International conference | Xalqaro konferensiya | Международная конференция

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

Abstracts

AMALIY MATEMATIKA VA INFORMATSION TEXNOLOGIYALARNING DOLZARB MUAMMOLARI - AL - XORAZMIY 2021

Ma'ruzalar tezisi

АКТУАЛЬНЫЕ ПРОБЛЕМЫ ПРИКЛАДНОЙ МАТЕМАТИКИ И ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ - АЛЬ - ХОРЕЗМИ 2021

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A B S T R A C T S

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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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NUMERICAL INTEGRATION OF FUNCTIONS DEFINED ON THE UNITE SPHERE $\mathbb{S}^2$

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It is known that, high accuracy quadrature formulas for integration on the unit sphere embedded in a Euclidean space are necessary in many practical applications such as geophysics and the numerical solutions of differential and integral equations. We consider integration on the unit sphere

$$I(f) = \int_{\mathbb{S}^2} f(\xi) d\mathbb{S}^2(\xi),$$

where $\xi = (x, y, z) \in \mathbb{S}^2$, $\mathbb{S}^2$ is the unit sphere, i.e., $\mathbb{S}^2 = \{x \in \mathbb{R}^3 : |x| = 1\}$ is usually parameterized by spherical polar coordinates (θ, ϕ), where θ and ϕ are the polar and azimuthal angles, respectively, satisfying $0 \le \theta \le \pi$ and $0 \le \phi < 2\pi$ and the point $\xi = \xi(\theta, \phi)$ is given by

$$x = \cos\phi \sin\theta, \ y = \sin\phi \sin\theta, \ z = \cos\theta, \quad 0 \le \phi < 2\pi, \quad 0 \le \theta \le \pi. \tag{1}$$

In the spherical coordinates (θ, ϕ), given by (1), the integral of any integrable function f over the sphere $\mathbb{S}^2$ is given by

$$I(f) = \int_0^{2\pi} \int_0^{\pi} f(\cos\phi \sin\theta, \sin\phi \sin\theta, \cos\theta) \sin\theta d\theta d\phi.$$

Here we can use single variable numerical integration on each of the iterated integrals. Since the integrand is periodic in ϕ with period 2π, it is suitable to use the rectangular quadrature formula with uniform spacing. The remaining integral in (1) for $0 \le \theta \le \pi$ is more problematic. The Gauss-Legendre method for solving this problem in θ variable is shown in [1].

The aim of this work is to survey the general problem of numerical integration on the sphere $\mathbb{S}^2$ in $\mathbb{R}^3$.

References

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15. ADDITIONAL TALKS