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

*Abstracts*

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*Ma'ruzalar tezisi*

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

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

**Hayotov A.R.<sup>1</sup>, Bozarov B.I.<sup>2</sup>**

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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  $(\theta, \phi)$ , where  $\theta$  and  $\phi$  are the polar and azimuthal angles, respectively, satisfying  $0 \leq \theta \leq \pi$  and  $0 \leq \phi < 2\pi$  and the point  $\xi = \xi(\theta, \phi)$  is given by

$$x = \cos \phi \sin \theta, \quad y = \sin \phi \sin \theta, \quad z = \cos \theta, \quad 0 \leq \phi < 2\pi, \quad 0 \leq \theta \leq \pi. \quad (1)$$

In the spherical coordinates  $(\theta, \phi)$ , 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  $\phi$  with period  $2\pi$ , it is suitable to use the rectangular quadrature formula with uniform spacing. The remaining integral in (1) for  $0 \leq \theta \leq \pi$  is more problematic. The Gauss-Legendre method for solving this problem in  $\theta$  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  $\mathbb{R}^3$ .

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