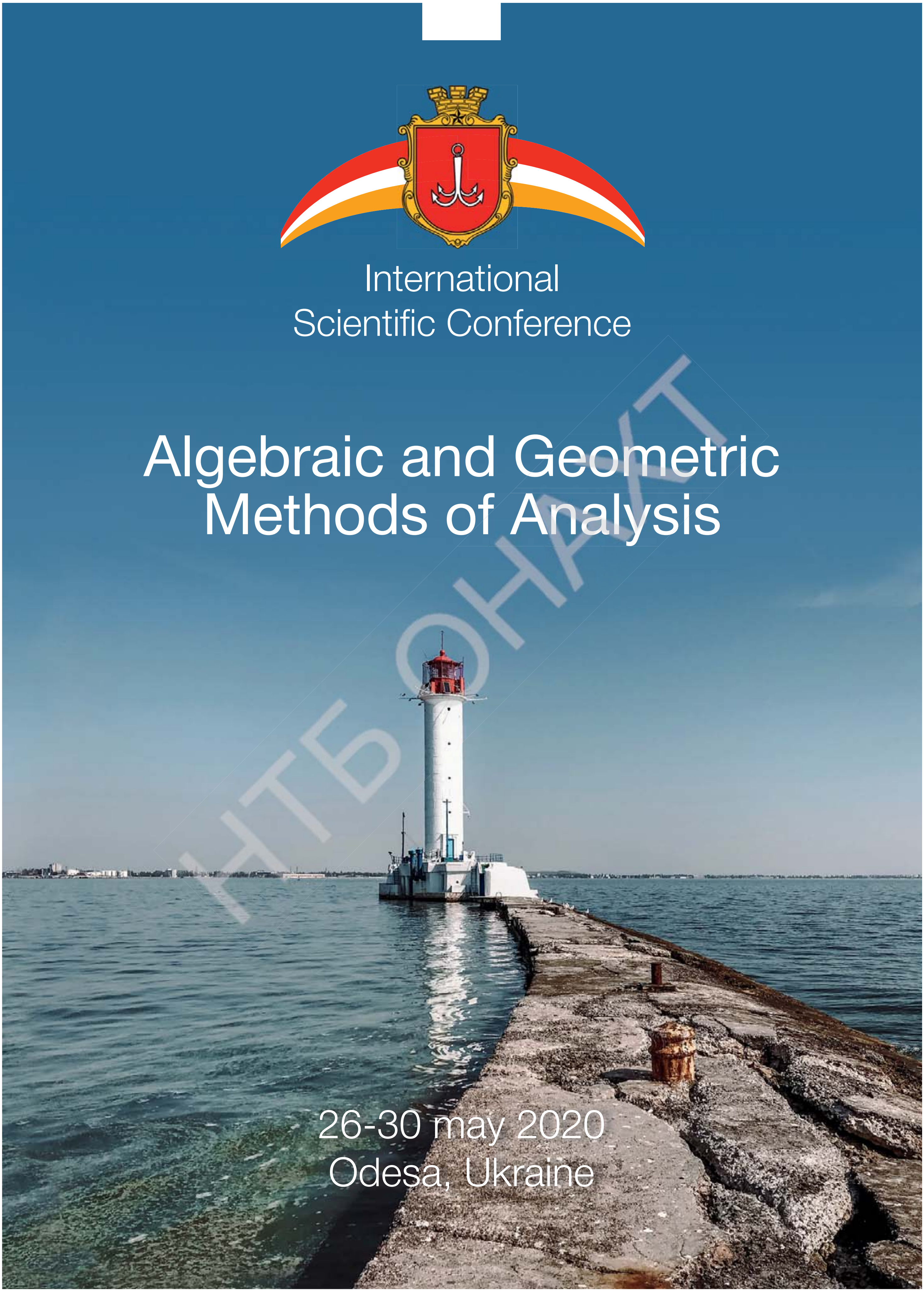

International
Scientific Conference

Algebraic and Geometric Methods of Analysis

26-30 may 2020
Odesa, Ukraine

List of topics

- Algebraic methods in geometry
- Differential geometry in the large
- Geometry and topology of differentiable manifolds
- General and algebraic topology
- Dynamical systems and their applications
- Geometric problems in mathematical analysis
- Geometric and topological methods in natural sciences

Organizers

- Ministry of Education and Science of Ukraine
- Odesa National Academy of Food Technologies
- Institute of Mathematics of the National Academy of Sciences of Ukraine
- Odessa I. I. Mechnikov National University
- Taras Shevchenko National University of Kyiv
- International Geometry Center
- Kyiv Mathematical Society

Program Committee

Chairman: Prishlyak A.
(*Kyiv, Ukraine*)
Balan V.
(*Bucharest, Romania*)
Banakh T.
(*Lviv, Ukraine*)
Bolotov D.
(*Kharkiv, Ukraine*)
Borysenko O.
(*Kharkiv, Ukraine*)
Cherevko Ye.
(*Odesa, Ukraine*)
Fedchenko Yu.
(*Odesa, Ukraine*)
Karlova O.
(*Chernivtsi, Ukraine*)
Kiosak V.
(*Odessa, Ukraine*)
Kirillov V.
(*Odesa, Ukraine*)
Konovenko N.
(*Odesa, Ukraine*)
Lyubashenko V.
(*Kyiv, Ukraine*)
Maksymenko S.
(*Kyiv, Ukraine*)
Matsumoto K.
(*Yamagata, Japan*)
Mormul P.
(*Warsaw, Poland*)
Mykhailyuik V.
(*Chernivtsi, Ukraine*)
Plachta L.
(*Krakov, Poland*)
Pokas S.
(*Odesa, Ukraine*)
Polulyakh E.
(*Kyiv, Ukraine*)
Sabitov I.
(*Moscow, Russia*)
Savchenko A.
(*Kherson, Ukraine*)
Sergeeva A.
(*Odesa, Ukraine*)
Shelekhov A.
(*Tver, Russia*)
Volkov V.
(*Odesa, Ukraine*)
Zarichnyi M.
(*Lviv, Ukraine*)

Administrative committee

- Egorov B., chairman, rector of the ONAFT;
- Povarova N., deputy chairman, Pro-rector for scientific work of the ONAFT;
- Mardar M., Pro-rector for scientific-pedagogical work and international communications of the ONAFT;
- Fedosov S., Director of the International Cooperation Center of the ONAFT;
- Kotlik S., Director of the P.M. Platonov Educational-scientific institute of computer systems and technologies "Industry 4.0";
- Svytyy I., Dean of the Faculty of Computer Systems and Automation.

Organizing commitee

Kirillov V.
Konovenko N.
Fedchenko Yu.
Maksymenko S.
Cherevko Ye.
Osadchuk E.
Prus A.

The Cauchy problem for matrix factorizations of the Helmholtz equation in a multidimensional bounded domain

D. A. Juraev
(The Higher Military Aviation School of the Republic of Uzbekistan, Karshi city, Uzbekistan)
E-mail: juraev_davron@list.ru

It is known that the Cauchy problem for elliptic equations is unstable relatively small change in the data, i.e., is incorrect (Hadamard's example). In unstable problems the image of the operator is not closed, therefore the solvability condition can not be written in terms of continuous linear functionals. Thus, in the Cauchy problem for elliptic equations with data on a part of the boundary of the region, the solution is usually unique, the problem is solvable for an everywhere dense set of data, but this set not closed. Consequently, the theory of solvability of such problems is essentially It is more difficult and deeper than the theory of solvability of the Fredholm equations. The first results in this direction appeared only in the mid-1980s in the works of L.A. Aizenberg, A.M. Kytmanov, N.N. Tarkhanov (See, for instance [1]).

Let $x = (x_1, ..., x_n), y = (y_1, ..., y_n)$ be are points of the Euclidean space $\mathbb{R}^n$ and $G \subset \mathbb{R}^m$ be a bounded simply-connected domain with piecewise smooth boundary consisting of the plane T: $y_m = 0$ and of a smooth surface S lying in the half-space $y_m > 0$, that i.s., $\partial G = S \bigcup T$.

We consider in the domain G a system of differential equations

$$D\left(\frac{\partial}{\partial x}\right)U(x) = 0, \tag{1}$$

where $D\left(\frac{\partial}{\partial x}\right)$ is the matrix of first-order differential operators.

We denote by $A(G)$ the class of vector functions in a domain G continuous on $\overline{G} = G \bigcup \partial G$ and satisfying system (1).

Problem 1. Suppose that $U(y) \in A(G)$ and

$$U(y)|_S = f(y), \ y \in S.$$

Here, $f(y)-$ a given continuous vector-valued function on S.

It is required to restore the vector function $U(y)$ in the region G, based on its values $f(y)$ on S.

Theorem 2. *Let $U(y) \in A(G)$ it satisfy the inequality*

$$|U(y)| \leq M, \ y \in T.$$

If

$$U_\sigma(x) = \int\limits_S N_\sigma(y, x) U(y) ds_y, \quad x \in G,$$

then the following estimate holds

$$|U(x) - U_\sigma(x)| \leq C(x)\sigma e^{-\sigma x_m}, \ \sigma > 1, \ x \in G.$$

Here and below functions bounded on compact subsets of the domain G, we denote by $C(x)$.

Corollary 3. *The limiting equality*

$$\lim_{\sigma \to \infty} U_\sigma(x) = U(x),$$

holds uniformly on each compact set in the domain G.

In the future, we will construct the Carleman matrix for matrix factorizations of the Helmholtz equation in multidimensional bounded domain and based on it we will find an approximate solution to the Cauchy problem in explicit form, using the methodology of previous works (See, for instance [2, 3, 4, 5, 6, 7, 8, 13]).

In many well-posed problems for a system of equations of elliptic type of the first order with constant coefficients, the factorizing operator of Helmholtz, the calculation of the value of the vector function on the whole boundary is inaccessible. Therefore, the problem of reconstructing, solving a system of equations of elliptic type of the first order with constant coefficients, the factorizing operator of Helmholtz, is one of the topical problems in the theory of differential equations (See, for instance [9, 10, 11, 12, 14]).

References

[1] N.N. Tarkhanov, *The Cauchy problem for solutions of elliptic equations*, volume 7 of *Mathematical topics*, Akad. Verl.: Berlin, 1995.

[2] D.A. Juraev, *Regularization of the Cauchy problem for systems of equations of elliptic type. LAP, Lambert Academic Publishing*, Saarbrucken: Germany, 2014.

[3] D.A. Juraev, The Cauchy problem for matrix factorizations of the Helmholtz equation in an unbounded domain. *Siberian Electronic Mathematical Reports*, 14: 752–764, 2017.

[4] D.A. Juraev, Cauchy problem for matrix factorizations of the Helmholtz equation. *Ukrainian Mathematical Journal*, 69(10): 1364–1371, 2017.

[5] D.A. Juraev, On the Cauchy problem for matrix factorizations of the Helmholtz equation in a bounded domain. *Siberian Electronic Mathematical Reports*, 15: 11–20, 2018.

[6] D.A. Juraev, The Cauchy problem for matrix factorizations of the Helmholtz equation in $\mathbb{R}^3$. *Journal of Universal Mathematics*, 1(3): 312–319, 2018.

[7] D.A. Juraev, On the Cauchy problem for matrix factorizations of the Helmholtz equation in an unbounded domain in $\mathbb{R}^2$. *Siberian Electronic Mathematical Reports*, 15: 1865–1877, 2018.

[8] D.A. Juraev, On a regularized solution of the Cauchy problem for matrix factorizations of the Helmholtz equation. *Advanced Mathematical Models & Applications*, 4(1): 86–96, 2018.

[9] D.A. Juraev, On the ill-posed Cauchy problem for matrix factorizations of the Helmholtz equation. *International Conference "Complex Analysis, Mathematical Physics and Nonlinear Equations". Book of Abstracts. Ufa, Russia*, Pp. 41–42, 2019.

[10] D.A. Juraev, On the integral formula for the matrix factorization of the Helmholtz equation in $m-$dimensional bounded domain. *International Mathematical Conference "Complex Analysis and Approximation Theory". Book of Abstracts. Ufa, Russia*, Pp. 20–21, 2019.

[11] D.A. Juraev, On a regularized solution of the Cauchy problem for matrix factorizations of the Helmholtz equation in $m-$dimensional bounded domain. *International scientific conference "Algebraic and geometric methods of analysis". Odessa. Ukraine. Book of abstracts*, Pp. 27–28, 2019.

[12] D.A. Juraev, On the Cauchy problem for matrix factorization of the Helmholtz equation. *Uzbek-Russian Scientific Conference "Non-classical equations of mathematical physics and their applications". Tashkent, Uzbekistan*, Pp. 563–565, 2019.

[13] D.A. Juraev, On the Cauchy problem for matrix factorizations of the Helmholtz equation. *Journal of Universal Mathematics*, 2(2): 113–126, 2019.

[14] D.A. Juraev, The integral formula for matrix factorizations of the Helmholtz equation in multidimensional space. *Complex Analysis, Mathematical Physics and Nonlinear Equations, Book of Abstracts of the International Conference. Ufa, Russia*, Pp. 30–31, 2020.

Зміст