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Vasil Kabulovich Kabulov

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The book of abstracts contains the brief description of talks of the participants of the international conference " **Modern problems of applied mathematics and information technologies al-Khwarizmi 2021**". The topics are related to the scientific heritage of Al-Khwarizmi, theory of algorithms, mathematical modeling of nonlinear processes, algebra and functional analysis, differential equations and dynamical systems, ill-posed and inverse problems, mathematical analysis, geometry and topology, computational mathematics, statistical modeling, artificial intelligence and digital technology, information security, digital technologies in education, engineering education.

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**ALGORITHM FOR FINDING THE NORM OF THE ERROR FUNCTIONAL OF
OPTIMAL INTERPOLATION FORMULAS IN THE PERIODIC SPACE $\tilde{W}_2^{(m)}(T_1)$**

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The question of constructing an interpolation formula is considered $P_f(x)$, i.e.

$$f(x) \cong P_f(x) = \sum_{\lambda=0}^N C_\lambda(x) f(x^{(\lambda)}), \quad (1)$$

coincident function $f(x)$ in interpolation nodes: $f(x_i) = P_f(x_i)$, $i = 0, 1, \dots, N$, here the points $x^{(\lambda)} \in T_1$ and parameters $C_\lambda(x)$ are called, respectively, the nodes and coefficients of the interpolation formula (1), T_1 - one-dimensional torus, i.e. circumference of length equal to one.

The main task in the theory of interpolation is to find the maximum error of the interpolation formula $f(x) \cong P_f(x)$ over a given class of functions. The value of this function at some point z is the functional defined as

$$\langle \ell_N(x), f(x) \rangle = \int_{-\infty}^{\infty} \ell(x) f(x) dx = f(z) - P_f(z) = f(z) - \sum_{\lambda=0}^N C_\lambda(z) f(x^{(\lambda)}), \quad (2)$$

where it is clear that $P_f(z) = \sum_{\lambda=0}^N C_\lambda(z) f(x^{(\lambda)})$ interpolation formula and

$$\ell_N(x) = \delta(x - z) - \sum_{\lambda=0}^N C_\lambda(z) \delta(x - x^{(\lambda)}) \quad (3)$$

error functional of this interpolation formula, $C_\lambda(z)$ - coefficients, and $x^{(\lambda)}$ nodes formulas $P_f(z)$, $\delta(x)$ - the Dirac delta function and $f(x) \in \tilde{W}_2^{(m)}(T_1)$.

Definition. Space $\tilde{W}_2^{(m)}(T_1)$ defined as the space of functions given by a one-dimensional torus - T_1 circles of length equal to one and having all generalized derivatives of order m summable with a square [5].

The norm of the function is determined by the formula

$$\|f / \tilde{W}_2^{(m)}(T_1)\|^2 = \left(\int_{T_1} f(x) dx \right)^2 + \sum_{k \neq 0} |2\pi k|^{2m} |\hat{f}_k|^2. \quad (4)$$

The following is true.

Theorem. The squared norm of the error functional of interpolation formula (1) in space $\tilde{W}_2^{(m)}(T_1)$ is

$$\|\ell_N / \tilde{W}_2^{(m)*}(T_1)\|^2 = \left| 1 - \sum_{\lambda=1}^N C_\lambda(z) \right|^2 + \frac{1}{(2\pi)^{2m}} \sum_{k \neq 0} \left| \frac{\cos 2\pi k z - \sum_{\lambda=1}^N C_\lambda(z) e^{2\pi i k x^{(\lambda)}}}{k^{2m}} \right|^2, \quad (5)$$

where $C_\lambda(z)$ are the coefficients, $x^{(\lambda)}$ are the nodes of the interpolation formula of the form (1).

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