



MINISTRY OF HIGHER EDUCATION,
SCIENCE AND INNOVATIONS OF
THE REPUBLIC OF UZBEKISTAN



V.I.ROMANOVSKIY
INSTITUTE
OF MATHEMATICS



UNIVERSITY OF EXACT
AND SOCIAL SCIENCES



OXUS
UNIVERSITY

INTERNATIONAL SCIENTIFIC CONFERENCE

**MATHEMATICAL ANALYSIS AND
DYNAMICAL SYSTEMS**

CONFERENCE PROGRAMME

MAY 20 - 21, 2025

TASHKENT, UZBEKISTAN

V.I.Romanovskiy Institute of Mathematics

University of Exact and Social Sciences

OXUS University

ABSTRACTS
OF THE INTERNATIONAL CONFERENCE
**MATHEMATICAL ANALYSIS AND DYNAMICAL
SYSTEMS**

May 20–21, 2025, Tashkent, Uzbekistan

TASHKENT – 2025

Rakhimov A.A., Tukhtasinov T.T. <i>The convergence nearly every where with respect to real W^*-algebras</i>	122
Rasulova M.A., Hakimov M.A. <i>H_A-periodic ground states for the Chui-Weeks model on the Cayley tree</i>	124
Rasulova M.Z., Khakimov O.N. <i>On dynamics of 1-Volterra operator on S^2</i>	126
Saburov M. <i>Ganikhodjaev's Conjecture on Mean Ergodicity of Quadratic Stochastic Operators</i>	128
Sadullaev A.K., Mukhamadiev F.G. <i>Semi-openness property of the space $SP_G^n X$</i>	130
Samijonova N.D. <i>p-adic quasi Gibbs measures for the Potts model on the Cayley tree of order three</i>	131
Sapoyeva M.U., Boxonov Z.S. <i>Analysis of periodic points in nonlinear difference equations</i>	133
Sattarov I.A. <i>Dynamical systems of isometry on the p-adic sphere</i>	134
Sattarov I.A. <i>On chaoticity of p-adic $(2, 2)$-rational mapping</i>	136
Sheraliyeva S.A., Xasanova Z.Z. <i>On the extension of solvable Leibniz algebras with a nilradical of codimension two</i>	137
Shermatova Z.H. <i>Transposed Poisson structures on infinite dimensional Lie algebras</i>	139
Shoyimardonov S.K. <i>On the dynamics of a discrete phytoplankton-zooplankton system with Holling-type toxic effects</i>	140
Soyibboev U.B. <i>Differential game with a life-line for nonlinear motion dynamics of players</i>	142
Subhonova Z.A. <i>A Cauchy problem for a fractional integro-differential diffusion-wave equation</i>	144
Suyarov T.R. <i>The problem of determining the unknown coefficient in the two-dimensional wave equation under initial and non-local boundary conditions</i>	146
Tashpulatov S.M. <i>Three-magnon systems in the Heisenberg model: two- and three-dimensional case.</i>	149
Tian J.P. <i>Evolution coalgebra</i>	151
Tukhtabaev A.M., Yusufjonov N.E. <i>Weakly periodic p-adic quasi Gibbs measures for the Potts model on a Cayley tree</i>	152
Turdibaev R.M. <i>Homogeneous system of parameters for anti-commuting pairs of matrices</i>	154
Turdiyeva Z.R. <i>Gibbs Measures for an Ising Model with Continuous Spin Values</i> ..	156
Tursunov O.E., Jamilov U.U. <i>On dynamics of an epidemic SIR model</i>	158
Umurova Sh.U., Khakimov O.N. <i>Dynamics of the 2-adic Ising Model: Periodic Orbit Structures</i>	161
Urolboeva A.I., Yusupbaeva Kh. <i>Periodic orbits of 2-adic Ising-Vannimenus model mapping</i>	162
Usmanov S.E. <i>Maximal operators associated with a family of singular surfaces</i>	163
Velasco M.V. <i>An Algebraic Perspective on Dynamical Systems</i>	166
Yusupov B.B., Atajonov Kh.O. <i>Local and 2-local anti-derivation on solvable filiform Lie algebras of rank 1</i>	167
Yusupov B.B., Ibragimova K.O. <i>2-Local $\frac{1}{2}$-derivation on Witt algebras</i>	169
Yusupov B.B., Vaisova N.Z., Madaminova G.Q. <i>2-Local derivation on solvable Lie algebras with naturally graded filiform nilradical</i>	171
Zhizhina E.A. <i>Periodic homogenization of nonlocal high-contrast elliptic operators and associated Markov jumps processes</i>	174
Zoyidov A. <i>Ergodicity of positive Riesz-type stochastic operators</i>	175
Abrayev B.O'., Jamolov M.X. <i>O'zgartirilgan tashqi maydonli Potts modeli uchun asosiy holatlar</i>	178
Achilova Z.Sh., Sheraliyeva S.A. <i>Kichik o'Ichamli yechiluvchan Li algebralarining δ-differensiallashlari</i>	180
Adxamov X.A., Mustapokulov X.Ya. <i>Impuls ta'sirli boshqariladigan sodda differentsial o'yin</i>	182
Abrayev B.O'., Mirzayeva D.M. <i>Ikkinci tartibli Keli daraxtida bir model uchun asosiy holatlar</i>	184

The problem of determining the unknown coefficient in the two-dimensional wave equation under initial and non-local boundary conditions

Suyarov T.R.

Bukhara State University, 11 M. Ikbol St., Bukhara 200100, Uzbekistan
tsuyarov007@gmail.com

Let $\Omega = D \times (0, T)$, where $D = \{(x, y) : 0 < x, y < 1\}$. We consider the initial boundary value problem for wave equation

$$u_{tt}(x, y, t) - \Delta u + q(t)u(x, y, t) = f(x, y, t), \quad (1)$$

with initial conditions

$$u(x, y, t)|_{t=0} = \varphi_1(x, y), \quad (x, y) \in \bar{D}, \quad (2)$$

$$u_t(x, y, t)|_{t=0} = \varphi_2(x, y), \quad (x, y) \in \bar{D}, \quad (3)$$

and non-local boundary conditions

$$u_x(0, y, t) = u_x(1, y, t), \quad u(0, y, t) = 0, \quad (y, t) \in [0, 1] \times [0, T], \quad (4)$$

$$u(x, 0, t) = u(x, 1, t), \quad u_y(x, 1, t) = 0, \quad (x, t) \in [0, 1] \times [0, T], \quad (5)$$

where $\bar{D} = \{(x, y) : 0 \leq x, y \leq 1\}$, $\Delta = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}$; $\varphi_1(x, y)$, $\varphi_2(x, y)$ and $f(x, y, t)$ are given functions.

In the **direct problem**, it is required to define a function $u(x, y, t) \in C^2(\bar{\Omega})$ satisfying the equalities (1)-(5), for given sufficiently smooth functions $q(t)$, $f(x, y, t)$, $\varphi_i(x, y)$, $i = 1, 2$, where $\bar{\Omega} = \{(x, y, t) : 0 \leq x, y \leq 1, 0 \leq t \leq T\}$.

The **inverse problem** is to find function $q(t) \in C[0, T]$, if with respect to the solution of the direct problem (1)-(5) the overdetermination condition is known

$$\int_0^1 \int_0^1 w(x, y) u(x, y, t) dx dy = h(t), \quad (6)$$

Lemma 1. Let $\varphi_1(x, y) \in C^4(\bar{D})$, $\varphi_2(x, y) \in C^3(\bar{D})$ and $f(x, y, t) \in C_{xy,t}^{2,0}(\bar{\Omega})$. Besides, the following equalities hold

$$\begin{aligned} \varphi_1(0, y) &= \varphi_{1xx}(0, y) = \varphi_1(1, y) = \varphi_{1xx}(1, y), & 0 \leq y \leq 1; \\ \varphi_1(x, 0) &= \varphi_{1yy}(x, 0) = \varphi_1(x, 1) = \varphi_{1yy}(x, 1), & 0 \leq x \leq 1; \\ \varphi_2(0, y) &= \varphi_{2xx}(0, y) = \varphi_2(1, y) = \varphi_{2xx}(1, y), & 0 \leq y \leq 1; \\ \varphi_2(x, 0) &= \varphi_{2yy}(x, 0) = \varphi_2(x, 1) = \varphi_{2yy}(x, 1), & 0 \leq x \leq 1; \\ f(0, y, t) &= f(1, y, t), & (y, t) \in [0, 1] \times [0, T]; \\ f(x, 0, t) &= f(x, 1, t), & (x, t) \in [0, 1] \times [0, T]. \end{aligned}$$

Then the numerical series:

$$2\Psi_{0,0}(T) + \sum_{k=1}^{\infty} \Psi_{0,2k-1}(T) + \sum_{k=1}^{\infty} \Psi_{0,2k}(T) + 2 \sum_{m=1}^{\infty} \Psi_{2m-1,0}(T) + \sum_{m,k=1}^{\infty} \Psi_{2m-1,2k-1}(T)$$

$$+ \sum_{m,k=1}^{\infty} \Psi_{2m-1,2k}(T) + 2 \sum_{m=1}^{\infty} \Psi_{2m,0}(T) + \sum_{m,k=1}^{\infty} \Psi_{2m,2k-1}(T) + \sum_{m,k=1}^{\infty} \Psi_{2m,2k}(T), \quad (7)$$

$$4 \sum_{m=1}^{\infty} \sqrt{\lambda_m} \Psi_{2m-1,0}(T) + 2 \sum_{m=1}^{\infty} \lambda_m \Psi_{2m-1,0}(T) + 2 \sum_{m,k=1}^{\infty} \sqrt{\lambda_m} \Psi_{2m-1,2k-1}(T) \\ + \sum_{m,k=1}^{\infty} \lambda_m \Psi_{2m-1,2k-1}(T) + 2 \sum_{m,k=1}^{\infty} \sqrt{\lambda_m} \Psi_{2m-1,2k}(T) + 2 \sum_{m=1}^{\infty} \lambda_m \Psi_{2m,0}(T) \\ + \sum_{m,k=1}^{\infty} \lambda_m \Psi_{2m-1,2k}(T) + \sum_{m,k=1}^{\infty} \lambda_m \Psi_{2m,2k-1}(T) + \sum_{m,k=1}^{\infty} \lambda_m \Psi_{2m,2k}(t), \quad (8)$$

$$2 \sum_{k=1}^{\infty} \sqrt{\gamma_k} \Psi_{0,2k-1}(T) + \sum_{k=1}^{\infty} \gamma_k \Psi_{0,2k-1}(T) + \sum_{k=1}^{\infty} \gamma_k \Psi_{0,2k}(T) \\ + 2 \sum_{m,k=1}^{\infty} \sqrt{\gamma_k} \Psi_{2m-1,2k-1}(T) + \sum_{m,k=1}^{\infty} \gamma_k \Psi_{2m-1,2k-1}(T) + \sum_{m,k=1}^{\infty} \gamma_k \Psi_{2m-1,2k}(t) \\ + 2 \sum_{m,k=1}^{\infty} \sqrt{\gamma_k} \Psi_{2m,2k-1}(T) + \sum_{m,k=1}^{\infty} \gamma_k \Psi_{2m,2k-1}(T) + \sum_{m,k=1}^{\infty} \gamma_k \Psi_{2m,2k}(T), \quad (9)$$

in (7)-(9) are converge.

Thus, we have proved the following theorem.

Theorem 1. Let $q(t) \in C[0, T]$ and if the functions $\varphi_1(x, y)$, $\varphi_2(x, y)$ and $f(x, y, t)$ satisfy the conditions of the Lemma 1, then there exists a unique solution to the problem (1)-(5).

The following assertion is main result in this paper:

Theorem 2. Let the conditions of Lemma 1 and $h(t) \in C^2[0, T]$, $|h(t)| \geq h_0 > 0$, be satisfied and

$$w(1, y) = w(0, y) = 0, \quad w_x(1, y) = 0, \quad y \in [0, 1], \\ w(x, 0) = 0, \quad w_y(x, 1) = w_y(x, 0) = 0, \quad x \in [0, 1].$$

Then there exists $T^* \in (0, T)$ so that the inverse problem (1)-(6) has unique solution $q(t) \in C[0, T^*]$.

Theorem 3. Let $(\varphi_1, \varphi_2, h, f) \in D_{\nu_0}$, $(\tilde{\varphi}_1, \tilde{\varphi}_2, \tilde{h}, \tilde{f}) \in D_{\nu_0}$ and $q, \tilde{q} \in G_{\nu_1}$. Then, for solution to the inverse problem (1)-(6) the following stability estimate holds:

$$\|q - \tilde{q}\|_{C[0, T]} \leq r \left[\|\varphi_1 - \tilde{\varphi}_1\|_{C^4[0, 1]} + \|\varphi_2 - \tilde{\varphi}_2\|_{C^3[0, 1]} + \|h - \tilde{h}\|_{C^2[0, T]} + \|f - \tilde{f}\|_{C^2(\bar{\Omega})} \right],$$

where the constant r depends only on ν_0, ν_1, T .

References

1. Romanov, V. G. Inverse Problems of Mathematical Physics, Utrecht, VNU Science Press, 1987.
2. Hasanov A., Romanov, V. G. Introduction to Inverse Problems for Differential Equations, Springer International Publishing, 2017.

3. Kabanikhin, S. I. Inverse and Ill-Posed Problems: Theory and Applications, Berlin, De Gruyter, 2011.