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MODERN PROBLEMS OF APPLIED MATHEMATICS AND INFORMATION TECHNOLOGIES AL-KHWARIZMI 2021

dedicated to the 100th anniversary of the academician
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.

This collection is intended for specialists in mathematics, applied mathematics and information technology, university teachers and for PhD, master students.

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

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

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

coincident function $f(x)$ in interpolation nodes: $f(x_i) = P_f(x_i), i = 0, 1, ...N$, 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

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

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

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

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

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

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

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

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

15. ADDITIONAL TALKS