



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 2015**

### **English summary**

The Annual report was discussed by the Supervisory Board of the Institute on 30 May 2016 and approved by the Board of the Institute on 29 June 2016.

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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 Tvrký, 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)

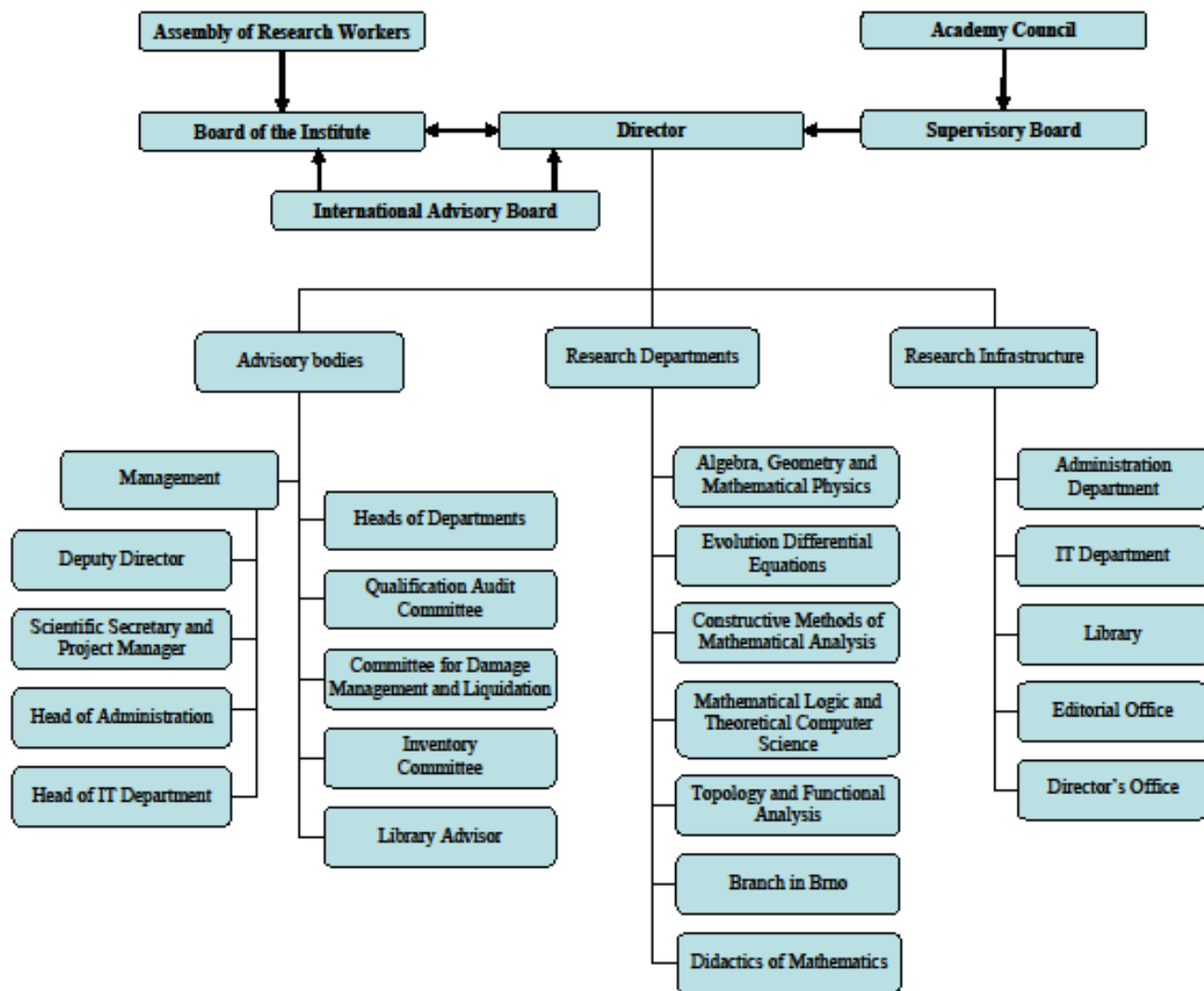
The director of the Institute cooperated with the Board of the Institute and relied on an informal advisory board formed by the chair of the Board Martin Markl, deputy director Milan Tvrký (till 31 July 2015) and Tomáš Vejchodský (since 1 August 2015), the scientific secretary and project manager Beata Kubiš, head of the Administration Department Růžena Roháčková and head of the IT Department Martin Jarník.

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

- proposal of the Premium Academiae for Vladimír Müller and of Otto Wichterle Premium for Ondřej Kreml
- selection of candidates for the postdoctoral positions in the Academy's programme supporting prospective human resources and in the ERC Advanced Grant MATHEF
- the annual report on activities and economic management in 2015 and auditor's reports on financial statements
- budget of the Institute for 2015
- rules for further employment postdocs: the contract of postdocs with very good results in whom the corresponding department is interested can be extended by one year on the basis of a regular evaluation, while for further extension of the contract they have to take part in an open competition for a position in the corresponding department
- 9 candidates to the International Advisory Board of the Institute

The Supervisory Board held three meetings, one of them remotely. The topics they dealt with included approval of two lease agreements for flats in the Institute's building and name the auditor for financial statements.

## 1.3 Structure

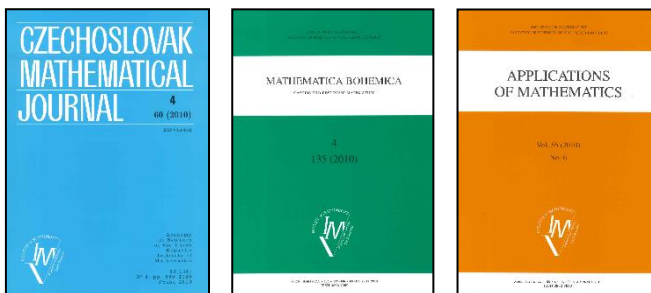


Didactics of Mathematics is a very small group (less than 1 FTE) which, however, plays an important role in providing an expert connection between the institute on the one side and institutions educating teachers of mathematics and teachers themselves on the other side.

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), mathematical physics, mathematical logic, complexity theory, combinatorics, set theory, numerical linear algebra, topology (general and algebraic), optimization and control, differential geometry, and didactics of mathematics.

### 2.2 Departments

#### Evolution Differential Equations

The scope of this section covers qualitative aspects of 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 Institute of Computer Science CAS 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.

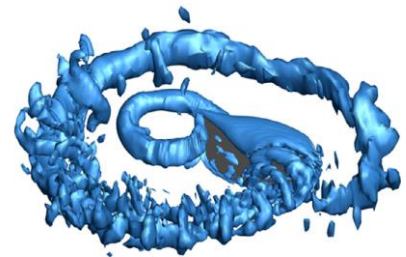
**DIMATIA – Centre for Discrete Mathematics, Theoretical Computer Science and Applications** (<http://dimatia.mff.cuni.cz/>) is a consortium of the Faculty of Mathematics and Physics of the Charles University in Prague, the Institute of Mathematics and the Institute of Chemical Technology in Prague established 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 researches. DIMATIA created an extensive international network with 14 further research institutions.

## 2.4 Research output

In 2015, members of the Institute of Mathematics published total of 169 journal and proceedings papers, 2 monographs and 7 chapters in monographs. The following seven 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. Chiodaroli, C. De Lellis, **O. Kreml**: *Global ill-posedness of the isentropic system of gas dynamics*. Comm. Pure Appl. Math. 68 (7), 2015, 1157–1190.  
The authors prove that entropy admissible weak solutions to the compressible Euler equations in multiple space dimensions are globally nonunique even for Lipschitz initial data. This result therefore disproves the conjecture that the entropy inequality implies the uniqueness of weak solutions which holds in one space dimension.
- [2] M. Cúth, **M. Fabian**, *Asplund spaces characterized by rich families and separable reduction of Fréchet subdifferentiability*. J. Funct. Anal. 270 (4), 2016, 1361–1378.  
Asplund property of a Banach space  $X$  is characterized by the existence of a “rich” family in the product  $X \times X^*$  consisting of some carefully chosen separable subspaces. Having this, we get easily a projectional skeleton on  $X^*$ . Furthermore, a suitable shrinking of the family obtained leads to a further rich family, which helps to add a lot of precision and simplicity to separable reductions of Fréchet subdifferentials. In addition, we obtain “isometric” assertions which were not known under earlier reductions. This essentially simplifies the whole Fréchet subdifferential calculus so important in variational analysis.
- [3] M. Dosoudilová, **A. Lomtadze**, **J. Šremr**: *Oscillatory properties of solutions to certain two-dimensional systems of non-linear ordinary differential equations*. Nonlin. Anal. 120, 2015, 57–75.  
For the system of non-linear differential equations, new oscillation criteria are given. The results obtained substantially fill the gaps existing in the oscillation theory, e.g. as for the particular case of the system—so called “equation with the scalar  $q$ -Laplacian”—an analogue of the Hartman-Wintner theorem and some Hille and Nehari type oscillations criteria can be derived from the obtained results without the sign restriction on the coefficient.
- [4] B. Kaltenbacher, **P. Krejčí**: *A thermodynamically consistent phenomenological model for ferroelectric and ferroelastic hysteresis*. Z. Angew. Math. Mech., 18 pp., DOI: 10.1002/zamm.201400292  
A new model is proposed for electromechanical behaviour of specific multifunctional (e.g., piezoelectric) materials, where exchange between mechanical and electric energies is taken into account including hysteretic losses in the energy balance. The full system of balance equations is shown to admit a unique solution.

- [5] A. Lazarev, **M. Markl**: *Disconnected rational homotopy theory*. Adv. Math. 283, 2015, 303–361. M. Markl, building on his work of the 1990's, generalized, together with A. Lazarev (University of Leicester, UK), the classical rational homotopy theory of Sullivan based on commutative associative algebras, and of Quillen based on Lie algebras, to the case of disconnected spaces. A very important by-product is the homotopy invariance of solutions of the Maurer–Cartan equation in complete differential graded Lie algebras.
- [6] **J. Neustupa**: *A spectral criterion for stability of a steady viscous incompressible flow past an obstacle*. J. Math. Fluid Mech. 18 (1), 2016, 133–156.  
The paper shows that the question of stability of a steady incompressible Navier–Stokes flow in a 3D exterior domain is essentially a finite-dimensional problem. Although the associated linearized operator has an essential spectrum touching the imaginary axis, we show that certain assumptions on the eigenvalues of this operator guarantee the stability of the flow. This was an open problem for several decades. No assumption on the smallness of the steady flow is required.
- [7] **J. Šístek**, F. Cirak: *Parallel iterative solution of the incompressible Navier–Stokes equations with application to rotating wings*. Comput. & Fluids, 122, 2015, 165–183.  
We present an efficient method for solving unsteady incompressible flows in three dimensions on parallel supercomputers. An operator-splitting scheme leads to solving three convection-diffusion problems followed by a Poisson problem for pressure. The parallel implementation uses the PETSc library, and we present several algorithms for enhancing efficiency. We use this approach for solving flow around a revolving model of a wing of *Drosophila* by means of the finite element method. The efficiency of the algorithm is verified on up to 65 thousand cores of a parallel supercomputer, while 2 thousand cores were used for an actual computation of one revolution of the wing.



## 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)
- 12 standard grant projects funded by the Czech Science Foundation
  - 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)
  - I 1921-N25/GF15-34700L The continuum, forcing and large cardinals (2015–2017, D. Chodounský)
  - 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)
  - P201/11/0345 Nonlinear functional analysis (2011–2015, P. Hájek)
  - 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)
  - P203-14-37086G Albert Einstein Center for Gravitation and Astrophysics (2014–2018, V. Pravda)
- 1 project for support of excellence funded by the Czech Science Foundation
- P202/12/G061 Centre of Excellence – Institute for Theoretical Computer Science (CE-ITI) (2012–2018, P. Pudlák)
- 1 project in the KONTAKT II programme of the Ministry of Education, Youth and Sports
- LH13012 Multi-level supervisory control (2013–2015, J. Komenda)
- 1 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)
- 1 project of bilateral international cooperation with the University in Stavanger, Norway
- M100191201 Algebraic classification of tensors on Lorentzian manifolds and its applications (2012–2015, V. Pravda)
- 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

Czech-Georgian Workshop on Boundary Value Problems 2015, Brno, Czech Republic, 26–27 January 2015 <http://users.math.cas.cz/~sremr/wbvp2015/main.php>

Winter School in Abstract Analysis, section Set Theory and Topology, Hejnice, Czech Republic, 31 January – 7 February 2015, <http://www.winterschool.eu>

Spring School on Variational Analysis 2015, Paseky nad Jizerou, Czech Republic, 19–25 April 2015 <http://kma.karlin.mff.cuni.cz/ss/apr15/>

Mathematical Thermodynamics of Complex Fluids, CIME courses, Cetraro, Italy, 29 June – 3 July 2015, in cooperation with Università di Milano, Italy and WIAS Berlin, Germany

Applications of Mathematics 2015, Conference held on occasion of the 90th birthday of Ivo Babuška and 85th birthday of Milan Práger and Emil Vitásek, Praha, Czech Republic, 18–20 November 2015 <http://am2015.math.cas.cz>

Mathematics in practice: Potential and reality, Praha, Czech Republic, 9–11 December 2015 <http://www.mcsp.amca.cz>

## 2.7 International collaboration

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

- 55 visitors to the Institute
- 251 working trips abroad
- 4 international conferences and meetings organized by the Institute
- 59 memberships in editorial boards of international scholarly journals

The Institute is a corporate member of the following organizations:

- 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.

## 2.9 Awards

**Eduard Feireisl:** The Neuron Award for Contribution to Science, awarded by the Neuron Fund for Support of Science

**Petr Hájek:** Rector's Award for Prestigious Publication, awarded by the Rector of the Czech Technical University in Prague

**Ondřej Kreml:** Otto Wichterle Premium for Young Researchers, awarded by the Czech Academy of Sciences

**Martin Markl:** Distinguished Ordway Visitor of the University of Minnesota, Minneapolis, USA

**Vladimír Müller:** Medal of the Faculty of Environmental Engineering and Land Surveying, University of Agriculture, Kraków, Poland



**Milan Práger:** Honorary Medal of the Czech Mathematical Society

**Emil Vitásek:** Honorary Medal of the Czech Mathematical Society

## 2.10 Further activities

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, the Institute of Information Theory and Automation CAS and the Computer Science Institute CAS organized an international interdisciplinary workshop *Mathematics and Computer Science in Practice: Potential and Reality* in December 2015. Specialists from industry and from research institutions shared their experience with applications of mathematics and computer science in practice. The workshop included also a panel discussion on two topics: *Barriers between science and practice – reality or prejudice?* and *Which Mathematics and Computer Science should be taught at technical universities today in order to be applied tomorrow?*

The twelfth prestigious annual **Eduard Čech Lecture** devoted to the memory of the eminent Czech mathematician and founder of the Institute was delivered on 14 December 2015 by Camillo De Lellis from University of Zürich on *Regularity and singularity of area-minimizing surfaces*.

 Camillo De Lellis Eduard Čech	<p>Matematický ústav AV ČR zve všechny zájemce na přednášku</p> <p><b>Regularity and singularity of area-minimizing surfaces</b></p> <p>kteřou prosloví <b>Professor Camillo De Lellis</b> Universität Zürich</p> <p>v pondělí 14. prosince 2015 v 10:30 hod. ve velké posluchárně Matematického ústavu AV ČR, Žitná 25, Praha 1.</p>  <p>Jde o dvanáctou přednášku konanou v rámci cyklu reprezentančních 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>	<p><b>Regularity and singularity of area-minimizing surfaces</b></p> <p>The Plateau's problem, named after the Belgian physicist J. Plateau, is a classic in the calculus of variations and regards minimizing the area among all surfaces spanning a given contour. Although Plateau's original concern were 2-dimensional surfaces in the 3-dimensional space, generations of mathematicians have considered such problem in its generality. A successful existence theory, that of integral currents, was developed by De Giorgi in the case of hypersurfaces in the fifties and by Federer and Fleming in the general case in the sixties. When dealing with hypersurfaces, the minimizers found in this way are rather regular: the corresponding regularity theory has been the achievement of several mathematicians in the 60es, 70es and 80es (De Giorgi, Fleming, Almgren, Simons, Bombieri, Giusti, Simon among others).</p> <p>In codimension higher than one, a phenomenon which is absent for hypersurfaces, namely that of branching, causes very serious problems: a famous theorem of Wirtinger and Federer shows that any holomorphic subvariety in <math>\mathbb{C}^n</math> is indeed an area-minimizing current. A celebrated monograph of Almgren solved the issue at the beginning of the 80es, proving that the singular set of a general area-minimizing (integral) current has (real) codimension at least 2. However, his original (typewritten) manuscript was more than 1700 pages long. In a recent series of works with Emanuele Spadaro we have given a substantially shorter and simpler version of Almgren's theory, building upon large portions of his program but also bringing some new ideas from partial differential equations, metric analysis and metric geometry. In this talk I will try to give a feeling for the difficulties in the proof and how they can be overcome. Moreover I will touch some recent developments which go beyond Almgren's result.</p>
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The Institute organized traditional **Open Houses** as part of the scientific festival Week of Science and Technology. During three days in November, almost 1000 high-school students and other interested people visited 33 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.



## 2.11 Evaluation of the Institute

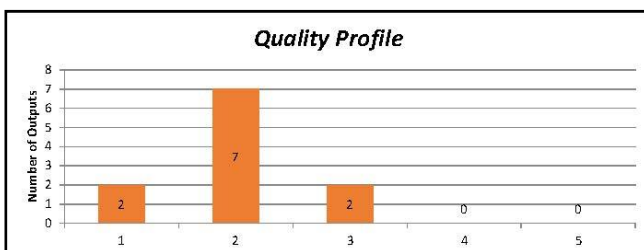
Evaluation of the Research and Professional Activities of the Institutes of the Czech Academy of Sciences for 2010–2014 was a highly significant activity in 2015.

The Institute registered six teams for the evaluation: Algebra, geometry and mathematical physics, Differential equations and theory of integral, Numerical analysis, Evolution differential equations, Topology and functional analysis, Logic and theoretical computer science – the first five of them in the field of mathematics and the last one in computer science.

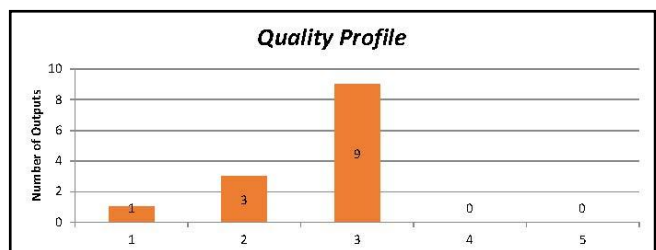
During the whole year, Jiří Rákosník together with the working group formed by the former director Pavel Krejčí, the head of the library Jarmila Štruncová, Beata Kubiš, Martin Markl and Milan Tvrđý and in cooperation with the heads of research teams were preparing materials for the evaluation including presentations of the Institute and its teams for the evaluation commissions.

In Phase I of the evaluation, foreign peers anonymously assessed the quality of limited number of selected research outputs and ranked them in five categories: *1 world-leading, 2 internationally excellent, 3 recognized internationally, 4 recognized nationally, 5 below the standard of nationally recognized work.*

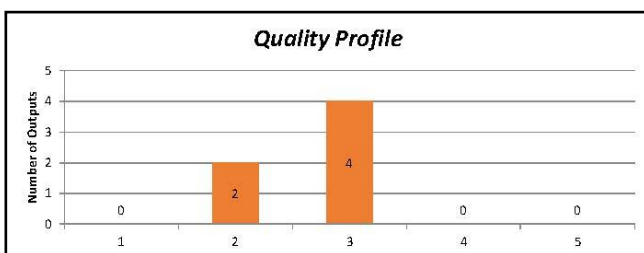
The following graphs resulting from Phase I confirm the overall high quality of all six teams in the Institute:



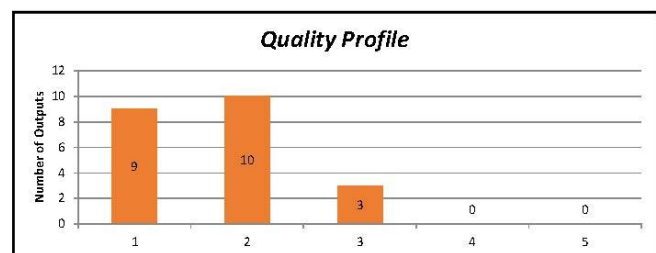
Algebra, geometry and mathematical physics



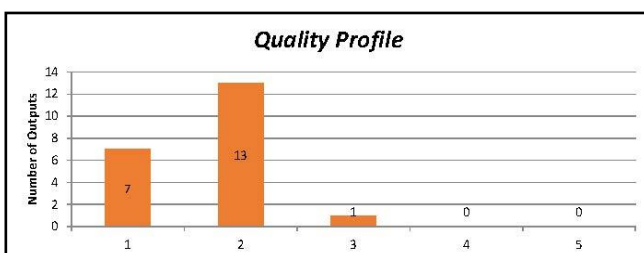
Differential equations and theory of integral



Numerical analysis



Evolution differential equation



Topology and functional analysis



Logic and theoretical computer science

In Phase II, using the outcomes from Phase I, all the materials submitted by the Institute, and presentations of the team leaders, the evaluation commissions assessed the individual teams and the Institute as a whole. The result for the Institute was very good. Inspiring comments and recommendations of the commissions will be used for fixing some deficiencies and further improvement of the research efficiency and quality.

All documents concerning the evaluation of the Institute are available in the freely accessed part of Intranet at

[https://intranet.math.cas.cz/index.php/Evaluation\\_of\\_the\\_Institutes\\_of\\_the\\_CAS\\_for\\_2010-2014](https://intranet.math.cas.cz/index.php/Evaluation_of_the_Institutes_of_the_CAS_for_2010-2014).

## 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 2015 was 42 441 thousand CZK, its remaining book value was 23 328 thousand CZK.

Further tangible fixed assets is formed mostly by devices and IT equipment with the book value to the date 31 December 2015 10 271 thousand CZK, remaining book value was 1 593 thousand CZK.

### 3.2 Expenses and revenues

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

<b>Total expenses</b>	<b>74,438</b>
Purchases of materials	1,635
Electricity	314
Gas	418
Maintenance and reconstructions	980
Travel expenses	3,828
Other services	3,047
Personal expenses	58,830
Other expenses (including grant overheads)	4,275
Depreciation	996
<b>Total revenues</b>	<b>74,438</b>
Sales of periodicals	2,044
Other revenues	4,004
Institutional subsidies from the Czech Academy of Sciences	45,347
Grants	22,449
<b>Earnings before taxes</b>	<b>0</b>

The total revenues compared to the previous year, increased by 10%. This was mainly due to institutional subsidies from the Czech Academy of Sciences (an annual increase of 3% compensated the loss of 2014 due to the government's budget reduction of the Academy's budget), and especially to funds for research projects (funding from the Czech Sciences Foundation increased by 10%, funding from the European projects increased by 23%).

### 3.3 Personnel and salaries

The average number of employees amounted to 77 FTE (annual increase of 4.1%).

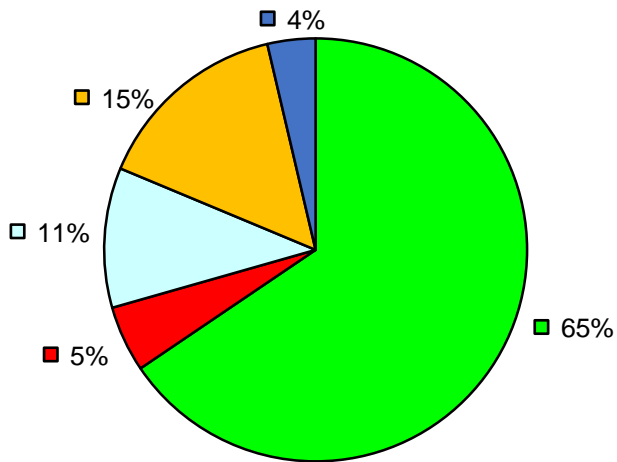
The personal expenses including statutory levies made 58,830 thousand CZK, representing 79% of total operating expenses.

The average monthly salary from all resources – institutional, project and commercial – was 46,010 CZK (annual increase of 7.3%).

In line with the general approach of the 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

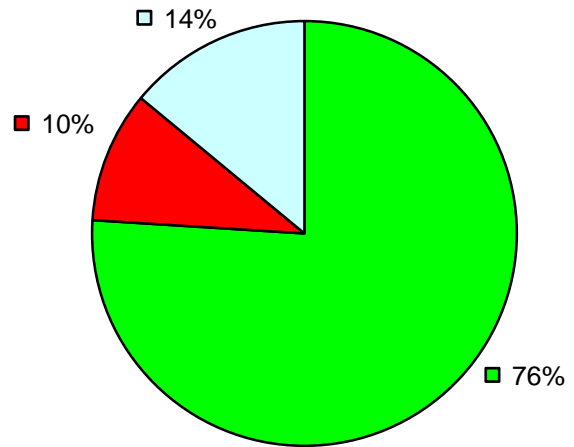
applications and reference letters (<https://application.math.cas.cz/Positions.html>). The system enables a preliminary remote discussion of the heads of departments and of the selection committee members and facilitates the subsequent assessment of applications. During 2015, 6 positions (2 researchers, 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