



Institute of Mathematics CAS, v. v. i.

Identification number: 67985840

Address: 115 67 Praha 1, Žitná 609/25

## **Annual report on activities and economic management in 2016**

### **English summary**

The Annual report was discussed by the Supervisory Board of the Institute on 16 March 2017 and approved by the Board of the Institute on 30 March 2017.

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# 1 The Institute

The Institute of Mathematics of the Czech Academy of Sciences, v. v. i. (“the Institute”), is a public research institution according to the Act No. 341/2005 Coll.

The founder of the Institute is the Czech Academy of Sciences seated at Praha 1, Národní street 1009/3, ZIP code 117 20.

The Institute was founded in order to carry out scientific research in the field of mathematics, to contribute to the utilisation of its research results, and to provide the research infrastructure.

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## 1.1 Foundation deed (unofficial translation)

Based upon Act No. 283/1992 Coll., on the Czech Academy of Sciences, as subsequently amended, and upon Act No. 341/2005 Coll., on public research institutions, as subsequently amended, and further, in accordance with the Statutes of the Czech Academy of Sciences issued on 24 May 2006, the Czech Academy of Sciences (hereinafter CAS) hereby issues the Full Text of the Foundation Deed of the Institute of Mathematics of the CAS (in Czech “Matematický ústav AV ČR, v. v. i.”) dated 28 June 2006 (English version dated 20 December 2006), as subsequently amended by the resolution of the twentieth session of the Academy Council of the CAS held on 15 July 2014 which changed English translation of the name of the CAS from the Academy of Sciences of the Czech Republic to the Czech Academy of Sciences as of 1 January 2015:

### I.

(1) The Institute was incorporated into the Czechoslovak Academy of Sciences (hereinafter CSAS) under the name the Mathematical Institute of the CSAS by a resolution of the third plenary meeting of the Government Commission for the Establishment of the CSAS held on 30 March 1952, which took effect on 1 January 1953. Under section 18 (2) of Act No. 283/1992 Coll., the Institute became an entity of the CAS as of 31 December 1992.

(2) Under Act No. 341/2005 Coll., the legal status of the Mathematical Institute of the CAS has been transformed from a state contributory organisation into a public research institution (abbreviated in Czech as v. v. i.) from 1 January 2007.

### II.

(1) The Institute of Mathematics of the CAS (hereinafter IM) is established for an indefinite period as a legal entity with identification number 67985840, and is located in Prague 1, Žitná 609/25, Postal Code 115 67.

(2) The founder of the IM is the CAS, an organisational body of the state, identification number 60165171, headquartered in Prague 1, Národní 1009/3, Postal Code 117 20.

### III.

(1) The purpose for which the IM has been established is to carry out scientific research in the field of mathematics, to contribute to the utilisation of its research results, and to provide the research infrastructure.

(2) The principal activity of the IM is scientific research in the fields of mathematics and its applications. The IM contributes to raising the level of knowledge and education and to utilising the results of scientific research in practice. It acquires, processes and disseminates scientific information, issues scientific and professional publications (monographs, journals, proceedings, etc.). It provides scientific assessments, professional opinions and recommendations, consulting and advisory services. In cooperation with universities, the IM carries out doctoral study programmes and provides training for young scientists. Within the scope of its activity, the IM promotes international cooperation, including the organisation of joint research projects with foreign partners, participation in exchange programmes for scientists and the exchange of scientific information, as well as the preparation of joint publications. The IM organises scientific meetings, conferences and seminars on the national and international levels and provides the infrastructure for research, including the provision of accommodation for its employees and guests. It pursues its aims both independently and in cooperation with universities and other research and professional institutions.

### IV.

(1) The director, the Board and the Supervisory Board are the bodies of the IM. The director is the statutory body of the IM and is entitled to act on behalf of the IM.

(2) Basic organisational units of the IM are scientific departments responsible for research and development, and service departments responsible for provision of the infrastructure.

(3) The detailed organisational structure of the IM is regulated by rules of organisation issued by the director after being approved by the Board.

### V.

The foundation deed in its present form took effect on 1 January 2015.

Prof. Jiří Drahoš  
President of the CAS

## 1.2 Governing bodies

**Director:** RNDr. Jiří Rákosník, CSc.

### **Board of the Institute:**

**Chair:** RNDr. Martin Markl, DrSc.

**Vice-chair:** doc. RNDr. Milan Tvrдый, CSc.

**Members at large:** prof. RNDr. Zuzana Došlá, DSc. (Masaryk University in Brno)  
prof. RNDr. Pavel Drábek, DrSc. (University of West Bohemia in Pilsen)  
prof. RNDr. Miroslav Engliš, DrSc.  
prof. RNDr. Eduard Feireisl, DrSc.  
Mgr. Robert Hakl, Ph.D.  
prof. RNDr. Jan Hamhalter, CSc. (Czech Technical University in Prague)  
prof. RNDr. Bohdan Maslowski, DrSc. (Charles University in Prague)  
prof. RNDr. Vladimír Müller, DrSc.  
RNDr. Šárka Nečasová, DSc.  
prof. RNDr. Ivan Netuka, DrSc. (Charles University in Prague)

### **Supervisory Board:**

**Chair:** prof. ing. Michal Haindl, DrSc. (Academy Council of the CAS)

**Vice-chair:** Mgr. Vojtěch Pravda, Ph.D.

**Members at large:** RNDr. Eva Čermáková, CSc. (Institute of Economy of the CAS)  
prof. RNDr. Miroslav Hušek, DrSc. (Charles University in Prague)  
prof. RNDr. Jiří Sgall, DrSc. (Charles University in Prague)

The director of the Institute cooperated with the Board of the Institute and relied on an informal advisory board formed by the chair of the Board Martin Markl, deputy director Tomáš Vejchodský, the scientific secretary and project manager Beata Kubiš, head of the Administration Department Radka Vrkočová (appointed to the position on 1 January 2016) and head of the IT Department Martin Jarník.

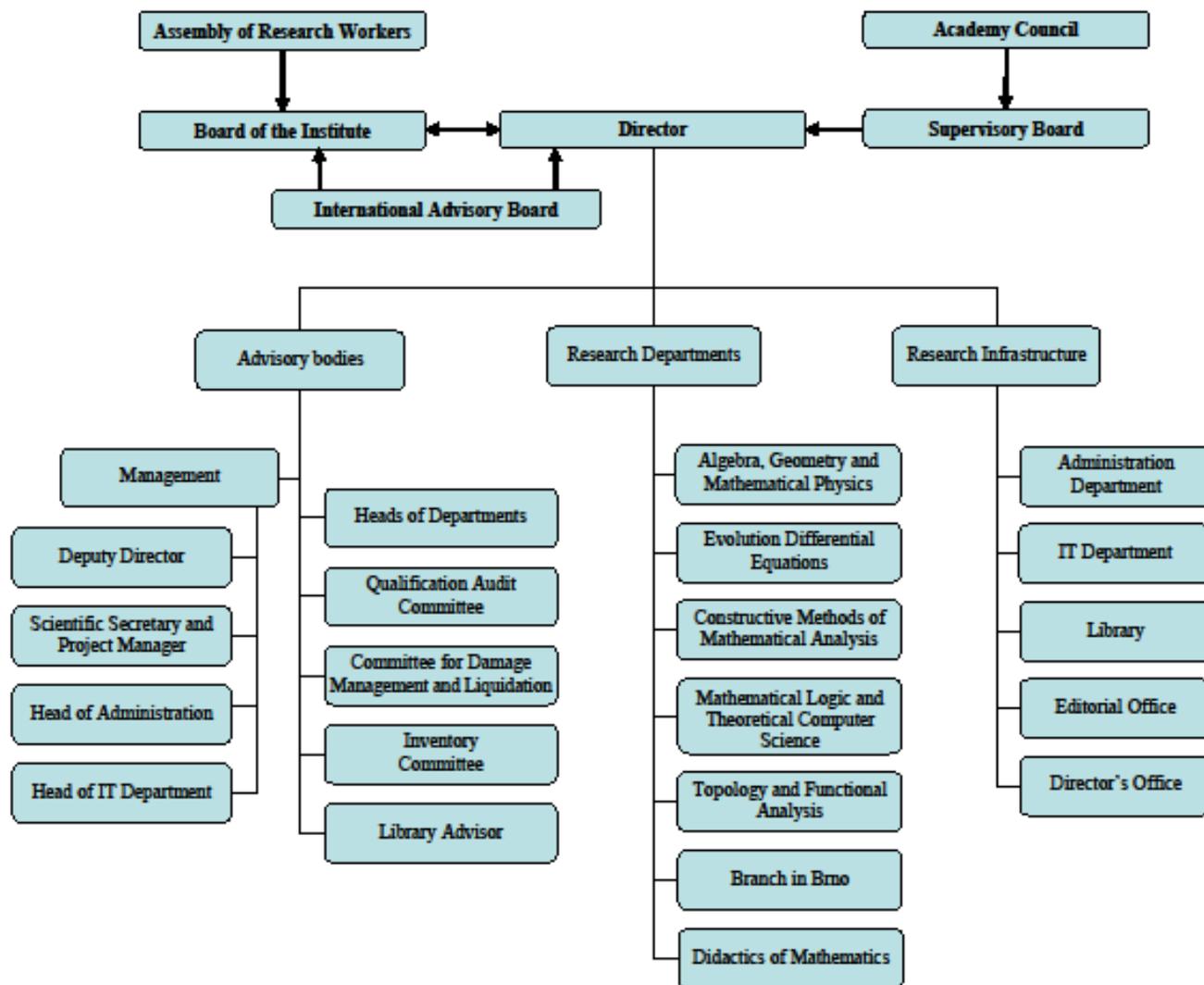
The **Board of the Institute** held four meetings, one of them remotely. The topics they discussed and approved included among others:

- budget of the Institute for 2016
- the annual report on activities and economic management in 2015 and auditor's report on financial statements
- proposal of the Otto Wichterle Premium for Jan Hladký (approved by the Academy Council of the CAS)
- selection of candidates for the postdoctoral positions in the Academy's programme supporting prospective human resources
- establishing the Eduard Čech Distinguished Visitor position
- proposal of the Award of the CAS for young scientific employees for outstanding results of scientific work, achieved with the financial support of the CAS before reaching the age of 35, for Ondřej Kreml (rejected by the Academy Council of the CAS)
- proposal of awarding the Bernard Bolzano Honorary Medal for Merit in Mathematical Sciences for Eduard Feireisl
- plan for reconstruction of the library

The **Supervisory Board** held five meetings, three of them remotely. The topics they discussed and approved included among others:

- approval of three lease agreements for flats in the Institute's building
- proposal of the budget of the Institute for 2017 the annual report on activities and economic management in 2016 and auditor's report on financial statements
- determination of the auditor for financial statements
- approval of the lease agreement with the Institute of Physics of Materials of the CAS for spaces for the Branch in Brno

## 1.3 Structure

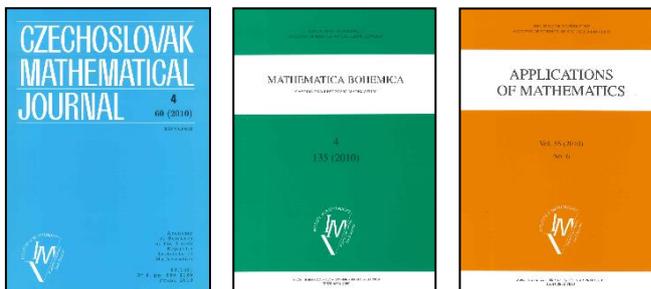


Didactics of Mathematics is a very small group (less than 1 FTE) which, however, plays an important role in providing an expert connection between the institute on the one side and institutions educating teachers of mathematics and teachers themselves on the other side.

The Institute publishes three internationally recognized mathematical journals:

- Czechoslovak Mathematical Journal
- Mathematica Bohemica
- Applications of Mathematics

The director nominates the Editorial Boards and the Editors-in-Chief.



The Institute is maintaining and developing the Czech Digital Mathematics Library DML-CZ accessed at <http://dml.cz> and participates in development of the European Digital Mathematics Library EuDML accessed at <http://eudml.org>. The Institute operates the Prague zbMATH Editorial Group contributing to the production of the database.

## 2 Research activities

### 2.1 Characteristics of the principal activity

The principal activity of the IM is to support fundamental research in the fields of mathematics and its applications, and to provide necessary infrastructure for research. The IM contributes to raising the level of knowledge and education and to utilising the results of scientific research in practice. It acquires, processes and disseminates scientific information, issues scientific and professional publications (monographs, journals, proceedings, etc.). In cooperation with universities, the IM carries out doctoral study programmes and provides training for young scientists. The IM promotes international cooperation, including the organisation of joint research projects with foreign partners and participation in exchange programmes. The IM organises scientific meetings, conferences and seminars on the national and international levels.

Research in the Institute focuses on mathematical analysis (differential equations, numerical analysis, functional analysis, theory of function spaces), algebraic and differential geometry, mathematical physics, mathematical logic, complexity theory, combinatorics, set theory, numerical linear algebra, topology (general and algebraic), optimization and control, and didactics of mathematics.

### 2.2 Departments

#### Evolution Differential Equations

The scope of this section covers qualitative aspects of the theory of partial differential equations in mechanics and thermodynamics of continuum, in biology and in other sciences. The research aims at verification of correctness of mathematical models and of the possibility to provide theoretical predictions of future development of a system without the full knowledge of the initial state. The work focuses on investigation of equations describing fluid flow including heat exchange and interaction with solid bodies. Attention is paid also to processes in solid matters focusing on mathematical modelling of memory in multifunctional materials, to dynamical behaviour of bodies in a contact with an underlay, and to phase transitions. Several members cooperate with the Branch in Brno investigating the integration theory and ordinary differential equations. Members of the department are involved in the Jindřich Nečas Centre for Mathematical Modeling (<http://ncmm.karlin.mff.cuni.cz/>) and in the network for industrial mathematics EU-MATHS-IN.CZ (<http://www.eu-maths-in.cz/>), part of the European network EU-MATHS-IN (<http://eu-maths-in.eu/>). E. Feireisl is the principal investigator of the prestigious ERC Advanced Grant Mathematical Thermodynamics of Fluids ([MATHEF](#)) devoted to development of mathematical theory of thermodynamics of compressible viscous fluids.

#### Mathematical Logic and Theoretical Computer Science

The research programme of this section is connected with the questions of information processing. The main topic is the theory of computational complexity which is used for classification of algorithmic problems and plays important role also in coding and electronic communication security. Further important research fields concern general questions of logical foundations of numbers and set theory, combinatorics and matrix theory. Members of the department are involved under leadership of P. Pudlák in the prestigious ERC Advanced Grant Feasibility, Logic and Randomness in computational complexity ([FEALORA](#)) devoted to study of basic open problems in computational complexity, such as the P versus NP problem. They also represent the Institute in the centre DIMATIA (<http://dimatia.mff.cuni.cz/>) and the research centre Institute of theoretical informatics (<http://iti.mff.cuni.cz/>).

#### Topology and Functional Analysis

Theoretical concept of infinite dimensional analysis and geometry developed in functional analysis and topology is suitable for description of systems with extremely large number state variables. Members of this department focus on fundamental questions of the structure of mathematical objects in spaces created by abstraction of notion originally defined to describe natural processes. This enables discovering hidden connections between individual elements of the system and helps to

design methods for solution of particular problems in applied mathematics. The research topics concern operator theory, theory of Banach spaces and function spaces, harmonic analysis and thermodynamics of continuum. Members of the department participate in the international project Asymptotics of operator semigroups ([AOS](#)).

### **Constructive Methods of Mathematical Analysis**

The department continues the long tradition of investigation and use of numerical methods established in the Institute by the world leading specialist Prof. Ivo Babuška. The importance of such methods is growing with the development of computational and experimental technique. Mathematical modelling of complex physical processes involving immense amount of data requires new methods of communication with computers, namely for optimal employment of their ever growing capacity, and for increasing speed and controlling rigour of computation by means of superconvergence and a posteriori error estimates. The main topic concerns analysis and optimization of the finite element method for solving partial differential equations describing physical processes in solid matters and fluids. Members of the department are involved in the network for industrial mathematics EU-MATHS-IN.CZ (<http://www.eu-maths-in.cz/>), part of the European network EU-MATHS-IN (<http://eu-maths-in.eu/>).

### **Algebra, Geometry and Mathematical Physics**

The department was formed in 2014 from researchers interested in algebraic and differential geometry and on closely related areas of mathematical physics. The research is focused on mathematical aspects of modern theoretical models of physics of microcosmos and cosmology related to logical correctness of physical hypotheses and mathematical models aiming at understanding the nature of matter and space. Research topics include the representation theory and their applications to algebraic geometry and theory of Einstein equations, homological algebra, algebraic topology, applied theory of categories, tensors classification, and generalized theory of gravitation. Members of the department are involved in two excellence centres: Eduard Čech Institute for Algebra, Geometry and Physics (<http://eci.math.muni.cz/>) and Albert Einstein Centre for Gravitation and Astrophysics (<http://www.albert-einstein-center.cz/>).

### **Branch in Brno**

The core research performed in this section in collaboration with several members of the Department of Evolution Differential Equations concerns qualitative properties of ordinary and functional differential equations. Such equations describing development of finite dimensional systems find important applications in biology and physics. The theoretical study of their solutions would help discovering mathematical causalities in real systems including singularities in time and space variables and in discontinuous processes which are modelled by means of the Kurzweil-Henstock integral as well as in terms of equations on time scales. Another important topic is studying methods of optimal control of complex processes.

### **Didactics of Mathematics**

This very small group represents a particular long-lasting research direction in the Institute, which has been gradually transferred to the Charles University. It is devoted to theoretical and practical aspects of didactics of mathematics, professionalism of teachers, providing a useful linkage to schools. The members cooperate with specialized groups at universities in the Czech Republic and abroad in theoretical and practical aspects of didactics of mathematics, providing a useful linkage to primary schools.

## **2.3 Research centres**

The centre of excellence **Institute of Theoretical Informatics** (ITI, <http://iti.mff.cuni.cz/>) is a consortium established for a joint project of the Faculty of Mathematics and Physics of the Charles University in Prague, the Institute of Mathematics, the Institute of Computer Science CAS in Prague, the Faculty of Applied Sciences of the University of West Bohemia in Pilsen and the Faculty of Informatics of the Masaryk University in Brno, funded by the Ministry of Education, Youth and Sports in 2005–2011. Its activity is currently supported by a joint project supported by the Czech Science Foundation in 2012–2018. The principal aim of ITI is to promote research in theoretical computer science and related fields with emphasis on the work of young researchers. ITI will also provide temporary positions for postdocs and distinguished senior researchers.

**Jindřich Nečas Centre for Mathematical Modeling** (<http://ncmm.karlin.mff.cuni.cz/>) is a joint department of the Institute of Mathematics, the Faculty of Mathematics and Physics of the Charles University in Prague, and the Institute of Computer Science CAS. It was established in 2013 to continue the efforts of a joint project funded by the Ministry of Education, Youth and Sports in 2005–2011. Its general goal is to establish a strong research team in the field of mathematical properties of models in continuum mechanics and thermodynamics, developed by an intensive collaboration of important research groups at both institutions and their goal-directed collaboration with top experts from abroad. Organization of lecture courses and the everyday interaction with PhD students and undergraduate students aims at upbringing new generation of competent scientist and forming a basis for a strong and stable research team.

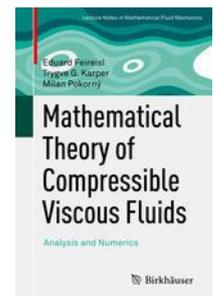
**DIMATIA – Centre for Discrete Mathematics, Theoretical Computer Science and Applications** (<http://dimatia.mff.cuni.cz/>) is a consortium of the Faculty of Mathematics and Physics of the Charles University in Prague, the Institute of Mathematics and the Institute of Chemical Technology in Prague. It was established in 1996 with the aim to foster research in all fields of discrete mathematics and its modern applications and relationship to computer science, operations research and fields as diverse as biology, chemistry and social sciences. The centre organizes a continuing programme of workshops, conferences and research visits, postdoctoral positions announced and jointly supported by the partners and short-term visits of senior researchers. DIMATIA created an extensive international network with 14 further research institutions.

## 2.4 Research output

In 2016, members of the Institute of Mathematics published total of 168 journal and proceedings papers, 2 monographs and 7 chapters in monographs. The following 7 results were selected to illustrate the output. The detailed information about all publications is available at Institute's web site <http://www.math.cas.cz/> in section Research > Publications.

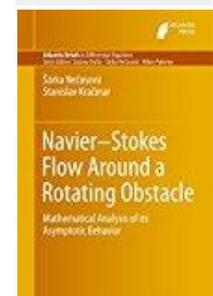
- [1] **E. Feireisl**, T. Karper, M. Pokorný: *Mathematical Theory of Compressible Viscous Fluids: Analysis and Numerics*, Birkhäuser-Verlag, Basel, 2016.

The book represents an introduction to the mathematical theory of compressible fluids. Its main goal is to present analytical methods from the point of view of their numerical applications. Starting with an introduction of the basic theoretical tools for investigating the Navier-Stokes equations, sequential stability, and construction of the implicit numerical scheme, the book presents in detail a synergy of analytical and numerical methods used in the mathematical theory of fluid mechanics.



- [2] **Š. Nečasová**, S. Kračmar: *Navier-Stokes Flow Around a Rotating Obstacle: Mathematical Analysis of its Asymptotic Behavior*, Atlantis Press, Paris, 2016.

The book provides a complex image as well as a detailed description of fundamental properties of the problem describing movement of an incompressible fluid along rotating solid bodies. It offers a new view of this topic by means of the potential theory. The fundamental solution of a stationary problem and a priori estimates for velocity field and its gradient are developed.



- [3] **D. Gavinsky**: *Entangled simultaneity versus classical interactivity in communication complexity*, in D. Wichs, Y. Mansour (eds.), STOC 2016 Proceedings of the 48th Annual ACM SIGACT Symposium on Theory of Computing, ACM, New York, 2016, 877–884.

In 1999, Ran Raz published an example of a communication problem which requires substantially more information to be solved by means of classical communication channels than by using the quantum communication. Gavinsky's result shows that the quantum communication is more efficient even if the communicating computers cannot interact and only send messages to the third party. This is so far the strongest proven separation of quantum and classical communications. The result has been published in the proceedings of the prestigious Symposium on the Theory of Computing.

- [4] **M. Douča**: *Metrically universal abelian groups*, Transactions of the American Mathematical Society 369 (2017), 5981–5998.

The author solves the long-standing open question of the Moscow school of topological groups whether there exists a separable metric abelian group that contains every separable metric

abelian group isometrically as a subgroup. The problem was formulated, e.g., in the paper On universal abelian topological groups, *Mat. Sb.* 190 (1999), no. 7, 127–144, by S. Shkarin.

- [5] **M. Engliš:** *High-power asymptotics of some weighted harmonic Bergman kernels*, *Journal of Functional Analysis* 271 (5), 2016, 1243–1261.

For weight functions either radial on a unit ball or dependent only on vertical coordinates in a halfspace, a description of asymptotics of the corresponding harmonic reproducing kernels was obtained for high powers of weights. The description is similar to the nowadays classical case of holomorphic reproducing kernels which is the basis for the theory of Berezin-Toeplitz quantization and is important also in complex geometry. It is the first general result of this type for spaces different from spaces of holomorphic functions. The proof requires completely new methods.

- [6] **M. Křížek, L. Somer:** *Excessive extrapolations in cosmology*, *Gravitation and Cosmology* 22 (3), 2016, 270–280.

The current standard cosmological model is based on a normalized Friedmann nonlinear ordinary differential equation. The authors showed that the Friedmann equation was derived by means of problematic extrapolations from Einstein's partial differential equations which are not scale invariant and are verified on much smaller scales. The observable Cosmos is however by at least 15 orders of magnitude larger than the astronomical unit. The authors explain why such extrapolation are incorrect and why the dark matter has been postulated only based on definition.

- [7] **A. Lomtatidze:** *Theorems on differential inequalities and periodic boundary value problem for second-order ordinary differential equations*, *Memoirs on Differential Equations and Mathematical Physics* 67 (1), 2016, 1–129.

Efficient criteria for solvability of a periodic problem for nonlinear differential equations of the second order are derived in case that the nonlinearity satisfies the local Carathéodory conditions, i.e., with a possible singularity in the phase variable in the origin. At first, a technique of differential inequalities is developed and the existence and uniqueness of a positive solution to the periodic problem for linear equations is solved. Then a thorough application of the developed technique allows to obtain efficient sufficient, and in many cases also necessary, conditions for solvability of the nonlinear problem. The extensive paper provides a comprehensive view of the topic.

## 2.5 Projects

- 2 ERC Advanced Grants, 7th Framework Programme, SP2–Ideas
- 320078 MATHEF (2013–2018, E. Feireisl)
  - 339691 FEALORA (2014–2018, P. Pudlák)
- 1 project, 7th Framework Programme, Marie Curie Actions – People – Intra-European Fellowships,
- 628974 PaECiDM (2014–2016, J. Hladký)
- 1 project, 7th Framework Programme, Marie Curie Actions – People – International Research Staff Exchange Scheme
- PIRSES-GA-2012-318910 Asymptotics of Operator Semigroups (2012–2016, V. Müller)
- 15 standard grant projects funded by the Czech Science Foundation
- 16-03230S Thermodynamically consistent models for fluid flows: mathematical theory and numerical solution (2016–2018, Š. Nečasová)
  - 16-07378S Nonlinear analysis in Banach spaces (2016–2018, P. Hájek)
  - P103-15-02532S Modular and decentralized control of discrete-event and hybrid systems with communication (2015–2017, J. Komenda)
  - P201-15-12227S Analysis of mathematical models of multifunctional materials with hysteresis (2015–2017, P. Krejčí)
  - P407-14-01417S Enhancing mathematics content knowledge of future primary teachers via inquiry based education (2014–2016, M. Tichá)
  - P201-14-06958S Singularities and impulses in boundary value problems for nonlinear ordinary differential equations (2014–2016, M. Tvrdý)
  - P201-13-14743S Function spaces, weighted inequalities and interpolation II (2013–2017, A. Gogatishvili)
  - P101-14-02067S Advanced methods for flow-field analysis (2014–2016, J. Šístek)

- P201-14-07880S Methods of function theory and Banach algebras in operator theory V (2014–2016, V. Müller)
  - 201/12/290 Topological and geometrical properties of Banach spaces and operator algebras (2012–2016, M. Fabian)
  - P203-13-10042S Higher dimensional gravity (2013–2017, V. Pravda)
  - P201-13-00522S Qualitative analysis and numerical solution of problems of flows in generally time-dependent domains with various boundary conditions (2013–2016, E. Feireisl)
- 2 international projects evaluated on the basis of the Lead Agency principle funded by the Czech Science Foundation
- 16-34860L / I2374-N35 Logic and Topology in Banach spaces (2016–2018, W. Kubiś)
  - I 1921-N25/GF15-34700L The continuum, forcing and large cardinals (2015–2017, D. Chodounský)
- 2 projects for support of excellence funded by the Czech Science Foundation
- P203-14-37086G Albert Einstein Center for Gravitation and Astrophysics (2014–2018, V. Pravda)
  - P202/12/G061 Centre of Excellence – Institute for Theoretical Computer Science (CE-ITI) (2012–2018, P. Pudlák)
- 2 project in the MOBILITY programme Ministry of Education, Youth and Sports
- 7AMB15ATXXX Topics in set theory: Traces of large cardinals, variants of Hechler's theorem, and ultrafilters on countable sets (2015–2016, D. Chodounský)
  - 7AMB16AT035 Performance and thermodynamic aspects of incrementally non-linear constitutive equations of the rate type (2016–2017, P. Krejčí)
- 3 joint projects, Shota Rustaveli National Science Foundation, Georgia
- 1 joint project, Australian Research Council Discovery Projects Programme
- 1 joint project, National Research Centre, Poland
- 1 joint project, research cooperation between the Czech and the Hungarian Academies of Sciences
- 1 joint project, research cooperation between the Czech and the Bulgarian Academies of Sciences
- 1 joint project, research cooperation between the Czech Academy of Sciences and the DAAD, Germany

A detailed information on the projects is available at the Institute's web site <http://www.math.cas.cz/> in section Research > Grants.

## 2.6 International conferences and workshops organized by the Institute

Program on Higher Structures in Geometry and Physics, Max Planck Institute for Mathematics, Bonn, Germany, 1 January – 31 March 2016, In cooperation with the Max Planck Institute, Bonn, Germany. <https://www.mpim-bonn.mpg.de/node/5883>

36th Winter School "Geometry and Physics", Srní, Czech Republic, 16–23 January 2016. <http://www.math.muni.cz/~srni/>

Winter School in Abstract Analysis, section Set Theory and Topology, Hejnice, Czech Republic, 30 January – 6 February 2016. <http://www.winterschool.eu>

Czech-Georgian Workshop on Boundary Value Problems 2016, Brno, Czech Republic, 8–11 February 2016. <http://users.math.cas.cz/~sremr/wbvp2016/main.php>

Workshop on Ordinary Differential Equations to honour 90th birthday of Prof. J. Kurzweil, Praha, Czech Republic, 12–13 May 2016. <http://users.math.cas.cz/tvrdy/seminar.html>

Function Spaces, Differential Operators and Nonlinear Analysis – FSDONA 2016, Praha, Czech Republic, 4–9 July 2016, <http://fsdona.karlin.mff.cuni.cz/>

EVEQ 2016, Praha, Czech Republic, 11–15 July 2016. <http://eveq.karlin.mff.cuni.cz/>

Prague School on Discrete Mathematics 2016, Praha, Czech Republic, 1–5 August 2016. <http://iuuk.mff.cuni.cz/events/conferences/pssdm/>

Twelfth Symposium on General Topology and its Relations to Modern Analysis and Algebra, TOPOSYM 2016, Praha, Czech Republic, 25–29 July 2016. <http://www.toposym.cz>

Fluids under Pressure, Praha, Czech Republic, 29 August – 2 September 2016. <http://www.praque-sum.com/>

Cosmology on Small Scales 2016. Local Hubble Expansion and Selected Controversies in Cosmology, Praha, Czech Republic, 21–24 September 2016. <http://www.CSS2016.math.cas.cz>

The first China-Czech workshop in fluid mechanics, Beijing, China, 26–30 September 2016. <http://www.iapcm.ac.cn/ccmfm2016/>

Interactions between Algebra and Functional Analysis, Praha, Czech Republic, 28 September – 2 October 2016. <http://users.math.cas.cz/~kubis/2016/09MiniWorkshop/>

Prague–Vienna Set Theory Workshop 2016, Praha, Czech Republic, 17–19 October 2016. <http://users.math.cas.cz/~chodounsky/workshop>

Sixth Czech-Israeli Workshop on Functional Differential Equations, Brno, Czech Republic, 17–20 October 2016. <http://czil.math.cas.cz/2016/>

## 2.7 International collaboration

The extensive international collaboration in 2015 is documented by the following facts:

- 56 visitors to the Institute
- 255 working trips abroad
- 14 international conferences and meetings organized or co-organized by the Institute
- 59 memberships in editorial boards of international scholarly journals

The Institute is a corporate member of the following organizations:

- The Union of Czech Mathematicians and Physicists
- The European Mathematical Society
- ERCOM (European Research Centres on Mathematics)
- European Digital Mathematics Library Initiative
- EU-MATHS-IN (European Service Network of Mathematics For Industry and Innovation) – through the national network EU-MATHS-IN.CZ

## 2.8 Cooperation with universities in education

Members of the Institute held a number of courses for students at Czech and foreign universities, supervised 4 Master theses and 36 PhD students. The Institute is accredited for 10 PhD programmes jointly with the Charles University in Prague and the University of West Bohemia in Pilsen.

### PhD students trained in the Institute in cooperation with the universities:

Matteo Caggio, University of West Bohemia, supervisor Š. Nečasová

Martin Fencl, University of West Bohemia, supervisor M. Kučera

Jan Grebík, Charles University, supervisor D. Chodounský

Martin Hanek, Czech Technical University, supervisor J. Šístek

Umi Mahnuna Hanung, University of Amsterdam, supervisor M. Tvrđý

Anna Horská, Charles University, supervisor P. Pudlák

Radim Hošek, University of West Bohemia, supervisor E. Feireisl

Rahele Jalali Keshavarz, Charles University, supervisor P. Pudlák

Jitka Jandová, Masaryk University, supervisor B. Půža

Marek Kobera, Charles University, supervisor Š. Nečasová

Jan Kubíček, Charles University, supervisor A. Pravdová

Martin Kuchynka, Charles University, supervisor A. Pravdová

Miroslava Maračková, Masaryk University, supervisor B. Půža

Martin Michálek, Charles University, supervisor E. Feireisl

Sinan Narin, Universität Trier, supervisor J. Kąkol

Josef Navrátil, Czech Technical University, supervisor M. Kučera

Matěj Novotný, Czech Technical University, supervisor P. Hájek

Václav Olešovský, Technical University in Brno, supervisor B. Půža

Jiří Příbyl, Charles University, supervisor F. Roubíček

Vita Pylypenko, Masaryk University, supervisor A. Rontó

Jan Reiss, Masaryk University, supervisor B. Půža

Tomasso Russo, Università degli Studi di Milano, supervisor P. Hájek

Vojtěch Růžička, Masaryk University, supervisor P. Řehák

Vojtěch Rybář, Charles University, supervisor T. Vejchodský

Nino Samashvili, I. Javakhishvili Tbilisi State University, supervisor A. Gogatishvili

Vincent Schlegel, Universität Zürich, supervisor U. Schreiber  
 Amirhossein Akbar Tabatabai, Charles University, supervisor P. Pudlák  
 Tomáš Tintěra, Charles University, supervisor V. Pravda  
 Claudia Viscardi, Università degli Studi di Milano, supervisor W. Kubiś  
 Marta Walczynska, Uniwersytet Śląski w Katowicach, supervisor W. Kubiś  
 Felix Wellen, Universität Karlsruhe, supervisor U. Schreiber

## 2.9 Awards

**Marián Fabian:** Bernard Bolzano Honorary Medal for Merit in Mathematical Sciences, awarded by the Czech Academy of Sciences  
**Jan Hladký:** Otto Wichterle Premium for Young Researchers, awarded by the Czech Academy of Sciences  
**Emil Jeřábek:** The Neuron Award for Promising Young Scientists, awarded by the Neuron Fund for Support of Science  
**Vladimír Müller:** Bernard Bolzano Honorary Medal for Merit in Mathematical Sciences, awarded by the Czech Academy of Sciences  
**František Neuman:** Award for Achievements in Science, awarded by the Council of the Southmoravian Region  
**Jiří Vanžura:** Silver Medal of the Faculty of Mathematics, Physics and Computer Science of the Comenius University in Bratislava

## 2.10 Further activities

in September 2016, in frames of the joint research programme *Prospects and dangers of the digital age* in the **Strategy AV21** of the Czech Academy of Sciences, the Institute organized an international interdisciplinary workshop *Two Applications of Mathematics in Practice*.

The thirteenth prestigious annual **Eduard Čech Lecture** devoted to the memory of the eminent Czech mathematician and founder of the Institute was delivered on 7 December 2016 by Jiří Outrata (Institute of Information Theory and Automation of the CAS, Prague) on *Variational tools in analysis of multifunctions*.

	<p>Matematický ústav AV ČR zve všechny zájemce na přednášku</p> <p><b>Variational tools in analysis of multifunctions</b> kterou prosloví <b>doc. Ing. Jiří Outrata, DrSc.</b> Ústav teorie informace a automatizace AV ČR v Praze</p> <p>ve středu 7. prosince 2016 v 10:30 hod. ve velké posluchárně Matematického ústavu AV ČR, Žitná 25, Praha 1.</p>	<p><b>Variational tools in analysis of multifunctions</b></p> <p>Local analysis of various types of Lipschitzian stability of multifunctions is one of the central topics in modern variational analysis. The obtained results have numerous applications in <i>post optimal analysis</i> of solutions to parameterized equilibrium problems, in the treatment of the so called equilibrium constraints, and also in the <i>generalized differential calculus</i>.</p> <p>Our main attention will be concentrated on the verification of two distinguished Lipschitzian stability properties, namely, the existence of a single-valued Lipschitzian localization and the Aubin (Lipschitz-like) property. To this aim, the basic generalized derivatives will be introduced and some first- and second-order rules of the generalized differential calculus will be presented. This background enables us to derive workable criteria for the mentioned stability properties which are applicable, e.g., in multifunctional extensions of the classical implicit function theorem. In turn, these results create a theoretical basis for the so-called <i>implicit programming approach</i>, which is an efficient technique for the treatment of a fairly broad class of optimization problems with parameterized equilibria among the constraints. The lecture will end up with a refinement of the derived condition, guaranteeing the Aubin property of implicit multifunctions. To this purpose, we employ the recently defined <i>directional limiting coderivatives</i> which allows a fine analysis of the investigated multifunctions <i>along specified directions</i>.</p>
	<p><b>Matematický ústav AV ČR</b> Akademie věd ČR</p> <p>Jde o třináctou přednášku konanou v rámci cyklu reprezentačních přednášek organizovaných na počest <b>prof. Eduarda Čecha,</b> jednoho z nejvýznamnějších českých matematiků novodobé historie a zakladatele Matematického ústavu AV ČR.</p>	
	<p>Jiří Rákosník, ředitel</p>	

The Institute organized traditional **Open Houses** as part of the scientific festival Week of Science and Technology. During three days in November, more than 1350 high-school students and other interested people visited 40 lectures and workshops in the Institute.

The Institute continued in providing professional and financial support to the **Mathematical Olympiad**, particularly in preparation of the national representatives to the International Mathematical Olympiad.

## 3 Economic management

### 3.1 Assets

The Institute owns the estate, parcel no. 2120, and the building, house no. 609/25, on that land. Total area of residential and non-residential premises is 1 551 square metres. Part of the ground floor in the front building of 62,4 square metres is leased for commercial purpose, 3 rooms and 1 storeroom of total area 40 square metres are leased for non-commercial purpose to the Union of Czech Mathematicians and Physicists. In the rear building there are 5 flats leased mostly to employees of the Institute. All other spaces in both buildings (1 070 square metres in total) are used for the purpose of the Institute.

The book value of the compound to the day of 31 December 2016 was 42 511 thousand CZK, its remaining book value was 22 626 thousand CZK.

Further tangible fixed assets is formed mostly by devices and IT equipment with the book value to the date 31 December 2016 10 096 thousand CZK, remaining book value was 1 609 thousand CZK.

### 3.2 Expenses and revenues

#### Principal entries (in thousands of CZK)

<b>Total expenses</b>	<b>79,681</b>
Purchases of materials	1,540
Electricity	320
Gas	484
Maintenance and reconstructions	861
Travel expenses	5,285
Other services	4,101
Personal expenses	60,621
Other expenses (including grant overheads)	5,408
Depreciation	1,061
<b>Total revenues</b>	<b>79,681</b>
Sales of periodicals	2,018
Other revenues	3,784
Institutional subsidies from the Czech Academy of Sciences	47,066
Grants	26,813
<b>Earnings before taxes</b>	<b>0</b>

The total revenues compared to the previous year, increased by 7%. This was due to institutional subsidies from the Czech Academy of Sciences (raised by 4% reflecting the very good preliminary results of the evaluation), and especially to funds for research projects (funding from the Czech Sciences Foundation increased by 35%, funding from the European projects increased by 12%).

### 3.3 Personnel and salaries

The average number of employees amounted to 76 FTE (annual decrease of 1%).

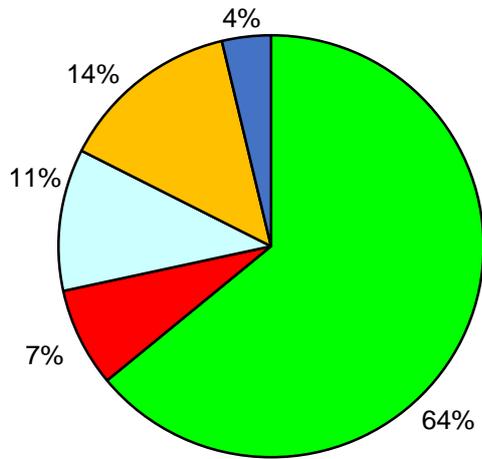
The personal expenses including statutory levies made 60,621 thousand CZK, representing 76% of total operating expenses.

The average monthly salary from all resources – institutional, project and commercial – was 48,433 CZK (annual increase of 5.3%).

In line with the general approach of the Czech Academy of Sciences, research staff in the Institute is employed on fixed-term contracts. The research staff is recruited in open competitions advertised at the Institute's web site and at the job server of the European Mathematical Society. Applicants are directed to the web site with detailed information and to the specialised web system for submitting applications and reference letters (<https://application.math.cas.cz/Positions.html>). The system

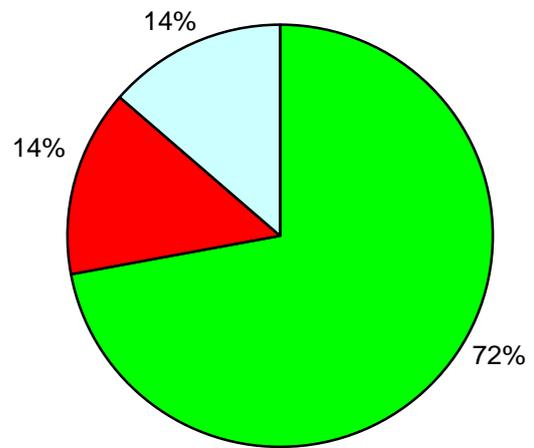
enables a preliminary remote discussion of the heads of departments and of the selection committee members and facilitates the subsequent assessment of applications. During 2016, 6 positions (2 researchers, 3 postdocs, and 1 PhD student) were filled in this way.

**Employee structure**



- Researcher
- PhD student
- Other specialist with university degree
- Technical and office staff
- Worker

**Resources of salaries**



- Institutional subsidies
- Domestic projects
- Foreign projects