КОНФЕРЕНЦИИ

THE INTERNATIONAL SCIENTIFIC CONFERENCE "ACTUAL PROBLEMS OF MATHEMATICS AND INFORMATICS: THEORY, METHODOLOGY, PRACTICE" DEDICATED TO THE 150TH ANNIVERSARY OF THE BIRTH OF ACADEMIC S. CHAPLYGIN

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Abstract. The 150th anniversary of the academician of the Academy of Sciences of the USSR, the famous mechanic and mathematician S. Chaplygin may be regarded as perhaps the most notable event in the field of mathematics, applied mathematics and mechanics in recent decades. He has solved a number of complex problems related to aeromechanics and aviation, mathematics and his works have contributed to increasing the country's defense capability. Held on the basis of the Bunin Yelets State University, anniversary international scientific conference devoted to this important date, became a very significant event. The article provides an analysis of the main results of the research on fundamental scientific problems discussed at this conference.

Keywords: mathematics, applied mathematics, mathematical modeling, differential equations, information and technical systems, improving the quality of mathematical education.

1. Introduction

The XX century is marked by the enrichment of world science with outstanding achievements in the field of mathematics, solving many important problems that remain relevant in the modern world. Such problems include, in particular, the problems considered in fundamental works of academician S. Chaplygin. These are the approximate integration of differential equations, the solution of wide classes of differential equations, the approximate solution of general classes of functional equations, the theory of equations of mixed type and the boundary problems associated with it. Currently, questions of the spectral theory for the considered types of equations of mathematical physics are one of the promising and intensively developing areas of mathematics, which are studied by modern mathematicians, such as N. Agakhanov, A. Dezin, V. Ilin, M. Lavrentiev, A. Bitsadze, K. Babenko, V. Vragov, S. Gellerstedt, M. Smirnov and others. Works of academician S. Chaplygin became a starting point, which allowed scientists, on the one hand, to introduce a classification of partial differential equations, to show, in terms of the spectral theory of linear operators, a comparative study of the properties of solutions of boundary problems for corresponding to each other irregular equations. On the other hand, new research paths were set, and serious applied problems were addressed in the fields of aerodynamics, gas dynamics,

hydrodynamics, and mechanics. All of this was possible thanks to the rapid development of information technology.

Modern mathematical knowledge is unthinkable without the use of the latest digital technology. Its widespread use in modern mathematical science leads to the emergence of new methods and means of research, the emergence of modern scientific areas of mathematical research, and a change in the nature of scientific research. The scientific and technological support of fundamental and applied research in the field of mathematical science and its applications allows the implementation of priority technologies, which are selected based on the main trends of world development. This is the analysis of big data, neuro-technology and artificial intelligence, distributed registry systems, quantum and new production technologies, 'industrial Internet', components of robotics and sensor technology, wireless communication technologies, virtual and augmented reality, NBIC – convergent technologies, etc.

The foregoing made it possible to organize a large-scale scientific event in the historic homeland of academician S. Chaplygin – the 5-th international conference "Actual problems of mathematics and computer science: theory, methodology, practice", dedicated to the 150th anniversary of the birth of academician S. Chaplygin.

2. Goals and objectives of the event

The Bunin Yelets State University (Russia), Samarkand State University (Uzbekistan), Higher School of Insurance and Finance (Bulgaria), Khachatur Abovyan Armenian State Pedagogical University (Armenia), Scientific and Methodological Council on Mathematics of the Ministry of Science and Higher Education of Russia organized and held on April 18-20, 2019 the 5th International Conference "Actual problems of mathematics and computer science: theory, methodology, practice" dedicated to the 150th anniversary of academician S. Chaplygin. The conference marked the three major milestones associated with the development of mathematical science in the Lipetsk region and in the oldest university center in the region – the Bunin Yelets State University.

1. April 2019, is the 150th anniversary of the birth of S. Chaplygin (1869–1942) –a well-known Russian scientist, academician of the Academy of Sciences of the USSR. S. Chaplygin is an outstanding representative of the Lipetsk region, whose surname is immortalized in the name of the city Chaplygin (previously Ranenburg), in the Lipetsk region.

2. 2019 year is the 80th anniversary of the foundation of the Faculty of Physics and Mathematics. It is the oldest faculty of the Yelets State University, where students of the scientific school of academician N. Zhukovsky were taught, whose famous representative was academician S. Chaplygin.

3. In October 2019, there will be 10 years since the organization of the Lipetsk Branch of the Scientific and Methodological Council for Mathematics of the Ministry of Science and Higher Education of Russia on the basis of the Bunin Yelets State University, the main purpose of which was to increase the scientific and innovative potential of the region, in which high-tech industrial production is focused.

International Scientific Conference "Actual Problems of Mathematics and Computer Science: Theory, Methods, Practice" dedicated to the 150th anniversary of academician S. Chaplygin, aimed at the implementation of an important task – the development of fundamental and applied directions and innovations in the field of mathematics and computer science, improving the quality of mathematical education.

The main goals of the conference were the creation of conditions for international scientific communication of representatives of fundamental and applied areas in the field of mathematics, understanding the importance of scientific works of S. Chaplygin, the actualization of his scientific achievements, taking into account the rapid development of information technologies and their adaptation to modern mathematical education.

3. The results of the conference

The plenary session of the conference was opened by the Rector of the Bunin Yelets State University, Professor Gerasimova E., continued by the President of the International Academy of the History of Science, Professor S. Demidov (Moscow, Russia), who presented the talk "Pure and Applied Mathematics at the M.V. Lomonosov Moscow State University in the first half of the twentieth century: N. Luzin and S. Chaplygin". Since the time of N. Brashman at Moscow University, the tradition of a close union of pure and applied mathematics has cultivated. At the same time, applied mathematics in Moscow (more broadly in Russia) was conceived as theoretical mechanics with an emphasis on continuum mechanics, that is, on hydro- and aeromechanics. The symbol of such unity was the work of Zhukovsky. Chaplygin and Luzin, being his disciples, continued this tradition. Chaplygin obtained a number of first-class results in mathematics (the theory of differential equations). The speaker systematized and critically reviewed an extensive complex of historical and mathematical data devoted to the study of the scientific heritage of S. Chaplygin, revealed a significant range of facts of his scientific and administrative activities at Central Aerohydrodynamic Institute and the Moscow Higher Women's Courses through the prism of new historical information about the scientific interaction of the two luminaries of Russian science. Famous for his results on the theory of functions and set theory, Luzin also worked for many years at Central Aerohydrodynamic Institute and is known for his achievements in the field of applied mathematics.

Professor A. Soleev (Samarkand, Uzbekistan) devoted his report to the disclosure of basic ideas and general provisions of the Power Geometry (in the case d = 2,3). The algorithms of Power Geometry are based on the study of nonlinear problems not in the original coordinates, but in the logarithms of these coordinates. They allow to simplify equations, to resolve their singularities, to isolate their first approximations, and to find either their solutions or the asymptotic of the solutions. The author indicated a many nonlinear problems, which may be solved by these algorithms (and by them only). For example, in the local analysis of two equations in three variables, i.e. the problem of resolving a singularity of an algebraic curve in the three-dimensional case in a small neighborhood of a singular point, we come to the problem of uniformization of a space algebraic curve and its transformation to a plane algebraic curve. After that, near the considered singular point, one can obtain the asymptotic expansion of a piece of this curve. The effectiveness of the algorithms was demonstrated on some complicated problems from various fields of science (Robotics, Celestial Mechanics, Hydrodynamics and s.o.).

Professor A. Soldatov (Moscow, Russia) focused on the consideration of the Dirichlet problem for equations of mixed type. In particular, the report considered various options for formulating boundary value problems with Dirichlet data for the Lavrentev – Bitsadze equation $(\text{sgn}\, y)u_{xx} + u_{yy} = 0$, $z = x + iy$ in the domain D, bounded at $y > 0$ and $y < 0$ by Lyapunov arcs, respectively, σ and γ with ends at the points $z = 0$, $z = 1$ (assuming that these arcs do not touch at the end points of the x axis, so that the angles $\frac{\pm}{k}$ of the domains $D^{\pm} = D \cap \{\pm y > 0\}$ at the points $z = k$ k are positive and that the arc γ does not concern the characteristics $x \pm y = \text{const}$ at the indicated points and domain D^- is convex with respect to the straight lines passing through these points).

The report of Professor G. Zhukova (Moscow, Russia) discussed the nature of the dependence of solutions for singularly perturbed linear differential systems on a small parameter. The author has established the features of asymptotic sequences of decomposition of solutions, the dependence of the structure of the asymptotics of solutions on the spectral properties of a certain operator pencil. The case was considered, in particular, when the limit operator for a derivative is degenerate.

The talk of Professors O. Masina (Yelets, Russia) and O. Druzhinina (Moscow, Russia) was devoted to the in-depth analysis of the known and developed approaches by the authors to study the stability of intelligent control systems. The approaches are based on the development of the method

of Lyapunov functions, divergent, spectral-bifurcation and other methods. Using these methods and approaches, the conditions for stabilization of some classes of control systems are obtained.

The talk of Professors V. Tikhomirov (Moscow, Russia), T. Sergeeva (Moscow, Russia) and E. Smirnov (Yaroslavl, Russia) addressed the issues of improving mathematical education, introducing novelty into the learning process while maintaining the best traditions of high-quality teaching mathematics, laid by S. Chaplygin in his productive teaching activities. In particular, the study of E. Smirnova is devoted to the processes of modernization of mathematical education in schools and universities with the manifestation of synergistic effects based on the identification and study of "problem areas" of mastering complex knowledge by means of computer and mathematical modeling. The author highlights the actualization of modern advances in science (fractal geometry, coding theory, fuzzy sets and fuzzy-logic, L. Schwartz distribution theory, nonlinear dynamics, etc.) as a basic factor in the manifestation of synergistic effects.

The relevance of the event was noted in the talks of the Professors A. Abylkasymova (Alma-Ata, Kazakhstan), A. Borovskikh (Moscow, Russia), S. Grozdev (Sofia, Bulgaria), M. Mkrtchyan (Yerevan, Armenia) and other scientists.

The following sections were organized at the conference:

In Section 1, "Modern Directions in Mathematics," reports were presented on various sections of real and functional analysis, differential equations and their systems, algebra and number theory, probability theory, and mathematical statistics; discrete mathematics and mathematical cybernetics. Particular attention is paid to the problems of regular boundary problems, spectral theory for certain types of equations, the theory of systems of partial differential equations, which are reflected in transonic gas dynamics. It is important to note that the construction of the spectral theory of boundary problems for differential equations, both ordinary and partial derivatives, is apparently impossible without using the modern theory of differential equations and the ideas and methods of functional analysis. The latter allow us to build a more coherent theory, as well as get the most complete and meaningful results. In this regard, the further development of scientific ideas of S. Chaplygin is significant and essential for modern mathematical science.

Section 2 "Applied problems of mathematics" included reports devoted to the problems of mathematical modeling and optimal control; mathematical physics; new materials and methods in the field of aviation and rocket and space technology; mathematical methods in financial economics. The reports of researchers from Ulyanovsk, St. Petersburg update the research of academician S. Chaplygin in the field of aerodynamics in the modern context of the development of mathematical science.

Section 3 "Computer modeling, information technologies and systems" included reports on new directions in the field of computing and communication systems, network technologies, methods of systems analysis, automation and artificial intelligence, allowing to carry out scientific and technological support of fundamental and applied research in the field of the development of mathematical science.

Section 4 "New theories, models and technologies of teaching mathematics and computer science at schools and universities" included reports on the development and implementation of web technologies as the main component of digital education, innovative technologies of teaching mathematics in the context of the effective development of a learner's personality and actual problems of economics and social policy in the system of education, monitoring and evaluation of students' educational results. Improving the system of mathematical education in these areas will ensure the formation of a market of highly qualified specialists participating in the scientific and technological development of the region in particular, and Russia as a whole, and the competitiveness of the domestic economic system in the world. Issues of improving mathematics education, introducing novelty into the learning process, provided that the best traditions of mathematics teaching are preserved and augmented, first of all, high-quality training of specialists, which were laid by S. Chaplygin during his productive teaching activities, were actively discussed by the scientific and pedagogical community at the conference.

At Section 5 "Actualization of the problems of the history of mathematics and mathematical education in modern conditions", the reports of scientists were devoted to the many-sided scientific and pedagogical activity of S. Chaplygin, in particular, the study of the fundamental works of the academician in the field of mathematics and its applications.

At the conference there were more than 250 participants, including leading foreign specialists from Armenia, Bulgaria, Uzbekistan, Kazakhstan, well-known scientists from more than twenty regions of Russia, as well as young researchers. Overall, it was a successful conference, which helped to increase the scientific and innovative activity of the region, stimulated the participants to develop mathematics, information technologies and mathematical education.

A distinctive feature of the Anniversary Conference was that, for the first time, an anniversary meeting of the Lipetsk Branch of the Scientific and Advisory Council on Mathematics was held at the conference with a summary of the department's work, with a broad discussion of the key areas of development of mathematics and its applications in the promising research and technology region of Russia. At the meetin, the report of the Scientific Secretary of the Scientific and Advisory Council on Mathematics S. Rozanova "Scientific and Advisory Council on Mathematics of the Ministry of Science and Higher Education of Russia: History, Activity" also took place. In the report, two important periods of the Council's activities were reviewed: the period chaired by Academician A. Tikhonov (70-90 years of the last century) and the period chaired by Academician S. Emelyanov since 1999, whose active assistant in these important activities for the state was a corresponding member of the Russian Academy of Sciences – L. Kudryavtsev. The report of the 20 regional divisions of the SAC highlighted the active work of five departments: Ulyanovsk, the Republic of Tatarstan, Lipetsk, Yelets, Orel and Samara; describes the contribution of the Scientific and Methodological Council for Mathematics to preserving the best traditions and improving the quality of Russian mathematics education. On the activities of the Lipetsk-Yelets Regional Branch of the Scientific and Methodological Council for Mathematics of the Ministry of Science and Higher Education of Russia reported its chairman S. Shcherbatykh.

4. The fundamental scientific problems of the event

The fundamental nature of the scientific problems of the Vth International Scientific Conference "Actual problems of mathematics and computer science: theory, methods, practice", dedicated to the 150th anniversary of the birth of the academician S. Chaplygin, substantiated by the fact that:

1. Modern directions of mathematical science in the field of real and functional analysis, differential equations, algebra and number theory, probability theory and mathematical statistics, discrete mathematics and mathematical cybernetics were supplemented by new scientific knowledge about the essential principles of the objects and phenomena under study, new methods for studying problems of this class, received new informative examples. The discussed issues of studying regular boundary problems, building spectral theory for certain types of equations, the theory of systems of partial differential equations, which are reflected in transonic gas dynamics, have made a significant contribution to the development of the modern theory of differential equations using ideas and methods of functional analysis.

2. New results of research and development in problem-oriented areas in the fields of applied mathematics, computer modeling, information technologies and systems were discussed. In the field of applied mathematics, problems of mathematical modeling in the problems of dynamics and stability of deformable structural elements under aerohydrodynamic effects, models of optimal control of the motion of a spacecraft in photogravitational fields, and mathematical modeling of bionanostructures were discussed. In the field of information technology and technical systems, the problems of the theory of stability and stabilization of dynamic systems were considered, using modern problem-oriented program complexes, the creation and maintenance of information systems that automate organizational management tasks and business processes in various industries. The obtained results will ensure competitiveness in the global space of domestic science, economy,

high-tech and knowledge-intensive industries through the creation of a scientific and technological reserve in the priority areas of modernization of the country's economy.

3. The issues of integration of science and education through the study of the possibilities of adaptation and introduction of new fundamental results of mathematical science in educational programs for bachelor, master and postgraduate students, ensuring the formation of a market of highly qualified specialists involved in the scientific and technological development of the region and the country were discussed. Methodological and technological aspects of the modernization of modern mathematical education and organization of the educational process, increasing the level of theoretical and applied training of students in the field of mathematics are complemented by the development and introduction of web technologies as the main component of digital education, innovative technologies of teaching mathematics in the context of effective development of the personality of a learner, modern methods and forms of monitoring and evaluating students' educational results, economics and social first policy in the education system.

4. Certain issues of the history of mathematics and mathematical education in modern conditions are actualized: from the fundamental research of the Italian mathematician F. Tricomi to the works of academician S. Chaplygin, dedicated to boundary problems for systems of differential equations, and equations of mixed type, and further to a more detailed research of the properties of solutions of equations that degenerate on the boundary of the domain. Fundamental analysis and research of the results of academician S. Chaplygin and his students in the field of mathematics will contribute to the solution of actual problems of modern mathematical science and its applications in various fields of other sciences, production and technology.

The conference made a significant contribution to the consolidation of the scientific community, to the design and development of topical areas of mathematical research, to the training of scientific and teaching personnel in the field of mathematics and the teaching of mathematical disciplines. The conference materials will serve as a reliable source of heuristic material for many years, both in the field of mathematics and in the practical application of mathematical research.