various research on brand building in the tea industry, innovation and reform in tea garden industry, and the integration of tea tourism for high-quality development. Revised 2: However, there is a limited amount of systematic research and summarization on the dissemination of Chinese tea culture. Some representative studies include: In 2019, Yang Hong analyzed the impact of tea culture development in Shandong and explored the specific meanings of tea culture, while also delving into the inheritance and development of tea culture in the region. In 2007, Liu Feng focused on the brand positioning of Shandong tea and identified three common dissemination misunderstandings: homogenization, vague generalization, and exaggeration. This paper utilizes Citespace software to address three misconceptions of communication.

This paper utilizes Citespace software to analyze the development trend, research hotspots, and evolution of the field of tea culture communication in China. The aim is to present an overview of China's tea culture communication research and provide a concise reference for future researchers.

II. Data Sources and Research Methodology

(I) Data Sources

In this paper, the Chinese core journals in the CNKI database were selected as the data source. An advanced search was conducted in the CNKI database using "Chinese tea culture" and "overseas dissemination" as the subject terms. A total of 307 articles were obtained that met the specified criteria. A total of 307 articles were obtained. After screening and excluding dissertations and specialty journals, a total of 259 valid documents (including academic journals and academic series) were ultimately obtained.

(II) Research Methods

Quantitative analysis of literature refers to the systematic, systematic and quantitative description of explicit apparent content of literary works. This approach which gained popularity used in years. CiteSpace years.CiteSpace is capable data analyzing literature data, providing provides an objective and scientific quantitative tool for tracking and the relevant issues in the field of Chinese tea dissemination. Currently, present, is been widely used to the research hotspots and advancements advances in disciplines. fields. In this paper, CiteSpace 6.2.2 software was chosen to carry out the related research work [6].

III. Analysis of the research lineage of the dissemination of domestic Chinese tea culture

(I)Analysis of the amount of literature published

This paper presents a time distribution map of literature on domestic Chinese tea culture communication research from 1984 to 2023. The map is based on the number of literature publications per year (as shown in Figure 1). It can be observed that the number of literature publications in this field exhibits a fluctuating increase followed by a decreasing trend over the years. The change in publication patterns can be categorized into three phases.

Stage 1: Budding (1984-2015). In (1984-2015). In 1984, China's tea exports exceeded the highest level in history for the first time. In that year, the China Tea Import and Export Corporation exported 139,300 tons of tea for the entire year, surpassing the previous record of 134,100 tons exported in 1886 for the first time. The export of tea also facilitated the dissemination of tea culture, and scholarly articles on the expansion of Chinese tea culture continued to surface. During this period, the dissemination of tea culture is in its infancy, and the annual number of papers issued is in single digits.

Stage 2: Explosion period (2016-2018). During this period, there has been continuous progress and development in network technology and

communication modes, particularly with the advancement of Internet new media. Simultaneously, the "One Belt, One Road" policy has facilitated the dissemination of Chinese culture and trade. As a result, Chinese tea culture is experiencing a significant boom. From 2016 to 2018, there was a significant increase in the number of articles focused on the dissemination of Chinese tea culture. On average, 39 articles were published each year, with a majority of them being related to new media. There are 39 articles, most of which are related to the new media environment, the Belt and Road context, and language teaching [7].

Stage 3: Fallback period (2019-2023). Due to factors such as the COVID-19 pandemic, the trade and cultural dissemination of Chinese tea have been impacted since 2019. Tea fairs cannot be carried out offline due to the decline of physical stores and the tightening of public consumption. These factors contribute to the downward trend of tea culture dissemination.

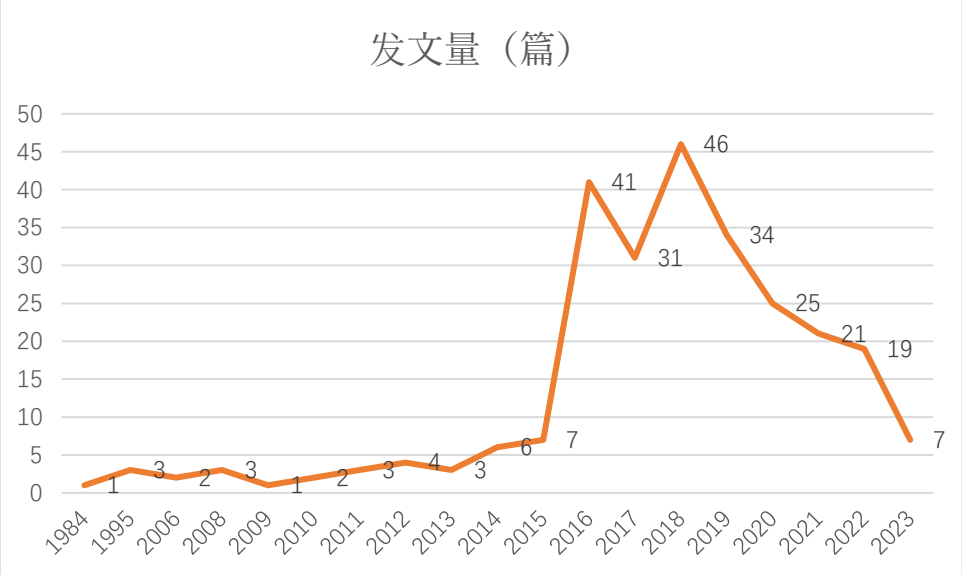

Fig. 1. Temporal distribution of Chinese tea culture dissemination research articles in China

(II) Author Analysis

The author co-occurrence knowledge graph can reflect the publication collaboration cooperation of scholars in specific certain field. In this paper, the author analyzed the co-occurrence of authors in the field of Chinese tea culture communication. The resulting knowledge graph of author co-occurrence is shown in Figure 2. The map consists of 272 nodes, with only 87 lines connecting them. The network density is calculated to be 0.0024, indicating a low level of connections between scholars in the field. This suggests that most publications are independent or involve collaboration between a small number of scholars, and there is a lack of large-scale academic cooperation.

The number of publications and the frequency of citations can, to a certain extent, reflect the degree of academic contribution and influence of scholars in a specific field. In this paper, we further analyze the top 10 authors based on the number of publications and their citation frequency. We found that there are seven scholars who have more than one publication. These scholars are Liu Xiaoping, Yu Yue, Fang Caiqin, Wang Lihong, Lin Hang, Liu Zhonghua, and Lin Fang. Among them, Liu Caiping stands out with four publications. Taken together, Liu Caiping is a prolific author in the field of Chinese tea culture communication research in China and has a strong influence in the academic community.

(iii) Analysis of Publishing Institutions

The co-occurring knowledge graph of authoring organizations can reflect collaboration among of academic communities and growth development of academic research networks in this field. In this paper, we constructed a co-occurring knowledge graph of research institutions in China that focus on the dissemination of Chinese tea culture (as shown in Fig. 3). We found that the number of nodes in the graph is relatively small (245), as well as the number of links between nodes (30). Additionally, the overall density of the network is relatively low, measuring only 0.001. This indicates that the institutions involved in the research and dissemination of Chinese tea culture in China are relatively decentralized. There is not only limited cross-institutional cooperation, but also weaker connections between institutions. As a result, a comprehensive academic research cooperation network has not yet been established.

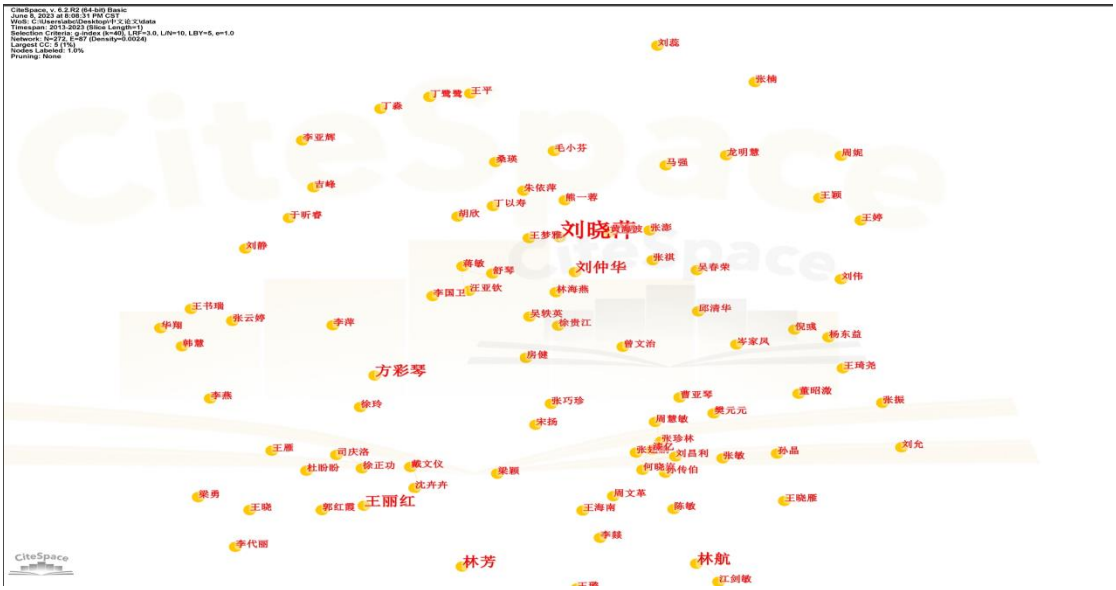

Fig. 2. Co-occurring knowledge map of authors of domestic research on Chinese tea culture dissemination

In this we conducted a count of counting the number of articles published by engaged article research on of Chinese tea communication. We found get that there are only three institutions with more than articles in this field. These institutions are namely Anhui Agricultural University, Jinzhong Institute of Information, and Xianyang College. They are considered to be are most more prolific institutions in the field of Chinese tea culture communication in China. However, when considering the type of issuing institutions, the primary ones are all higher education institutions. This means that the institutions responsible for disseminating Chinese tea culture in China are relatively homogeneous, lacking the participation of enterprises and other non-academic entities.

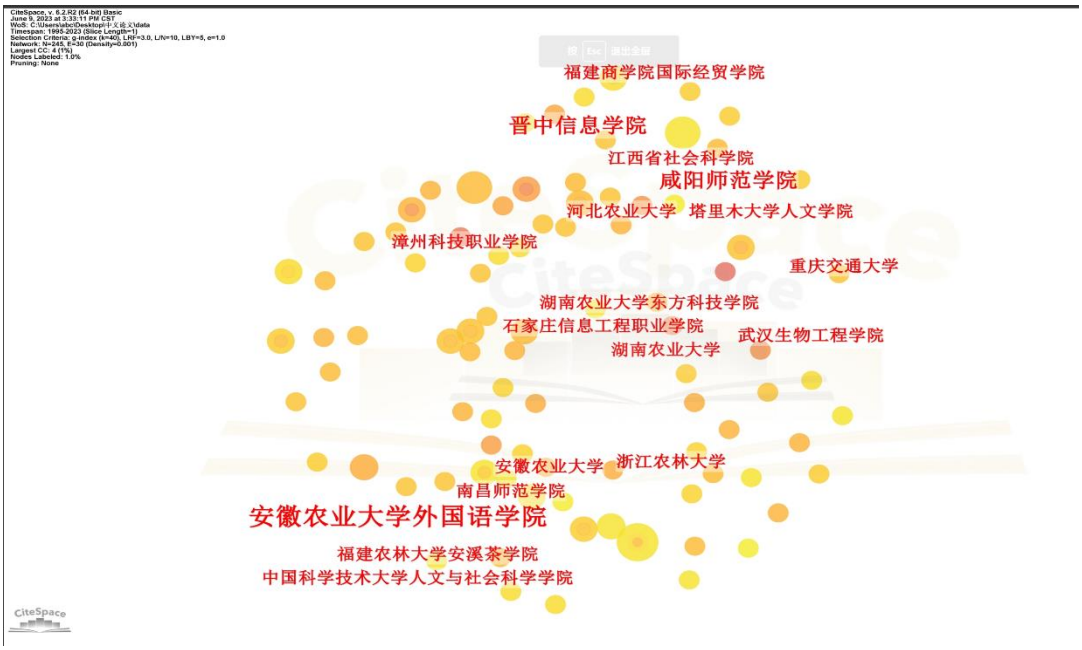

Fig. 3. Co-occurring knowledge map of Chinese tea culture dissemination research organizations in China

IV. Analysis of Domestic Research Hotspots in Chinese Tea Culture

(I) Keyword Co-occurrence Analysis

High-frequency keywords are words that occur frequently in the literature data, and they can effectively reflect the core content and current issues in the research field. In this paper, we conducted a keyword analysis to identify the main keywords in research on domestic Chinese tea culture. We found a total of 262 main keywords, which appeared 603 times. Among these keywords, there were 14 with a frequency of occurrence of at least 5 times, totaling

276 occurrences. These 14 words account for 45.77% of the total frequency of occurrence of all keywords, and are therefore classified as high-frequency words. Moreover, the higher the centrality of a node, the greater its influence on other nodes. Statistics have shown that words such as "tea culture," "dissemination," "cultural communication," "The Tea Scripture," "cultural exchange," and "role" appear more than 8 times, indicating that they are the main focal points in the study of Chinese tea culture dissemination in China. Furthermore, when analyzing keywords with a centrality greater than 0.1, it becomes evident that "tea culture," "dissemination," and "cultural dissemination" are the central themes in domestic research on the dissemination of Chinese tea culture. From a comprehensive perspective, "tea culture," "dissemination," and "cultural dissemination" are the focal points and core research topics in the field of Chinese tea culture dissemination research in China. Additionally, research on cultural differences holds a prominent position. The study of cultural differences dominates the field.

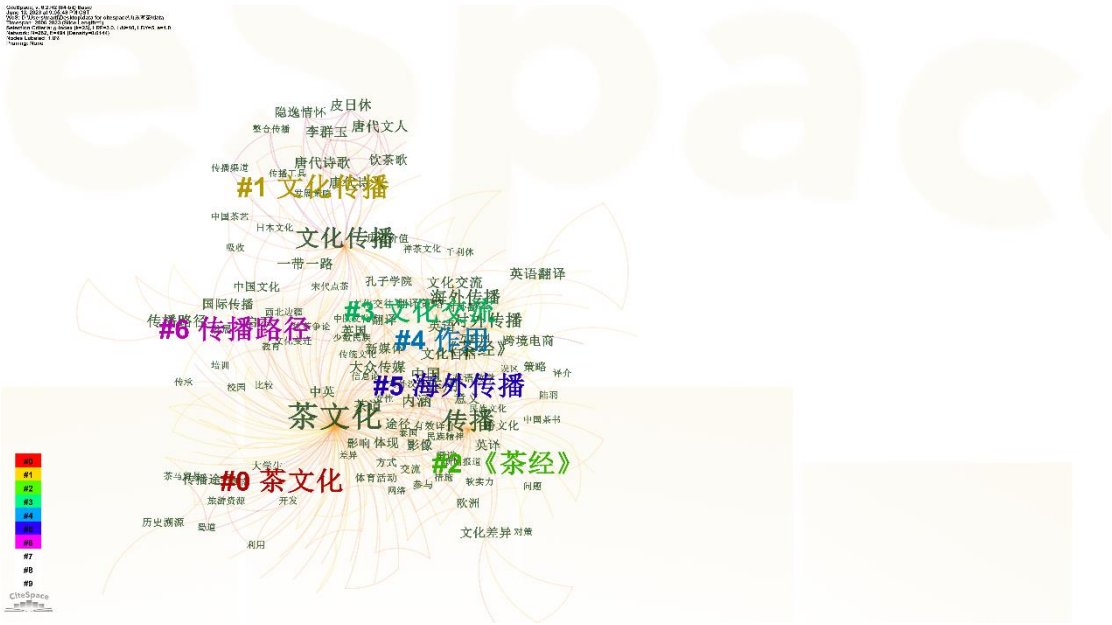

Fig. 4. Knowledge map of keyword co-occurrence in domestic research on Chinese tea culture dissemination

Through the co-occurrence knowledge map of keywords in the study of Chinese tea culture dissemination in China (as shown in Figure 4), it can be observed that scholars in the field of Chinese tea culture dissemination in China have conducted extensive research on various themes such as "Tea Culture," "Dissemination," "Culture Dissemination," "Tea Scripture," "Cultural Exchange," and "Role." The study on the dissemination of Chinese tea culture is characterized by fragmented themes.

(ii) Keyword clustering analysis

Keywords are highly condensed representations of the literature, which intuitively reflect the research themes. High-frequency keywords can effectively identify and describe the current hot topics in specific subject areas. Cluster analysis is the primary method used to identify hot topics, and the keyword clustering function in CiteSpace software assists in exploring hot topics within a specific field. In this paper, we use a time slice of 1 year and employ the TOP5% threshold setting method. We conduct cluster analysis using the minimum spanning tree algorithm (MST) and obtain 7 clustered themes. The analysis includes 262 nodes and 494 lines, with a network density value of 0.0144. As can be seen in Fig. 5, the 7 clustered themes are "Tea culture," "Communication," "Tea production," "Tea consumption," "Tea ceremonies," "Tea history," "Tea varieties," and so on. "Tea culture," "dissemination," "cultural dissemination," "Tea scripture," "cultural exchange," "role," and "culture." The seven clustered themes are "tea culture," "dissemination," "cultural dissemination," "tea scripture," "cultural exchange," "role," and "overseas dissemination." These themes are currently popular research topics in the field of domestic research on the dissemination of Chinese tea culture.

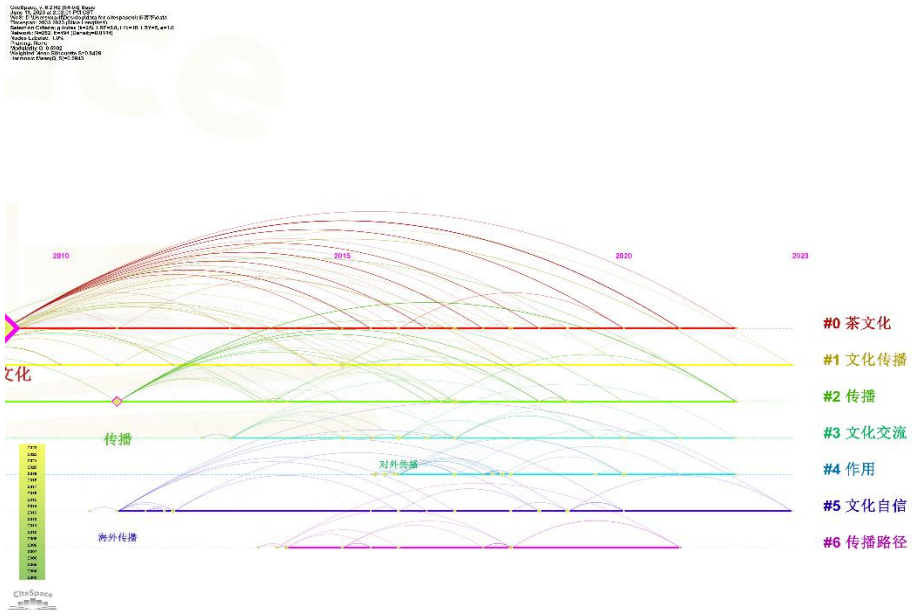

Fig. 5. Knowledge map of keyword clustering for Chinese tea culture research in China

V. Analysis of the Evolution of Chinese Tea Culture Communication in China

The burst detection function of CiteSpace software can identify keywords that experience a sudden appearance or a significant increase in frequency during a specific stage. This feature allows for a more comprehensive representation of the evolution of research topics and highlights the focal points of academic research during that particular stage. In this paper, the knowledge graph of emergent words is obtained based on the research samples, as shown in Fig. 6.

Top 21 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2013 - 2023
≪茶经≫	2014	1.63	2014	2017	
跨文化	2014	1.24	2014	2015	
中英	2014	1.19	2014	2016	
翻译	2014	0.97	2014	2016	
信息论	2014	0.94	2014	2016	
英国	2015	1.5	2015	2016	
作用	2016	0.97	2016	2018	
大学生	2016	0.82	2016	2017	
传播途径	2017	1.16	2017	2018	
大众传媒	2018	0.78	2018	2019	
传播策略	2018	0.78	2018	2019	
文化自信	2019	1.06	2019	2020	
措施	2019	0.88	2019	2020	
传统文化	2019	0.88	2019	2020	
华侨华人	2019	0.88	2019	2020	
东南亚	2019	0.88	2019	2020	
跨境电商	2020	1.22	2020	2023	
文化交流	2017	1.06	2020	2021	
孔子学院	2020	0.98	2020	2021	
新媒体	2017	0.94	2020	2023	
传播效果	2020	0.76	2020	2023	

Fig. 6. Co-occurrence knowledge map of keywords for Chinese tea culture dissemination in China

As shown in Figure 6, there are 21 emerging terms in the field of Chinese tea culture communication research in China from 2013 to 2023. Based on the timeline of the emergence of key terms, research on Chinese tea culture communication in China can be roughly categorized into the following three stages:

Stage 1: 2014-2016. The emerging words during this period include "Tea Scripture," "cross-cultural," "Chinese-English," "translation," "information theory," "Britain," and other terms. Among them, "Tea Scripture" and "Britain" have a higher intensity of emergence, with values of 1.63 and 1.5 respectively. "Tea Scripture" also has a longer duration, spanning from 2014 to 2017. During this period, against the backdrop of globalization and with the strong support of the Chinese government's "Belt and Road" policy, the study of the grounded theory of Chinese tea culture dissemination in China has emerged as a prominent research topic [8].

The second stage (2017-2020) witnessed the emergence of several key terms, including "role,"

"university," "communication channel," "mass media," "communication strategy," and "role of tea culture." "communication strategy," "cultural confidence," "measures," "traditional culture," "Chinese diaspora," and "Chinese culture" are repeated multiple times in the text. "Overseas Chinese" and "Southeast Asia". Among them, the factors that have a greater impact are the emergence of "communication channels" and "cultural self-confidence," with scores of 1.16 and 1.06 respectively. Additionally, the duration of the "role" factor is longer, spanning from 2016 to 2018. The duration of the "role" was longer (2016-2018). During this period, domestic scholars are paying more attention to the specific modes of dissemination and regions of Chinese tea culture within China.

Stage 3: 2021-2023. The emergent terms in this period are "cross-border e-commerce," "cultural exchanges," "Confucius Institutes," "new media," and "communication." The most prominent terms in this period include "cross-border e-commerce," "cultural exchange," "Confucius Institute," "new media," and "communication effect." Among them, "cross-border e-commerce" and "cultural exchanges" have a higher intensity of emergence, with 1.22 and 1.06 respectively. The terms "new media" and "communication effect" also appear frequently, along with "cross-border e-commerce" and "cultural exchanges". "Cross-border e-commerce" will have a longer duration (2020-2023). During this period, the Chinese tea trade and cultural communication were severely impacted by the Xin Guan epidemic. Traditional physical communication methods, such as tea fairs and offline trade, were disrupted. As a result, the industry had to adapt and shift towards online development, utilizing new media and e-commerce platforms for communication and trade.

Conclusion and Prospect

This paper utilizes CiteSpace visualization software to conduct a bibliometric analysis, systematically organizing the publications in the field of Chinese tea culture dissemination research in China from 1984 to 2023. The analysis reveals that, firstly, the research on the dissemination of Chinese tea culture in China has experienced the stages of "budding," "exploding," "exploding," and "explosive," indicating progress in the field. First, in terms of research progress, domestic research on Chinese tea culture communication has gone through three phases: the "emerging period", the "boom period", and the "decline period". It continues to be one of the prominent areas of communication research. At the same time, the journals and organizations that publish articles are scattered, and there is less cooperation among different organizations and scholars. Secondly, in terms of research hotspots, "Tea Sutra," "Britain," "communication channels," "cultural confidence," and "new media" are still some of the prominent areas in communication studies. "New media," "communication effect," and "cross-border e-commerce" are the hot topics of cross-cultural communication research in China, and the overall research is fragmented. Most of the research topics focus on international communication, but the content is generalized and lacks a systematic approach. Third, in terms of research trends, the communication of domestic Chinese tea culture has roughly gone through three stages. These stages include the study of basic theories (2014 - 2016), media models and regions (2017 - 2020), and new media communication models in the context of the epidemic (2021 - 2023). Reviewing the previous studies, it is evident that research on the dissemination of Chinese tea culture in China has undergone a complex evolutionary stage, progressing from a superficial understanding to a deeper exploration. With the continuous enhancement of China's soft and hard power, Chinese culture is bound to be more widely disseminated globally. Therefore, the author believes, with boldness yet caution, that in the future, Chinese tea culture will undoubtedly achieve a greater level of internationalization, thereby enhancing China's international cultural influence.

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Issue Article

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INTEGRATION OF MARKETING RESEARCH INTO THE STRUCTURE OF THE PROCESS OF DESIGNING AN ASSORTMENT OF CLOTHING COLLECTION

Abstract: *The article discusses methods for collecting information about consumer preferences. The proposed structure of the assortment collection design process determines the place of marketing research both at the head and at the end of the design process.*

Key words: *marketing research, assortment collection design, external marketing factors.*

Language: *Russian*

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ИНТЕГРАЦИЯ МАРКЕТИНГОВЫХ ИССЛЕДОВАНИЙ В СТРУКТУРУ ПРОЦЕССА ПРОЕКТИРОВАНИЯ АССОРТИМЕНТНОЙ КОЛЛЕКЦИИ ОДЕЖДЫ

Аннотация: *В статье рассмотрены методы сбора информации о потребительских предпочтениях. Предложенная структура процесса проектирования ассортиментной коллекции определяет место маркетинговых исследований как во главе, так и в завершении процесса проектирования.*

Ключевые слова: *маркетинговые исследования, проектирование ассортиментной коллекции, внешние факторы маркетинга.*

Введение

Проектированием ассортиментной коллекции является последовательность действий от постановки задачи до разработки решения, удовлетворяющего общественным потребностям и производственным возможностям. В основе маркетинговых исследований лежит анализ внутренних и внешних факторов, которые в свою очередь влияют на разработку дизайна и ассортиментного ряда коллекции. По мере развития интернет-магазинов одежды и совершенствования цифровых технологий, потребители получают обширные возможности выбора удовлетворяющих их товаров. Вследствие доступа к масштабу различной информации, пользователи становятся более разборчивыми.

Решить поставленные задачи способны современные информационные технологии,

главную роль среди которых играют компьютерные информационные системы и Интернет. Опрос можно проводить путём размещения анкеты на сайтах, посещаемых целевой аудиторией или путём рассылки по электронной почте. Метод проведения опроса посредством размещения анкет на web-сайтах возможен как при наличии собственного ресурса, так и при его отсутствии, например, в популярных социальных сетях «В Контакте», «Facebook», «Twitter» и других.

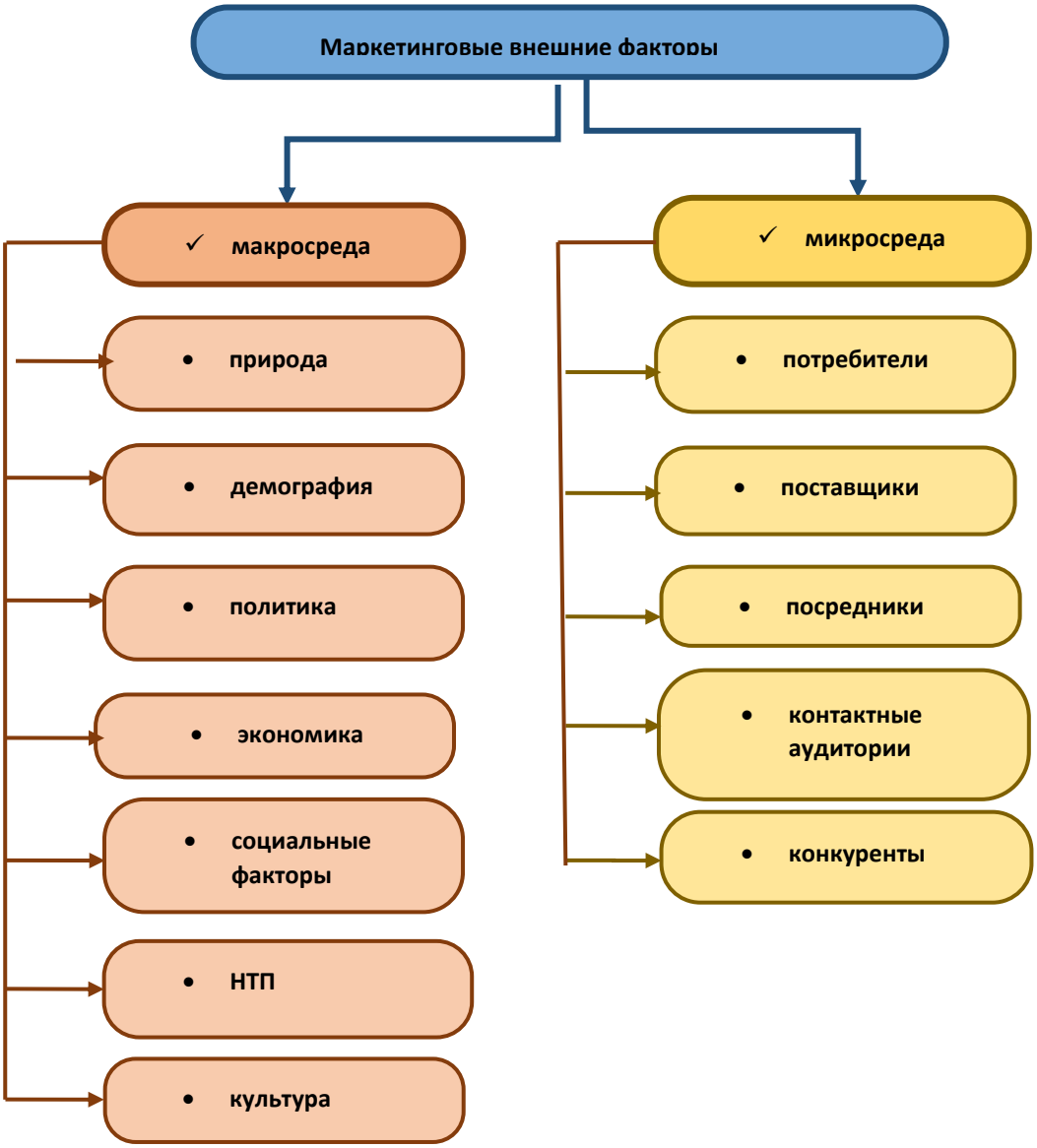

Рисунок 1. Классификация внешних факторов маркетинга

Другим современным подходом к методам сбора информации о потребительских предпочтениях является наблюдение, с помощью которого осуществляется систематическое, планомерное изучение поведения потребителя. Это действие, в отличие от опроса, не зависит от готовности наблюдаемого объекта сообщать информацию и является процессом открытого или скрытого сбора и регистрации событий или особых моментов, связанных с его поведением. Предметом наблюдения могут быть как объекты, так и характеристики и поведение покупателей. К этому методу относятся маркетинговые исследования, проводимые компаниями при наличии у них собственного web-сервера. Процесс заключается в сборе и последующем анализе данных файлов журналов (logfiles) web-сервера или благодаря использованию технологий с применением файлов cookie. Эти данные могут относиться к поведению посетителей, очередности их переходов по страницам или статистике посещений web-сервера. Возможности

анализа статистики посещений сервера являются одним из эффективных инструментов маркетинга. В отличие от проведения опросов, требующих активного участия респондентов, анализ статистики позволяет собрать ценную информацию, не привлекая посетителей к активным действиям.

Каждое предприятие существует в определенной маркетинговой среде, которая представляет собой совокупность внутренних и внешних факторов, которые необходимо учитывать при планировании коллекции и разработке программы действий.

Внешняя маркетинговая среда фирмы в свою очередь подразделяется на микросреду и макросреду. К внешней маркетинговой среде относятся все объекты, факторы и явления, которые находятся за пределами предприятия и непосредственно влияют на его деятельность. В микросреду фирмы входят взаимоотношения фирмы с поставщиками, посредниками, клиентами и конкурентами, тогда как в макросреду фирмы входят факторы преимущественно социального плана. К ним относятся факторы: экономического, демографического, политического, природного, технического и культурного характера. Классификация внешних факторов маркетинга представлена на рисунке 1.

• природные факторы (сезон, климатические условия) влияют на ассортимент коллекции, на эргономические показатели формирующие защитные свойства одежды. Если проектируемая коллекция одежды рассчитана на континентальный климат с продолжительной зимой и коротким летом, в ассортимент обязательно должны входить: куртки, пальто, свитера, платья, юбки, шапки, шарфы. Для регионов с континентальным климатом будет актуальна одежда с использованием натурального меха.

• демографические факторы определяются средой, которая во многом определяет будущий спрос: численность населения, возрастную структуру, соотношение городского и сельского населения, этническую и религиозную структура населения и другое. Данные факторы выявляют число и динамику потребителей. Например, демографический анализ Сибирского региона показал, что удельный вес молодежи - в Томской области 24%, в Забайкальском крае 23% и в Новосибирской области 21%. Следовательно, в Новосибирске, Томске и Забайкальском крае, будет наиболее востребована коллекция молодёжной одежды.

• экономические факторы определяются экономическим положением страны (региона), структурой и динамикой потребления, покупательской способностью населения, состоянием финансовой системы, уровнем инфляции. Сегодня закончилась эпоха импульсивного и бездумного потребления. При выборе одежды потребитель сравнивает цены, ищет наиболее выгодные предложения и ориентируется на более доступные, дешевые бренды.

• социальные факторы характеризуются положением отдельных социальных слоев общества, распределением его по принадлежности к различным классам, уровнем социальной стабильности.

• культурные факторы определяют индивидуализацию запросов потребителей по отношению к товарам и услугам. К этим факторам относятся: уровень образования и профессия, традиции, обычаи, вероисповедание, стиль, образ жизни.

Предложенная структура процесса проектирования (рис.2) ассортиментной коллекции определяет место маркетинговых исследований как во главе, так и в завершении процесса проектирования. При помощи сформированных отчетов маркетинговых исследований разрабатывается окончательное техническое задание, в котором определяются требования к проектируемой ассортиментной коллекции.

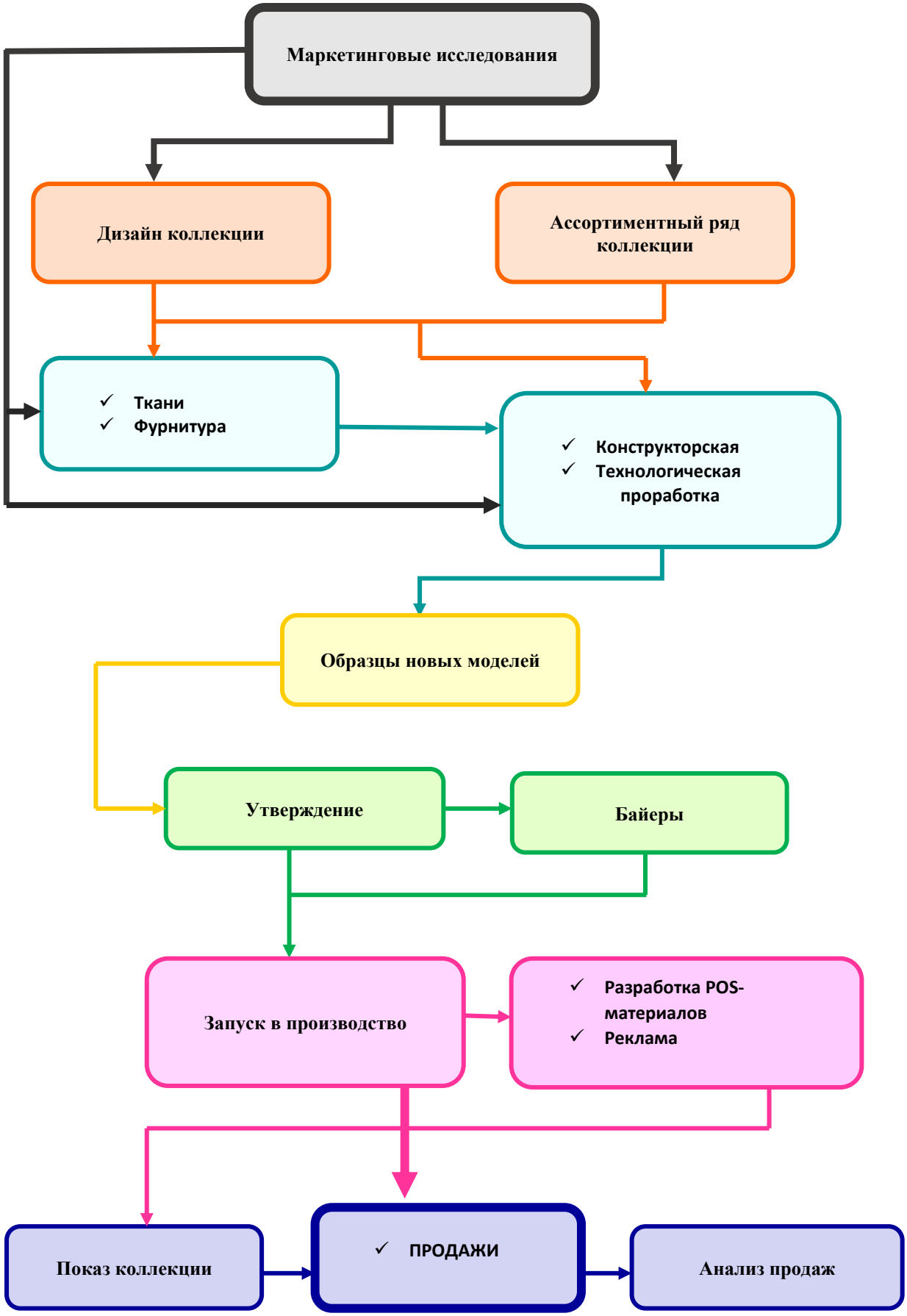

Рисунок 2. Структура процесса проектирования ассортиментной коллекции

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Issue Article

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SYNTACTIC METHOD OF FORMATION OF COMPARATIVE CONSTRUCTIONS IN THE KARAKALPAK LANGUAGE

Abstract: *In this article analyzes the issues of comparative constructions formed with the help of postpositions and words in the function of postpositions, as well as comparative constructions expressed by complex sentences.*

Key words: *comparison, comparative constructions, postposition, language, linguistic analysis, technique, syntactic method, assimilation, work of art, phrase, expressive means of language, semantic and stylistic features, complex sentence, complex sentences with a subordinate comparison.*

Language: *Russian*

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Scopus ASCC: *1200.*

СИНТАКСИЧЕСКИЙ СПОСОБ ОБРАЗОВАНИЯ СРАВНИТЕЛЬНЫХ КОНСТРУКЦИЙ В КАРАКАЛПАКСКОМ ЯЗЫКЕ

Аннотация: *В данной статье рассматриваются вопросы, сравнительных конструкций образованные с помощью послелогов и слов в функции послелогов, а также выраженные сложноподчиненными предложениями с придаточным сравнительным.*

Ключевые слова: *сравнение, сравнительные конструкции, послелог, язык, лингвистический анализ, прием, синтаксический способ, уподобление, художественное произведение, словосочетание, выразительные средства языка, семантико-стилистические особенности, сложноподчиненное предложение, сложноподчиненные предложения с придаточным сравнительным.*

Введение

Как язык является первоэлементом литературы, так и лингвистический анализ художественного текста является фундаментом его литературоведческого и стилистического изучения. Только после него можно переходить к серьезному рассмотрению идейного содержания и художественных особенностей литературного произведения в их синтетическом историко-филологическом единстве. [13, 8;]

Одним из языковых средств образности является сравнение, суть которого заключается в сопоставлении двух или нескольких объектов, явлений, имеющих близкие или одинаковые признаки.

«Сравнение принадлежит к числу важнейших приемов познании мира. Техника сравнения позволяет читателю выявить сходства и различия реалий мира, с целью получения новой, объективной информации о процессах и явлениях жизни. Использование сравнения в литературе также имеет эффект связи, помогает изобразить субъект с помощью многообразных ассоциаций с целью более полного восприятия. По этим причинам, на протяжении сотен лет, сравнение является популярной литературной техникой. При этом несмотря на пристальный интерес ведущих философов и лингвистов к проблеме природы функций сравнения, целый ряд аспектов остаётся неизученным» [8,10]

Изучение функций сравнения в художественном произведении является задачей литературоведа. Однако это представляет большой интерес и у лингвиста. Для языковеда важно изучение сравнительных конструкций (оборотов) и их структур, объема слов и словосочетаний, используемых в этих конструкциях. Поэтому последнее время в некоторых тюркских языках велись специальные исследования по всестороннему изучению сравнений [1; 3; 4; 5; 6; 8; 11; 12]. Тем не менее, нельзя сказать, что данная проблема обрела окончательную систематизацию. В этих исследованиях можно проследить различные мнения относительно сравнений, которые обусловлены, на наш взгляд, устройством и внутренними возможностями каждого языка. Подобное многообразие мнений и взглядов вовсе не означает, что тюркские языки не имеют ничего общего в передаче сравнений. Раскрытие общего и своеобразного в том или ином тюркском языке, выступающем в качестве закономерности, представляет собой весьма большое научное значение.

Каракалпакский язык обладает потенциальными возможностями и средствами, образующими сравнительные конструкции, изучение и теоретическая оценка которых обусловливает научно-практическую ценность исследования.

Сравнение - это уникальное качество, которым наделен человек природой и с помощью которого он различает и оценивает существующие в мире предметы, явления, события, признаки. Систематизация выразительных средств, выражение и раскрытие семантико-стилистических особенностей сравнительных конструкций —это одна из основных проблем лингвистики, ее специальной области - стилистики. В каракалпакском языкознании до сих пор нет научно обобщенного исследования по этой проблеме.

Сравнение является одним из самых сложных видов выразительных средств языка, отличающихся от других изобразительно-выразительных средств своими структурными, семантическими и стилистическими особенностями, всестороннее исследование которого обусловлено своей актуальностью в каракалпакском языкознании.

Сравнением называется стилистическое средство, которое передает образное, художественное, эмоционально-экспрессивное воздействие тождественных или различных сторон предметов или явлений путем сравнения одного предмета с другим на основе общих, схожих признаков.

Как конструкция, сравнение имеет свое собственное построение, которое состоит из четырех элементов: 1) сравниваемого предмета — «предмет сравнения»; 2) предмета, с которым сравнивается другой — «образ сравнения»; 3) общего элемента для обоих сравниваемых предметов, то есть общего для сравнения признака — «основа сравнения»; 4) грамматического показателя— «показателя сравнения».

В каракалпакском языке сравнительные конструкции образуются при помощи послелогов и слов в функции послелогов типа *киби, сыяқлы, мысалы, тәризли, секилли, яңлы* и т. п:

1) послелог *киби* образует сравнительную конструкцию, находясь после образа сравнения. Функция этого послелога в образовании сравнительных конструкций близка к функции аффикса *–дай//-дей*, но они различаются по употреблению: *-дай//-дей* употребляется во всех стилях речи, а *киби* в основном встречается в письменном стиле.

Например: ***Ләйли киби*** ышқы отына күйдирип,

Мени Мәжнун еттиң әрманый дүнья. (Әжинияз);

2) послелог *яңлы* образует сравнительные конструкции в сочетании с именными словами в основном (именительном) падеже. Хотя этот послелог является менее продуктивным в каракалпакском языке, в поэтических и некоторых прозаических произведениях он употребляется в различных стилистических целях. Например:

Нарзан булақлары қандай азада,

Сениң ***кеўлиң яңлы тынық ҳәм таза.*** (И.Юсупов)

3) послелог *сыяқлы* образует сравнительные конструкции в сочетании со словами в основном (именительном) падеже. По сравнению с вышеуказанными послелогами, сфера употребления этого послелога несколько шире: он может использоваться в поэзии, прозе, а также в устной разговорной речи. Например: Баласы уйықлап қалса да ***ертек сыяқлы узын-шубай әңгимелерди*** сөйлеп жататуғын еди (Т. Қайыпбергенов).

Выражая значение сравнения, этот послелог в то же время имеет и отдельные стилистические и смысловые оттенки;

4) послелог *мисли* при образовании сравнительной конструкции употребляется не очень продуктивно. От других послелогов, образующих сравнительную конструкцию, его отличает обязательная препозиция по отношению к образу сравнения, которая находится только в форме именительного падежа. Послелог *мисли* присущ письменному стилю. Например:

Кийген кийимлери мисли зағпыран

Қозғалып орнынан турды, яранлар. (Әжинияз);

5) послелог *мысалы* по своему употреблению, функции в предложении близок к послелогу *мисли* и активно употребляется в образовании сравнительных конструкций. Различаются они только порядком расположения в сравнительной конструкции: послелог *мисли* имеет негибкую позицию, а послелог *мысалы* — гибкую позицию, т. е. он может находиться и до, и после образа сравнения [7, 49.].

Например: Келди енди жигирма сегиз,

Шектим ***мийнет мысал өгиз***. (Бердақ).

Қулпырған көриниси

таўлар толқында,

Уйқыдан оянған ***арыўдай мысал***

6) активно употребляется для образования сравнительных конструкций в каракалпакском языке и слово *секилли*. Оно выражает значение сравнения, уподобления в сочетании с существительными, местоимениями, наречиями и в большинстве случаев выступает как синоним глагола *уқса*, хотя имеются между ними стилистические различия. «...слово *секилли* употребляется в качестве синонима к слову *уқсаған*, если слово *уқсаған* имеет нейтральное значение, то слово *секилли* в большинстве случаев склонно выражать отрицательное значение» [2, 114;].

Кроме этого, в каракалпакском языке сравнительные конструкции образуются при помощи послелогов – *тәризли, тақылетте, шелли, түўе, гөре*.

В каракалпакском языке определенную часть сравнений, образованных синтаксическим способом, составляют конструкции, выраженные в форме сложноподчиненных предложений с придаточным сравнительным. В них придаточное конкретно не распространяет главную часть, как в других сложноподчиненных предложениях, а сопоставляются, сравниваются содержания главного и придаточного в целом. Например:

Ал оның тереңлиги
Қаншелли десең егер,
Әрманлы Арицаның
Гегоға болған ышқы
Қаншелли терең болса
Көл сондай түпсиз терең (И.Ю.).

При образовании сравнительных конструкций могут участвовать не все формы сравнительных сложных предложений, а только те из них, которые образованы с помощью соотношения местоимений *қандай, қаншелли, қалай, неше* и соотносительных слов *сондай, соншелли, солай, сонша*. В сравнительных конструкциях, образованных таким способом, образ сравнения находится в составе придаточного предложения, а предмет сравнения — в составе главного. Вопросительно-относительные местоимения же выполняют роль показателя сравнения.

Например: Шынар тамыры **қанша** кетсе тереңге,

Сонша беккем, **сонша** қойыў саясы (И. Юсупов).

В современном каракалпакском языке сравнительные конструкции передаются также посредством синтаксического параллелизма. «Параллелизм как прием сравнения распространен во многих языках. Сущность этого типа сравнения заключается в том, что словосочетания, составляющие объект и образ сравнения, имеют одинаковую структуру, что усиливает художественно-эстетическое воздействие сравнения» [1, 26]. Например:

Устаға барсаң, сандал бар,
Сандалды көр де, шашын көр,
Моллаға барсаң, қәлем бар.
Қәлемди көр де, қасын көр.
Шершиге барсаң, хинжи бар,
Хинжини көр де, тисин көр,
Қар үстине қар жаўар,
Қарды көр де, етиң көр.
Қан үстине қан тамар,
Қанды көр де, бетин көр.
Құмнан қашқан порсықтай,
Хәр емшеги торсықтай. («Алпамыс»).

Таким образом, в статье рассмотрены основные элементы сравнительные конструкции, выраженные синтаксическим способом и их употребление в каракалпакском языке. Здесь можно увидеть большие возможности языка в выражении тонких чувств человеческого мышления. Анализируя примеры, мы можем обнаружить, что сфера употребления всех основных показателей, участвующих в построении сравнительных конструкций, не одинакова. Если некоторые из них употребляются продуктивно, то другие непродуктивно, некоторые присущи только к письменному или к разговорному языку, а некоторые и письменному, и разговорному языку. Вместе с тем, некоторые из них уподобляя предметы, явления, действия друг с другом показывают их близость, тем самым образуют сравнительные конструкции со значением сравнения, а некоторые показывают их различия и образуют сравнительные конструкции со значением уподобления.

А послелог *шелли* может образовать сравнительные конструкции и со значением сравнения и со значением уподобления.

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Issue Article

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PRINCIPLES OF CRIMINAL RESPONSIBILITY IN LEGAL RELATIONS

Abstract: *The article analyzes issues such as the factual basis of criminal responsibility, the act committed by a person, the recognition of an act as a crime, the legal (normative) basis of criminal responsibility, the criminal consequence, and the signs of criminal responsibility.*

Key words: *Factual basis of criminal liability, Legal (normative) basis of criminal liability, Criminal consequence, Signs of criminal liability.*

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Introduction

Criminal responsibility is understood as the legal consequence of committing a crime, which is represented by a sentence, punishment or other measure of legal effect by the court against the person who is guilty of committing the crime.

Committing an act that has all the symptoms of a crime is the basis for prosecution [1. B-37].

Criminal responsibility is a form of legal responsibility, which is defined in the criminal law and consists in applying responsibility to a person who is guilty of committing a crime by the court. Accordingly, criminal responsibility differs from other types of responsibility (moral, civil, administrative, etc.) primarily in terms of its content [2. B-105].

The concept of criminal responsibility is generally understood as a criminal legal relationship between the state and the person who committed the crime. In this case, the state has the right to apply criminal legal measures against the person who committed the crime. A person who commits a crime shall be obliged to apply the punishment specified in the sanction only for this offense, and the same measure of impact shall be applied to him.

Three theories are important in interpreting the concept of criminal responsibility:

The first theory states that criminal liability is a personal or property measure against a person who commits a crime.

The second theory understands criminal liability as a state coercive measure specified in the criminal law, that is, a coercive measure is applied to the guilty party that results in a conviction.

The third theory, criminal liability, refers to all criminal legal relations, as well as relations between the individual and the state (in the form of law enforcement agencies).

The issue of criminal responsibility of a person is considered from the moment of criminal liability. The issue of criminal responsibility is carried out in the form of involving a person in the inquiry and preliminary investigation (application of coercion and preventive measures), hearing the case in court, issuing a guilty verdict (indictment), conditional sentence and conviction. Criminal responsibility ends when the conviction ends or is removed. Criminal responsibility begins or ends with the entry into force of the court verdict. As soon as the guilty verdict of the court enters into legal force, the coercive measure of the state specified in the sentence will affect the person who committed the crime. Or from this time the criminal responsibility ends. As a result, criminal

responsibility is not established and conviction does not occur.

Criminal responsibility has a number of legal characteristics, which include:

firstly, according to its legal content, criminal responsibility creates legal consequences;

secondly, criminal liability is caused only by a socially dangerous act committed by a person's fault;

thirdly, it is expressed in forms of coercion of the state, such as the application of legal action, punishment or other criminal-legal measures;

fourthly, it arises, takes place and is canceled within the framework of criminal legal relations [3. B-35].

Criminal responsibility begins with the court's decision on the conviction, that is, the conviction of a person found guilty of committing a crime. Criminal responsibility can be carried out in the following forms:

1. to try the culprit without punishment;
2. judging the culprit by imposing punishment, but exempting him from actual execution;
3. judging the guilty party by imposing a punishment and executing it;
4. Applying punitive and medical coercive measures to the culprit, as well as judging them with their real execution.

Criminal liability differs from other legal liabilities by having its own characteristics. These are:

2. According to the basis of application.

Criminal liability is applied only to persons who have committed a socially dangerous act, which includes all the elements of the criminal structure specified in the Special Part of the Criminal Code. Civil liability in the form of pecuniary damage compensation is applied not only when pecuniary damage is caused due to acts constituting a criminal offense, but also when damage is caused as a result of other offenses.

According to the content of the responsibility. Criminal responsibility has the character of state coercion and is applied on behalf of the state. The rest of the impact measures do not have this feature.

1. According to the subject applying criminal responsibility. Criminal responsibility is applied only on the basis of a conviction by a court. No other official can apply such a measure of influence. Other measures of responsibility may be applied by competent bodies and officials outside the court.

2. According to the order of application. The special procedure for criminal prosecution is defined only in the Code of Criminal Procedure. The Code of Criminal Procedure determines the procedure for criminal prosecution by the inquiry, investigative bodies and the court. Other legal measures are regulated by other legal norms.

3. According to the range of entities subject to responsibility. Criminal responsibility is specific and applies only to the individual who committed the crime. Other liability measures can be applied to legal entities. For example, the Civil Code defines liability for legal entities.

The Criminal Code only determines the criminal liability of a natural person, that is, a person. This means that legal entities are denied criminal responsibility according to the Criminal Law of the Republic of Uzbekistan.

In accordance with international treaties, agreements or current laws, if the question of the responsibility of foreign citizens does not belong to the courts of the Republic of Uzbekistan, they will be resolved in accordance with the norms of international law if they committed a crime on the territory of the Republic of Uzbekistan.

Article 11 of the Criminal Code defines the cases of legal exclusion of the principle of territoriality from the criminal legislation of the Republic of Uzbekistan. This represents the current world concept of granting legal immunity to criminal prosecution of certain persons performing public duties.

Regardless of the type and level of the socially dangerous act committed by the person who is granted the right to use immunity, he will not be held criminally liable without the consent of the country that served the interests of that country.

In accordance with the current legislation, the following foreign citizens can use the right of immunity in the territory of Uzbekistan:

* employees of diplomatic missions of foreign countries;
* employees of consular offices of foreign countries;
* employees of international intergovernmental organizations;
* other representatives of foreign countries.

There are factual and legal (normative) bases of criminal responsibility.

The factual basis of criminal liability is an act committed by a person. In order for an act to be recognized as a crime, it must have all the elements of the crime under the law.

The legal (normative) basis of criminal responsibility is the composition of the crime provided for in the Criminal Code. Factual and normative bases form the general basis of criminal responsibility. If there is full correspondence between the committed act and the signs specified in the law, the evaluation of the act allows the competent authorities of the state to exercise their rights and obligations to bring the guilty party to criminal responsibility.

A necessary feature of the objective aspect of the crime is the criminal consequence. Every human action causes certain changes in the surrounding reality. A socially dangerous consequence of a criminal act (inaction) is that it creates a socially dangerous consequence because of itself.

The criminal consequence is the real damage caused by the crime to social relations, it is expressed in direct, indirect, direct and indirect negative changes (damage, damage, loss, etc.) causally connected with the criminal behavior, and in the last account, social (economic, moral, legal and other) values will undergo negative changes. A criminal consequence should be understood as a change in social relations protected by criminal law as a result of the commission of an act. The consequence causes direct harm or threatens to cause direct harm. A criminal consequence is a necessary element in crimes with a material content, and a consequence is not required in crimes with a formal content.

Material or immaterial damage to social relations protected by criminal law is represented by damage or other negative change.

Criminal legal consequences can be divided into groups according to the following criteria:

* depending on the nature of the damage;
* depending on the degree of danger of the damage caused;
* as defined by law;
* depending on the importance of qualifying the crime.

Consequences resulting from a socially dangerous act can be divided into tangible and intangible types.

Material consequences are consequences in the form of property and physical damage that tend to be clearly proven. If physical damage is expressed in the death of a person or in various degrees of damage to health, property damage, for example, crimes aimed at robbing the property of others, are aimed at reducing the property of the victim. It is possible to accurately measure material and physical damage. Therefore, such damage is differentiated according to the amount of the crime. It is customary to divide into simple, aggravating and special contents. For example, in the case of looting property: the looting is large and very large. However, measuring the political, ideological, organizational, psychological, social and other aspects of material damages is more complicated.

Intangible consequences are expressed in two types:

- intangible damage in the form of real damage, for example, the damage provided for in the first part of Article 144 of the Criminal Code;
- a consequence in the form of a risk of harm;

According to the degree of danger of the damage, the consequences are divided into two groups:

- intended as a sign of the main criminal offense, for example, the first part of Article 104, intentional infliction of grievous bodily harm;
- intended as a sign of a qualified crime, for example, the third part of Article 104, intentional infliction of grievous bodily harm that caused the death of the victim.

Depending on the law:

- Consequences clearly defined in the provisions of the Special Part of the Criminal Code;
- measurable consequence, i.e. such damage is not clearly specified in the law or other normative legal documents, which are determined by the law enforcement bodies based on the factual circumstances when the act is committed, for example, "significant amount of damage" or "other we can show the phrases "serious consequences".

Pursuant to Article 182, Part 1 of the Criminal Code, a person is prosecuted for the violation of customs legislation, due to the fact that he illegally transported goods and other valuables in large quantities (amounts from 300 to 500 times the basic calculation amount) across the customs border of the Republic of Uzbekistan, administrative punishment for such action occurs if, after application, there is a very large amount (amount 500 times the base calculation amount or more) according to Part 2.

In the provision of the relevant article of the Criminal Code, the norms providing for administrative prejudice belong to the category of crimes with a low social risk. Crimes of low social risk are committed intentionally and punishable by imprisonment for a term of not more than three years, as well as crimes committed due to carelessness and punishable by imprisonment for a term of not more than five years [4. B-16].

Administrative prejudgment is an act of repeating the offense committed by a person who has been held administratively responsible for a year. Certain crimes with a low social risk may not be punishable by imprisonment. Most of the articles dealing with crimes of low social risk do not provide for imprisonment (only for some specialized or highly specialized crimes).

The existence of the committed act is the only basis for bringing criminal responsibility in the literature from the elements of the criminal law related to the criminal law. The basis for bringing to criminal responsibility arises from the time when a person commits a socially dangerous act that has criminal elements [5. B-41]. However, in order to apply it to a specific person, there must be a legal document - a legally binding conviction of the court. The judgment of the court is the basis for the application of criminal liability.

Article 5 of the Criminal Code establishes the principle of equality of citizens before the law, according to which: "Persons who have committed crimes have the same rights and obligations, regardless of gender, race, nationality, language, religion, social origin, faith, personal and social status, equality before the law is established." This basis leads to the conclusion that no person is considered an ameliorating or mitigating circumstance.

Article 8 of the Criminal Code states: "No one can be held responsible for the same crime twice."

Non-criminal liability for the same offense is only a feature of criminal liability. But in addition to criminal responsibility for one crime, other measures of responsibility can be applied. For example, compensation for material damage caused by crime (civil liability), dismissal from work (disciplinary liability).

Conclusions

From the above it can be concluded as follows:

1. The only and sufficient basis for criminal liability is the presence of all the signs of the criminal element in the committed act.

Although the criminal code does not define the concept of crime, the theory of criminal law defines the crime. The term "criminal composition" means the set of objective and subjective elements that describe a certain socially dangerous act as a crime, for which responsibility is defined in the Criminal Code. The disposition of the norms of the Special part of the Criminal Code specifies which acts are crimes and defines them. Social relations protected by the Criminal Code using the objective signs of the crime (the object of the crime), the act itself and its consequences and the causal connection between them (the objective side of the crime); the subjective signs of the crime mean guilt, the motive and purpose of the crime (the subjective side) and the demands placed on the person who committed the crime.

2. Only the committed act can be a crime. In this way, it is guaranteed that a person will not be held criminally responsible for the idea, thought, imagination of committing a crime in the Criminal Code.

3. The deed, which has the structure of a crime, must be socially dangerous, have encroached on social relations, or they must have created a real risk of causing such damage. Article 16 of the Criminal Code, which defines the basis of criminal liability, does not indicate that the act is socially dangerous. However, from the content of other articles of the Criminal Code, it is established that actions that are dangerous for a person, state or society are considered crimes.

Objective criteria of social dangerousness of an act are constructed. The task of law enforcement is to evaluate its implementation as socially dangerous and fight against it. If the act has all the signs of a criminal content, but it is not socially dangerous, it is not considered a crime.

4. In order to determine the basis for criminal prosecution, it is necessary to analyze the committed act according to the norms of the Special Part of the Criminal Code. If the constituent elements of the committed act are in accordance with the composition of the crime specified in the provisions of the article of the Special Part, the composition of the crime is present in the committed act and is the basis for bringing a person to criminal responsibility. If the committed act does not have any signs of crime or it is not socially dangerous, it is not considered a crime.

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Contents

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