EQUADIFF 15

**History, Personalities,
Plenary and Invited Abstracts,
and Program**

Pavel Řehák, Roman Šimon Hilscher

Editors

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EQUADIFF 15

Conference on Differential Equations and Their Applications

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organized by

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Brno University of Technology (Faculty of Mechanical Engineering)
Czech Academy of Sciences (Institute of Mathematics)
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- the Institute of Mathematics of the Czech Academy of Sciences for help with the scientific program and with the proceedings,
- the Faculty of Economics and Administration of Masaryk University for providing the venue for the conference and for organizational support,
- the Accommodation and Catering Services of Masaryk University for their help with the organization and realization of the catering during the conference,
- the Botanical Garden of the Faculty of Science of Masaryk University for providing the flower decoration,

and to all people, academic and support employees, graduate and PhD students, who helped making Equadiff 15 to be a real conference. Finally, our special thanks belong to the members of the Scientific Committee of the conference for their hard work on nominations of plenary, invited, and keynote speakers.

Contents

Preface **9**

History of Equadiff **11**

Eastern Equadiffs in pictures **14**

Remembering outstanding Czech and Slovak mathematicians **21**
Pavol Brunovský 22
Jaroslav Kurzweil 25
František Neuman 29
Alexander Ženíšek 32

Abstracts of plenary and invited speakers **35**

Scientific program in details **49**
Scientific program in details — Monday 49
Scientific program in details — Tuesday 55
Scientific program in details — Wednesday 61
Scientific program in details — Thursday 65
Scientific program in details — Friday 71

Scientific program — tables **73**
Scientific program — tables — Monday 73
Scientific program — tables — Tuesday 77
Scientific program — tables — Wednesday 81
Scientific program — tables — Thursday 83
Scientific program — tables — Friday 87

List of participants **89**

Preface

Dear Colleagues, dear Friends of Differential Equations,

It is our pleasure to welcome you at Equadiff 15, the Conference on Differential Equations and Their Applications. The tradition of the Czechoslovak Equadiff dates back to 1962 when Equadiff 1 took place in Prague. Subsequent Czechoslovak Equadiff conferences were held periodically in Prague, Bratislava, and Brno. The Western Equadiff conferences were organized in various cities in Western Europe, starting in Marseille in 1970 and with the last meeting in Leiden in 2019. Equadiff is therefore one of the oldest active series of mathematical conferences in the world. The current Equadiff in Brno in summer 2022 is the 15th conference within the Czechoslovak Equadiff series, and hence it bears the name Equadiff 15. The conference was rescheduled to the year 2022 from the original date in July 2021 due to an unstable pandemic situation in the world. More information about the history of Equadiff is presented on page 11 of this booklet.

The Czechoslovak series of Equadiff conferences is closely tied with many distinguished mathematicians from the Czech Republic and Slovak Republic, or formerly from the Czechoslovakia. We wish to commemorate several of them, who deceased since the last Equadiff in Bratislava in 2017. Hence, in this booklet you find portraits of Professors Pavol Brunovský, Jaroslav Kurzweil, František Neuman, and Alexander Ženíšek.

The topics of the conference cover differential equations in a broad sense, including their theoretical aspects, numerical methods, and applications. The main goal of the conference is therefore to stimulate the cooperation among researchers in various branches in the theory and applications of differential equations and in related disciplines. In earlier time, say at least 25 years ago, Equadiff was a place for meeting the mathematicians from both sides of the iron curtain, i.e., the East and the West. There is a similar parallel to this at the current Equadiff, where mathematicians can meet in person after two years of isolation due to the covid world pandemic. We hope that you will enjoy this privilege to really see and meet your colleagues and friends, and not just to see their images on the computer screens.

The five-days scientific program of the conference consists of plenary lectures, invited lectures, minisymposia (including keynote lectures), contributed talks, and posters. Except of the plenary lectures, the program is divided into three parallel sessions:

- ordinary differential equations (ODE),
- partial differential equations (PDE),
- numerical analysis and applications (NAA).

The plenary speakers, invited speakers, and keynote speakers, who organize invited minisymposia, have been selected by the Scientific Committee of the conference. The list of registered participants (as of June 20, 2022) consists of

278 people from 37 countries from all over the world. In addition to the standard scientific program, we organize, in cooperation with the Committee for Applications and Interdisciplinary Relations of the European Mathematical Society, a presentation on funding opportunities in Mathematics and the ERC evaluation process, which will be delivered by the ERC Mathematics Panel coordinator Maria Gonzalez. The presentation will include contributions of the ERC grant holders Giovanni Alberti and Sylvie Méléard.

Following the tradition of the Czech-Slovak series of Equadiff conferences, the Equadiff 15 proceeding will be published in the journal Archivum Mathematicum (Brno) as a supplement of the 2022 volume. The editors of the proceedings are Zuzana Došlá, Jan Chleboun, Pavel Krejčí, Martin Kružík, Šárka Nečasová, and Roman Šimon Hilscher. The submitted papers will be peer-reviewed during the editorial procedure. All proceedings from the previous Equadiff 1–14 conferences are available via the Czech Digital Mathematics Library.

The social program of the conference includes a welcome reception in a beautiful place of the Augustinian Abbey Garden in Brno Mendel square, trips to various destinations of the Southern Moravia region, and a conference dinner in the Brewery house Poupě in Brno city center. The participants are offered to choose one of the following trips: Château Lednice (including tasting local products in a wine cellar), Pernštejn castle (including an excursion in the brewery Černá Hora), the Slav Epic exhibition in Moravský Krumlov (including an excursion in the brewery Dalešice), Villa Tugendhat and Brno underground, Špilberk castle and Brno underground.

In July 2022, the city of Brno celebrates the 200th anniversary of the birth of Gregor Johann Mendel (July 20, 1822), abbot and brilliant scientist, and father of genetics. During the welcome reception the participants of the conference have an opportunity to visit the Gregor Johann Mendel Museum.

The conference Equadiff 15 is organized by joint efforts of the following institutions:

- Masaryk University (Faculty of Science),
- Brno University of Technology (Faculty of Mechanical Engineering),
- Czech Academy of Sciences (Institute of Mathematics),
- The Union of Czech Mathematicians and Physicists (Brno branch).

The conference is held under the auspices of the dean of the Faculty of Science of Masaryk University, prof. Tomáš Kašparovský.

We hope that you will find the scientific program, as well as the social program, interesting and fruitful. We also trust that you will remember Brno as a place where Differential Equations have distinguished history and auspicious future.

Brno, June 21, 2022 Editors

History of Equadiff

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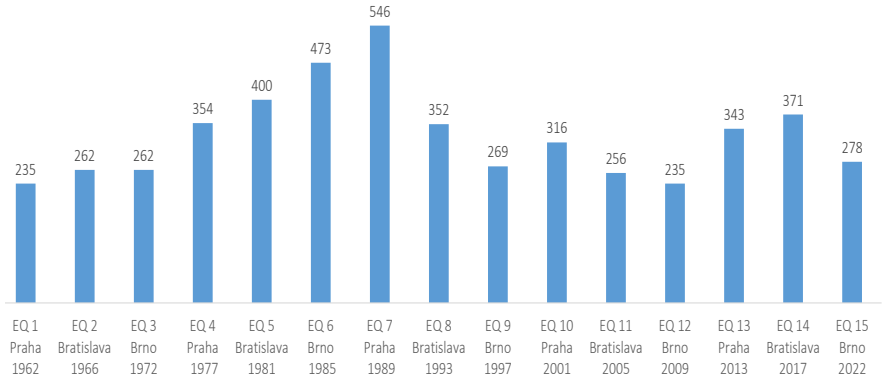
Equadiff is not just an abbreviation of the English words "differential equations", but also a European platform for the exchange of knowledge, ideas, and cooperation in various aspects of differential equations. Actually, this is the name of an international series conferences that have taken place and are still taking place across Europe. Equadiff conferences are unique international project with a long tradition. Even after sixty years of existence these conferences still bring to the mathematical field of differential equations not only new knowledge or ideas, but also significantly help international cooperation.

The first of the series of Equadiff conferences in Czechoslovakia took place in 1962 in Prague. About four years later it was followed by a conference under the same name in Bratislava. In 1969, a symposium focused on nonlinear differential equations was organized in Mons, Belgium, and in the same year an international congress on nonlinear oscillations was held in Kiev. Based on these two meetings, it took place in 1970 in Marseille the seminar "Semaine de discussions sur les équations différentielles et fonctionnelles non linéaires". This conference later entered history as the first of the Western European branches of the Equadiff conference series.

The year 1970 is also the year in which the third Equadiff conference was planned to take place in Brno. Most likely, however, the year 1968 and with it the occupation of Czechoslovakia by Soviet army intervened in the preparations, so the conference took place two years later, i.e., in 1972. At that time, preparations for another conference dedicated to differential equations culminated, which subsequently took place in 1973 in Brussels under the name Equa–Diff 73. Next in line is then again the Equadiff conference in 1977 in Prague and a year later the Equadiff conference in Florence.

From the previous list of conferences, we can see that two lines of conferences dealing with differential equations are forming. One of the lines includes the original conferences, which take place under the name Equadiff in Czechoslovakia and after its disintegration in the Czech Republic and the Slovak Republic (Prague, Bratislava, Brno). The second line consists of the conferences that take place all over Europe and gradually they also move to the name Equadiff. From the materials which are available to individual conferences, it can be concluded that in the period before the conference in Florence some agreements were reached and the name Equadiff was established as the European platform for knowledge exchange, ideas, and cooperation in practically all aspects of dif-

ferential equations. The mutual cooperation was attested also by the fact that between 1985 (conference in Brno) and 1987 (conference in Xanthi) there was the agreement reached on the regular alternation of the so-called Western European branch of conferences and Eastern European branch of conferences. Until then, the conferences in Czechoslovakia were held regularly every four years, which suggests that the Western European conferences program has probably been adjusted so that one international conference dedicated to differential equations is held in Europe every two years. As the the first one in the Western series of conferences is considered the symposium in Marseille from 1970. Individual conferences in both branches therefore take place independently of each other, but under the same designation. Of course, similar groups of mathematicians are involved in them. The names Western European branch and Eastern European branch of Equadiff conferences seem to come from the beginning of both series, and they actually no longer correspond to the reality. Indeed, the conference of the Western European series at first took place west of Czechoslovakia, but later spread throughout Europe. At present, therefore, this designation is most likely retained to distinguish both series. Conferences from individual branches also differ in the label. While the conferences from the Eastern European branch follow the number order (initially Roman numerals, later Arabic), the conferences from the Western European branch are marked by the year in which they take place.



Number of participants of Eastern Equadiff conferences

An important document from each conference is the proceedings. Interestingly, all the proceedings from the conferences of the Eastern European branch have been digitized and are available at `www.dml.cz`. On the contrary, the proceedings of the conferences of the Western European branch are not up to exceptions available publicly.

The following diagram provides an overview of the individual conferences of both branches of Equadiff. It is apparent that there was a kind of synchronization of the two separate series.

Eastern European branch	**Western European branch**
1962 Prague	
1966 Bratislava	
	1970 Marseille (France)
1972 Brno	
	1973 Brussels, Louvain-la-Neuve (Belgium)
1977 Prague	
	1978 Florence (Italy)
1981 Bratislava	
	1982 Würzburg (Germany)
1985 Brno	
	1987 Xanthi (Greece)
1989 Prague	
	1991 Barcelona (Spain)
1993 Bratislava	
	1995 Lisbon (Portugal)
1997 Brno	
	1999 Berlin (Germany)
2001 Prague	
	2003 Hasselt (Belgium)
2005 Bratislava	
	2007 Vienna (Austria)
2009 Brno	
	2011 Loughborough (United Kingdom)
2013 Prague	
	2015 Lyon (France)
2017 Bratislava	
	2019 Leiden (The Nederlands)
2022 Brno	

The next Equadiff conferences will be held in Karlstad (Sweden) in 2024 for the Western European branch and then in Prague in 2025 or 2026 for the Eastern European branch.

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Eastern Equadiffs in pictures

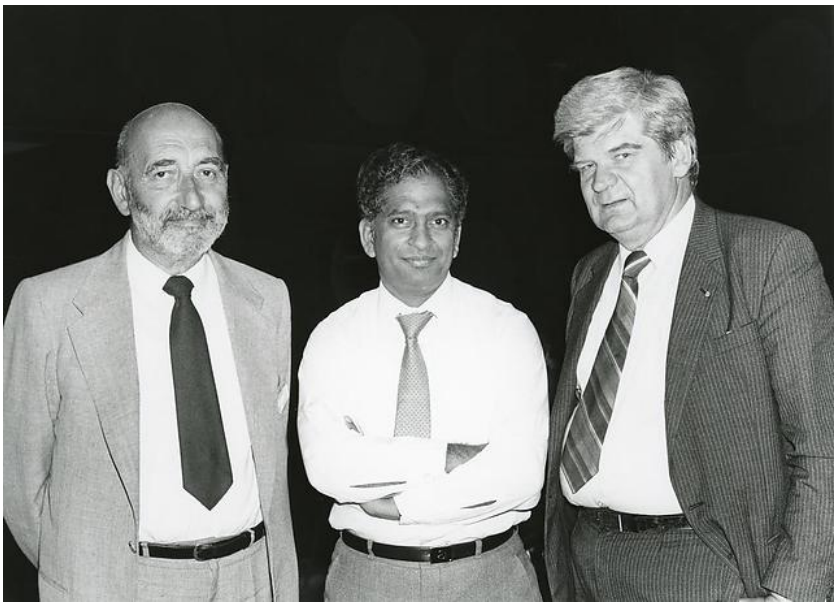
Photos by courtesy of Jan Franců, Milan Tvrdý, and the Digital Library of Photos (Masaryk University).

Farewell party, J. Vosmanský on the left, J. Mawhin in the middle, Equadiff III, Brno, 1972

P. Brunovský and others, Equadiff 5, Bratislava, 1981

E. A. Coddington, Equadiff 5, Bratislava, 1981

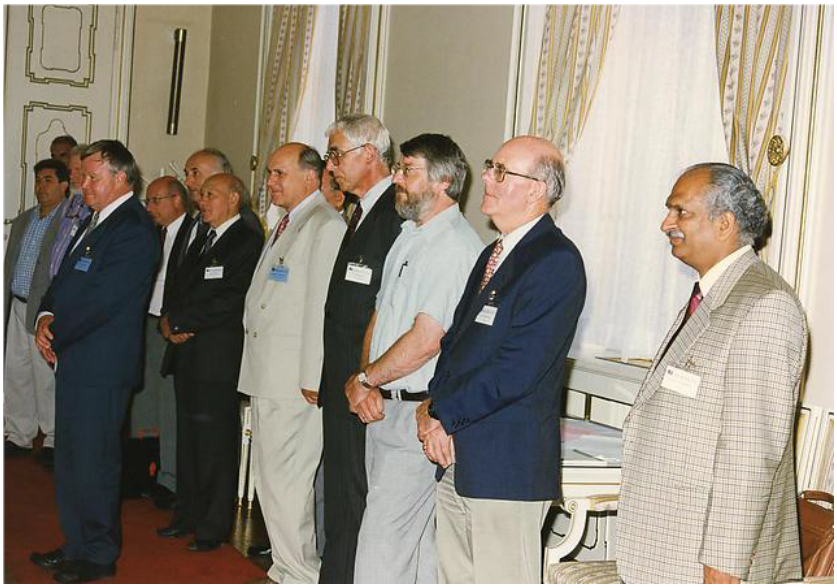
W. N. Everitt, F. N. Arscott, Equadiff 5, Bratislava, 1981



R. Conti, R. Agarwal, C. Olech, Equadiff 6, Brno, 1985

J. Kojecká, Z. Došlá, Equadiff 6, Brno, 1985

Visit to the city Brno Mayor, Equadiff 6, Brno, 1985



Visit to the city Brno Mayor, Equadiff 9, Brno, 1997

I. Babuška, Equadiff 10, Praha, 2001

P. Drábek, J. Milota, Equadiff 10, Praha, 2001

P. Brunovský on the left, Equadiff 10, Praha, 2001

J. Vosmanský and P. Brunovský on the left, Equadiff 10, Praha, 2001

Equadiff 12, Brno, 2009

O. Došlý, P. Krejčí, Equadiff 12, Brno, 2009

Remembering outstanding Czech and Slovak mathematicians

In the period since the last Equadiff 14 in Bratislava (2017), several outstanding personalities related to Czech and Slovak Equadiff passed away. In this section we wish to commemorate their contribution to Equadiff by presenting the portraits of Pavol Brunovský, Jaroslav Kurzweil, František Neuman, and Alexander Ženíšek.

Photos by courtesy of Jan Franců, Milan Tvrdý, and the Digital Library of Photos (Masaryk University).

Pavol Brunovský – his life and opus

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On December 12, 2018, Professor Pavel Brunovský, a world famous Slovak mathematician, passed away after a short but hard sickness. He was born on December 12, 1934 in Vienna. At the Comenius university, Bratislava, he studied mathematical analysis. After his studies, he started to work at the Institute of Theoretical Cybernetics of the Slovak Academy of Sciences (SAS) (1957–1970). The fathers-founders of this institute have realized very well that it is not possible to develop cybernetics without mathematics. A short but very deep trace in mathematics was done by him when he worked at the Mathematical Institute of SAS (1970–1974). Since 1974, his life and work were closely connected with the Faculty of Mathematics, Physics and Informatics of the Comenius university.

He defended the CSc degree (Candidate of Science = PhD) in 1964, he obtained the DrSc degree (Doctor of Science, the highest scientific degree in Czechoslovakia) in 1978, he defended his habilitation in 1990, and he became a full professor in 1991. Prof. Brunovský was one of the most important contemporary Slovak mathematicians whose importance crossed over our borders long time ago. During his life, he gained many highest estimations in Slovakia. He was an emeritus member of the Learned Society of SAS and an emeritus honorary member of the Learned Society of the Czech Republic.

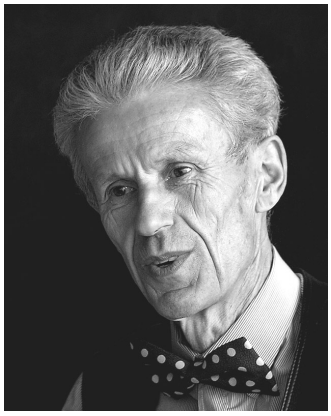

Photo by courtesy of Comenius University Bratislava

At the beginning of his scientific career, the main area of his interest was the theory and applications of optimal control. He gained a lot of very interesting and important results like regularity of synthesis of the optimal control, or a canonical form for linearly controlled systems, known nowadays as Brunovský's normal form (1970). Well-known are also his results on classifications of typical bifurcations of discrete dynamical systems (1971), regularity of optimal feedback systems (1976–1978), and attractor description of scalar reaction-diffusion equations (1985–1990). His name can be found on more than 100 top publications having hundreds of citations.

Later he was interested in the theory of dynamical systems. In particular, he obtained results in the theory of bifurcations of finite-dimensional dynamical systems and on chaotic dynamics of partial differential equations of the first order. In the eighties, he was involved into the theory of the quantitative theory of evolutional partial differential equations. In the next papers, he studied genericity of the Morse–Smale property for some class of evolutional partial differential

equations of the parabolic type. He founded a seminar on the qualitative theory of dynamical systems, where many famous Slovak mathematical personalities of international importance grew up, such as Prof. M. Fečkan, Prof. M. Fila, Prof. T. Kmeť, Prof. J. Komorník, Prof. M. Medveď, Prof. P. Poláčik, Prof. D. Ševčovič, Dr. M. Halická, Prof. K. Pastor, and others.

One of the proofs of appreciation evidence of the scientific activity of Prof. Brunovský was the invited lecture on the International Congress of Mathematicians (ICM) in Helsinki (1978), where he addressed his results on the structure of optimal feedback systems, see [4]. So far he is the only Slovak mathematician, who was invited to address a talk at ICM.

In the nineties, he was involved into the study program Economical and financial mathematics, which was an unparalleled program attracting students to apply mathematical knowledge in the area of the mathematical economy and the theory of finances. The program was introduced at the faculty in the time, when the number of students of mathematical orientation was descending not only at the faculty but in the whole Slovakia, in general. Nowadays, this program is very attractive among students.

Prof. RNDr. P. Brunovský, DrSc. awarded by the Golden Medal of the SAS for his life-work, 2015. Photo by courtesy of Slovak Academy of Sciences.

An additional feature of scientific-pedagogical activity of Prof. Brunovský was his popularization and publishing activity. In a series of articles he promoted his interesting points of view at different mathematical problems. In articles devoted mainly to young readers, he was trying to clear up the view of an experienced mathematician to solutions of interesting problems arising in different applications. His publishing activity was enormous. His thoughts on the role of mathematics and of mathematicians in the modern society or on general

tendency of the science in Slovakia appeared not only in new times after 1989, but also during the real socialism when to write on critical and sensitive topics was not easy. Also in new times his voice was possible to hear very often on commenting of actual problems of support of the science and the education in Slovakia.

Nevertheless of his high age, he was still active at the Faculty. Recently, a textbook [2] and book [3] with his name among coauthors were published. His life enthusiasm, physical and mental condition, and appetite to mathematics were integral parts of his life. He was a triple master of Czechoslovakia in orientation cross and a master of the West Slovakia region in ski cross country relay.

Prof. Brunovský was a member of the organizing and scientific committees of Equadiff III (Brno 1972), Equadiff 8 (Bratislava 1993), and Equadiff 11 (Bratislava 2005).

The scientific work of Pavol Brunovský wears well on his enormous load and his influence on the scientific life in Slovakia. A lot of positive energy, optimism and enthusiasm emitted from his personality and work. For younger colleagues, who had a chance to meet Prof. Brunovský, to discuss or solve different theoretical or practical problems, it was always an inspiring experience. It is possible to read more about his opus in Slovak in [1, 5] and also at the website [6].

Prof. Brunovský belonged to one of the most important generation of Slovak mathematicians who studied mathematics in Slovakia after the second world war. His fellow students were e.g. Černý, A. Dávid, O. Erdélska-Klaučová, M. Franek, J. Gruska, P. Kluvánek, J. Moravčík, Z. Petrovičová-Riečanová, Z. Zalabai, and others.

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Jaroslav Kurzweil (7.5.1926–17.3.2022)

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Jaroslav Kurzweil significantly contributed e.g. to the metric theory of Diophantine approximation, geometry of Banach spaces, stability theory of differential equations, theory of differential inclusions, control theory, invariant manifolds flows or global solutions of functional differential equations. Particularly valuable is his impact on the theory of differential equations.

Photo by M. Tvrdý

However, in mathematical world he is now famous primarily as the creator of a new approach to the integration and qualitative theory of differential equations. His Riemann-type definition of an integral was first published in 1957 in the Czechoslovak Mathematical Journal (see [1]). Its main idea is similar to the classical Riemann's approach: The integral of a function over an interval $[a, b]$ is approximated by the sum of the lengths of subintervals of a division of $[a, b]$ multiplied by the value of the function in particular points called the *tags*. The novelty is that the tags are chosen first, while the division points are allowed to vary in a controlled neighborhood of the tag. This made it possible to control the singularities and integrate very general classes of functions. his integral, now generally called the Kurzweil (or more often Henstock–Kurzweil) integral has proved to be very strong and inspiring, not only for the integration theory itself but also for differential and integral equations. It includes the classical concepts of the Riemann, Newton, Lebesgue and Perron integrals, as well as their improper modifications. In particular, it can integrate non-absolutely integrable functions. At the same time, the Kurzweil integral calculus is surprisingly simple. Despite these facts and despite that Kurzweil published his first monograph [2] on the integration theory in 1980, it took about forty years until the Kurzweil integral made its way through. Its research and application became an important part of mathematical analysis, it is now used worldwide as a new approach to teach theory of integration. After 2000, J. Kurzweil himself published three monographs [3]–[5] which had and apparently will long have a remarkable impact in the international mathematical community. The Henstock–Kurzweil integral is now considered to be a fundamental object with deep applications in the description of discontinuous physical and social processes.

Of course, the new approach to the general integration theory was growing up from the needs of ordinary differential equations. The main goal of the paper [1], where J. Kurzweil introduced his new integral, was to obtain new results on

the continuous dependence on a parameter of solutions to systems of nonlinear differential equations. In particular, when rapidly oscillating external forces were present on the right hand sides, it turned out that, under reasonable conditions, the solutions of the approximating systems converge to a function that need not be absolutely continuous and thus it cannot be a solution of any ordinary differential equation (in the sense of Carathéodory). However, using the new integral, it was possible to observe that this limit function satisfies a certain integral equation. Since then, this new kind of equations is called *generalized ordinary differential equations*. They were studied later by several authors, see e.g. the monographs [6] and [7]. The drawback of those results was that they restricted themselves only to solutions of bounded variation and thus the fast oscillating right hand sides were not allowed.

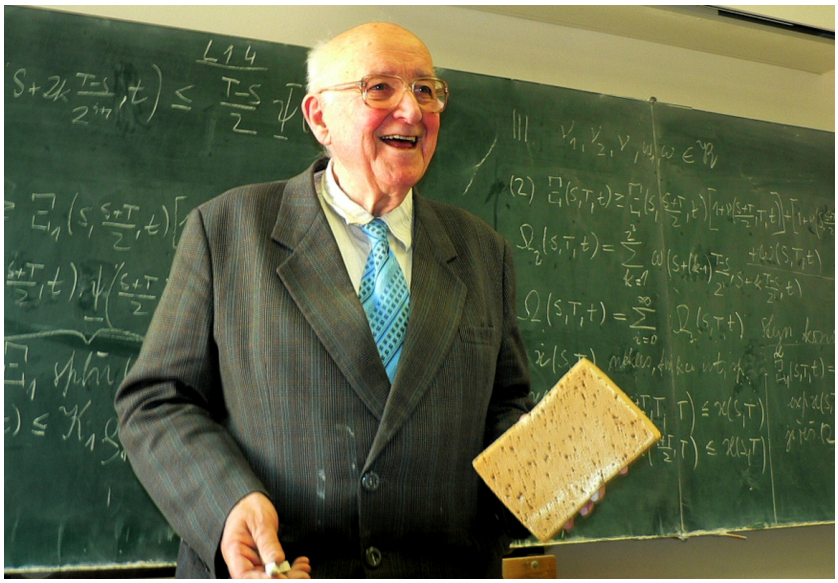

Photo by M. Tvrdý

Already in 2004, being encouraged by W. N. Everitt to develop a theory of generalized differential equations covering also the cases of rapidly oscillating right hand sides, J. Kurzweil started the preparation of a new monograph. A significant motivation came from the study of motion of Kapitza's pendulum. The first version of the monograph devoted to generalized differential equations with non-absolutely continuous solutions was ready for print in 2009. However, Kurzweil essentially reorganized the manuscript and extended it with five new chapters. He completed the work in 2011, and the book [5] was finally published in 2012. The first three chapters are devoted to the equation of Kapitza's pendulum and related problems. Next, Kurzweil focuses on generalized differential equations, whose solutions are regulated functions and they do not need to have a bounded variation. The main results are new theorems on the existence and

uniqueness of solutions, as well as on the continuous dependence on the right-hand side. Since the solutions can take values in arbitrary Banach spaces, it was necessary to introduce and develop a new concept of integral for vector-valued functions, namely the strong Kurzweil-Henstock integral. Therefore, the book also represents an important contribution to integration theory.

Jaroslav Kurzweil, together with another outstanding Czech mathematician Ivo Babuška founded the tradition of international scientific conferences bearing the name EQUADIFF. Since 1962 they have been held every four years alternately in Prague, Bratislava, and Brno. There were just two exceptions: the first one was caused by the Soviet invasion of Czechoslovakia in 1968 and the second one by the covid pandemy in 2021. Nowadays, Equadiff is one of the oldest active series of mathematical conferences in the world.

Due to his scientific contributions, Jaroslav Kurzweil received many awards. Let us mention just few of them:

- in 1978 he was elected an honorary foreign member of the Royal Society of Edinburgh;
- in 1996 he was elected a foreign member of the Belgian Royal Academy of Sciences and awarded the honorary medal "DE SCIENTIA ET HUMANITATE OPTIME MERITIS" of the Academy of Sciences of the Czech Republic;
- in 1997 he was awarded the State Decoration of the Czech Republic "Medal of Merit (First Grade)" for meritorious service to the state;
- in 2006 he was awarded the National Prize of the Government of the Czech Republic "Czech Brain".

Sixty five years lasting devoted scientific research by Kurzweil led to numerous results in several branches of mathematics which have been admired by the worldwide mathematical community for their richness and depth. His contributions are characterized by a rare combination of high creativity and exceptional technical power. Many generations of Czech and Slovak mathematicians were influenced by his work and often profited directly from his expert advice.

More detailed information about Kurzweil's life and works, including complete bibliographies, can be found in the following papers:

- J. Jarník, Š. Schwabik, M. Tvrdý, and I. Vrkoč, Sixty years of Jaroslav Kurzweil. *Czechoslovak Mathematical Journal* 36 (1986) 147–166.
- J. Jarník and Š. Schwabik, Jaroslav Kurzweil septuagenarian. *Czechoslovak Mathematical Journal* 46 (1996) 375–386.
- J. Jarník, Š. Schwabik, M. Tvrdý, and I. Vrkoč, Jaroslav Kurzweil septuagenarian. *Mathematica Bohemica* 121 (1996) 215–222.
- J. Jarník, Š. Schwabik, M. Tvrdý, and I. Vrkoč, Eighty years of Jaroslav Kurzweil. *Mathematica Bohemica* 131 (2006) 113–143.

- T. W. Pavlíček, Ninety-five years of Jaroslav Kurzweil, *Mathematica Bohemica* 146 (2021), 115–129.
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František Neuman (28.5.1937–23.5.2018)

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Professor František Neuman, a recognized Czech mathematician specialized in the fields of linear differential and functional equations, passed away on May 23, 2018 at the age 81.

František Neuman was born on May 28, 1937 in Brno, Czechoslovakia (now the Czech Republic). His mathematical talent became evident already during secondary school studies, when he won (even twice) the Czechoslovak Mathematical Olympiad. After graduation at Masaryk University in 1960, he started to work as an Assistant Lecturer at the Department of Mathematics at the Faculty of Science. A future mathematical specialization of František Neuman was strongly influenced by Professor Otakar Borůvka who was a supervisor of his postgraduate studies finished in 1965.

In 1966 František Neuman became Associate Professor of Mathematical Analysis, in 1980 he received the title Doctor of Science, and finally in 1991 he was appointed Professor of Mathematical Analysis.

Photo by courtesy of the Otakar Borůvka Company, z.s.

An important institutional change in the scientific life of František Neuman occurred in 1974 when he left his university position for the newly established Brno branch of Mathematical Institute of the Academy of Sciences (in 1991 he became the head of this scientific workplace). Despite of his broad scientific activities, also after leaving the university Professor Neuman continued in education of undergraduate and postgraduate students.

A scientific interest of František Neuman was very wide and not limited only to mathematical analysis. Nevertheless, his most remarkable achievements are connected just with qualitative theory of linear differential and functional equations. At the beginning of his career, he concentrated on the second order linear differential equations to obtain significant results on periodicity and related asymptotic properties of these equations. In late sixties, Professor Neuman started to investigate these properties for higher order differential equations. His investigations were based on development of various original techniques originating from tools of differential geometry, category theory, algebra and other mathematical disciplines. The main conclusions of these investigations are summarized in the monograph [1].

In late seventies, František Neuman extended these studies also to differential equations with deviating arguments. Thus he became one of the first Czech

mathematicians dealing with this type of differential equations and considerably helped to get them into a broader attention of the Czech mathematical community. From this research area, we can mention at least the paper [2], where certain canonical forms for a class of differential equations with delayed and advanced arguments were suggested, and their usefulness was demonstrated.

A specific position among scientific interests of Professor Neuman belonged to the theory of functional (nondifferential) equations. He became acquainted with this type of equations during sixties when studying and extending phase and dispersion theory of the second order differential equations. Later, he published a series of papers documenting a significant role of functional equations in qualitative theory of differential equations. In addition, Professor Neuman became a recognized expert in the theory of functional equations itself. He posed and solved new problems of this theory and thus inspired its further development. In this connection, we can mention his paper [3], describing conditions for decomposition of functions of two variables into finite sums of products of functions of single variables, and paper [4] where foundations of the theory of continuous iteration groups of certain functions were established. For other information on scientific activities of Professor Neuman we refer to [5].

Professor Neuman awarded by the Bernard Bolzano Medal at Equadiff 9, with Prof. Segeth (left) and Prof. Kurzweil (right). Photo by courtesy of the Digital Library of Photos, Masaryk University.

The personality of František Neuman was determining for a further development of Brno school of differential equations. For many years, he organized the seminar on differential equations at Masaryk University, and acted as a supervisor of eight postgraduate students who have been following his research directions. His international reputation was confirmed by many invitations to

lecture at foreign universities and to plenary lectures at international conferences on theory of differential or functional equations. Also, he served as a member of Editorial Boards of several international journals, and as an organizer of several important international conferences. In particular, he significantly contributed to the organization of Equadiff conferences. He was the chairman of the Scientific and Organizing Committees of Equadiff 9 held in Brno in 1997, and acted at least in one of these committees also in Equadiff 3 (Brno, 1972), Equadiff 7 (Prague, 1989), Equadiff 8 (Bratislava, 1993), and Equadiff 10 (Prague, 2001).

During his life, Professor Neuman obtained several significant appreciations of his work. Among them, we can mention the Bolzano medal awarded to distinguished scientists by the Presidium of the Czech Academy of Sciences, and the Prize of the Southmoravian Region for his contribution to science.

However, František Neuman was known not only as a recognized mathematician, but also as a very kind teacher and colleague. He kept very close relations with his teacher Otakar Borůvka until his death, and after it, he took care of his scientific heritage. It is a challenge for all his followers to keep and continue in this tradition.

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Alexander Ženíšek (29.1.1936–30.12.2020)

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Professor Alexander Ženíšek, an outstanding Czech mathematician and physicist, one of the world's recognized founders of the finite element method, passed away on December 30, 2020 at the age 84.

Alexander Ženíšek was born on January 29, 1936 in Brno, Czechoslovakia (now the Czech Republic). After studies of physics at Masaryk University (1954–1959), he started to work as an Assistant Lecturer at the Energetic Faculty (now the Faculty of Mechanical Engineering) of the Brno University of Technology (BUT).

At the same time, he studied mathematics at Masaryk University. A turning point in his professional career occurred in 1967 when Alexander Ženíšek met with Jiří Kratochvíl (an ensuing Professor at the Brno University of Technology). When performing statical calculations of earth fill dams, Kratochvíl applied quite a new and at that time nearly unknown computational method. Since his approach to the studied problems was especially engineering, he was looking for a mathematical support. Such a support was offered by the director of the Laboratory of Computing Machines at BUT, Professor Miloš Zlámal, and just to Alexander Ženíšek. They started to work on analysis and algorithm developments of this computational method and their effort put theoretical foundations of the finite element method that is till now considered to be the most important computational method in engineering. These foundations are connected especially with their papers [1] and [2] that brought a worldwide recognition to both authors. However, Alexander Ženíšek was always emphasizing a contribution of the whole Brno school to the mathematical foundations of the finite element method. Besides Jiří Kratochvíl and Miloš Zlámal, the core of this group was formed by František Leitner (the bridge partner of Alexander Ženíšek who put Ženíšek together with Kratochvíl) and Libor Holuša (an excellent programmer who confirmed theoretical results by numerical calculations). Their joint effort was summarized in the monograph [3]. However, without any doubts, Alexander Ženíšek was one of the leading persons from this group.

Photo by courtesy of the Brno University of Technology

In 1969 he defended his habilitation to become an Associate Professor. Because of his disagreement with the situation in communist Czechoslovakia, he

did not receive this degree until 1978. In 1981 he was awarded the scientific degree Doctor of Science in the field Approximate and Numerical Methods.

Later in 1986, he became a full Professor in the same field, but his lecture and educational activities were still limited. Only after political changes in 1989, Alexander Ženíšek (along with Miloš Zlámal and several other workers of the Laboratory of Computing Machines, which was later renamed to the Regional Computing Center) became a member of the Department of Mathematics (later the Institute of Mathematics) of the Faculty of Mechanical Engineering at BUT.

In the period 1994–2003, Alexander Ženíšek was a director of this institute and significantly influenced its development and transformation to a recognized mathematical workplace. He founded (with a support of Miloš Zlámal and other colleagues) the study program Mathematical Engineering at the Faculty of Mechanical Engineering with many outstanding graduates. It is worth noting that the chairman of the historically first state exam committee in this study program was Professor Jaroslav Kurzweil reminded at other place of this brochure. Alexander Ženíšek retired in 2005 when he became a Professor Emeritus at BUT.

Alexander Ženíšek and Jiří Grygar affirm a place in Brno to be the "Universe center". Photo by courtesy of Brno Observatory and Planetarium.

A scientific scope of Alexander Ženíšek was very wide and not limited only to mathematics. Besides his fundamental contribution to the mathematical theory of the finite element method to approximate solutions of partial differential equations and numerical solution of problems of mathematical physics, he was recognized as an expert in various problems of calculus of variations, functional analysis, theory of relativity and other areas. For a more detailed survey of his scientific activities, we refer to the commemorative paper [4].

Alexander Ženíšek gave a plenary lecture at Equadiff 9 in Brno in 1997

entitled “The use of semiregular finite elements”. He was also nominated an honorary chairman of the current Equadiff by its Scientific Committee.

During his life, Professor Ženíšek received many formal as well as informal acknowledgments of his scientific work. In 1994 he became one of the founding members of the Learned Society of the Czech Republic. In 2001 he received the Gold Medal of the Faculty of Mechanical Engineering at BUT for his lifelong contributions to the development of science. Both mathematical and engineering community respected him as a profound representative of an applied mathematician.

However, Alexander Ženíšek was not only the scientist; he was especially an original personality. His hobbies included bridge theory, writing of poems, listening to classical music, and the life at all its forms. The last public appearance of Alexander Ženíšek was more than symbolic. In September 12, 2019 a special event took place in the crossroad of the Brno streets Trávníky a Demlova (near the Villa Tugendhat). Under the auspices of local authorities and the director of the Brno observatory Jiří Dušek, Alexander Ženíšek and his lifelong friend, famous Czech astronomer Jiří Grygar, officially affirmed this place to be the “Universe center”. It was more than 70 years afterwards when both of them, as small boys living nearby, made jointly this “scientific discovery”. A memorial stone, placed in this crossroad, will remain also as the remembrance of Professor Alexander Ženíšek.

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Abstracts of plenary and invited speakers

Plenary speakers:

- Douglas Norman Arnold (USA)
- Alessandro Fonda (Italy)
- Barbara Kaltenbacher (Austria)
- Mária Lukáčová–Medviďová (Germany)
- Stefan Siegmund (Germany)
- Juncheng Wei (Canada)

Invited speakers:

- Vincenzo Ambrosio (Italy)
- Elena Braverman (USA)
- Dorin Bucur (France)
- Jan Čermák (Czech Republic)
- Gianluca Crippa (Switzerland)
- Patrick Farrell (UK)
- Ulrik Skre Fjordholm (Norway)
- Jaqueline Godoy Mesquita (Brazil)
- Philippe Laurencot (France)
- Jean-Philippe Lessard (Canada)
- Masakazu Onitsuka (Japan)
- Daniel Peterseim (Germany)
- Dirk Praetorius (Austria)
- Carola-Bibiane Schönlieb (UK)
- Ulisse Stefanelli (Austria)
- Agnieszka Świerczewska-Gwiazda (Poland)
- Pedro J. Torres (Spain)
- Barbara Wohlmuth (Germany)

GENERALIZATIONS OF THE POINCARÉ – BIRKHOFF THEOREM FOR HAMILTONIAN SYSTEMS

Alessandro Fonda
University of Trieste

In 1983, Conley and Zehnder [3] proved a remarkable theorem on the periodic problem associated with a general Hamiltonian system, giving a partial answer to a conjecture by V.I. Arnold. In the same paper they also proposed a second theorem, mentioning a possible relation with the Poincaré – Birkhoff Theorem.

First conjectured by Poincaré [5] in 1912, shortly before his death, this theorem has been proved by Birkhoff in [1, 2]. Both Poincaré and Birkhoff were interested in it because of its consequences in the existence of periodic solutions for some Hamiltonian systems originating from Celestial Mechanics.

More recently, a deeper relation between the above quoted second theorem by Conley and Zehnder and the Poincaré – Birkhoff theorem has been established by the first author jointly with A.J. Ureña [4].

The main result in [4] has found so far several applications, and has been extended in different directions. Besides the usual periodic – twist assumption, the coupling with some nonresonant linear terms can now also be treated, as well as with terms involving lower and upper solutions.

I will report on some of the most recent advances in this still very fertile field.

[1] G.D. Birkhoff, *Proof of Poincaré's geometric theorem.* Trans. Amer. Math. Soc. **14** (1913), 14–22.

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MATHEMATICS OF NONLINEAR ACOUSTICS: MODELING, ANALYSIS AND INVERSE PROBLEMS

Barbara Kaltenbacher
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The importance of ultrasound is well established in the imaging of human tissue. In order to enhance image quality by exploiting nonlinear effects, recently techniques such as harmonic imaging and nonlinearity parameter tomography have been put forward. As soon as the pressure amplitude exceeds a certain

bound, the classical linear wave equation loses its validity and more general nonlinear versions have to be used. Another characteristic property of ultrasound propagating in human tissue is frequency power law attenuation leading to fractional derivative damping models in time domain. In this talk we will first of all dwell on modeling of nonlinearity on one hand and of fractional damping on the other hand. Then we will give an idea on the challenges in the analysis of the resulting PDEs and discuss some parameter asymptotics. Finally, we address some relevant inverse problems in this context, in particular the above mentioned task of nonlinearity parameter imaging, which leads to a coefficient identification problem for a quasilinear wave equation.

DISSIPATIVE WEAK SOLUTIONS OF COMPRESSIBLE FLUID FLOWS

Mária Lukáčová-Medvid'ová
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This is a joint work with E. Feireisl (Academy of Sciences, Prague, Czech Republic), H. Mizerová (Comenius University, Bratislava, Slovakia), B. She (Academy of Science, Prague, Czech Republic) and Y. Yuan (University of Mainz, Germany).

In this talk we introduce generalized solutions of compressible flows, the so-called dissipative weak solutions. We will concentrate on the inviscid flows, the Euler equations, and mention also the relevant results obtained for the viscous compressible flows, governed by the Navier-Stokes equations.

The existence of dissipative weak solutions has been shown by the convergence analysis of suitable, invariant-domain preserving finite volume schemes [1, 2, 3, 4]. In the case that the strong solution to the above equations exists, the dissipative weak solutions coincide with the strong solution on its life span [1].

Otherwise, we apply a newly developed concept of $\mathcal{K}$-convergence and prove the strong convergence of the empirical means of numerical solutions to a dissipative weak solution [5, 6]. The latter is the expected value of the dissipative measure-valued solutions and satisfies a weak formulation of the Euler equations modulo the Reynolds defect measure. In the class of dissipative weak solutions there exists a solution that is obtained as a vanishing viscosity limit of the Navier-Stokes system [7]. Theoretical results will be illustrated by a series of numerical simulations.

The present research has been partially supported by TRR 146 Multiscale simulation methods for soft matter systems, TRR 165 Waves to Weather funded by the German Science Foundation and by the Gutenberg Research College.

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MAXWELL'S EQUATIONS REVISITED - MENTAL IMAGERY AND MATHEMATICAL SYMBOLS

Stefan Siegmund

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This is joint work with Dr. Matthias Geyer, B.Sc. Jan Hausmann, M.Sc. Konrad Kitzing and B.Sc. Madlyn Senkyr (TU Dresden, Germany). Maxwell developed his famous equations

$$\operatorname{curl} E + \frac{\partial B}{\partial t} = 0, \quad \operatorname{div} D = \rho,$$
$$\operatorname{curl} H + \frac{\partial D}{\partial t} = j, \quad \operatorname{div} B = 0,$$
$$D = \varepsilon_0 E, \quad B = \mu_0 H,$$

in what Hon and Goldstein [7] call an odyssey in electromagnetics consisting of four stations:

- Station 1 (1856-1858): on Faraday's lines of force [1]
- Station 2 (1861-62): on physical lines of force [2]
- Station 3 (1865): A dynamical theory of the electromagnetic field [3]
- Station 4 (1873): A treatise on electricity and magnetism [4]

Maxwell's original work is a rich source for methodological inspiration [6, 7, 8]. In this talk we pick up some of this inspiration from his original work as well as the mental imagery which he developed and look at his ideas again. We first discuss Maxwell's imaginary fluid approach in vector calculus notation and then formulate a research hypothesis based on Maxwell's constitutive relations

$$D = \varepsilon_0 E,\ B = \mu_0 H,$$

in the language of differential forms.

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STABILITY OF SOBOLEV INEQUALITIES AND RELATED TOPICS

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Suppose $u \in \dot{H}^1(\mathbb{R}^n)$. In a seminal work Struwe (1984) proved that if

$$||\Delta u + u^{\frac{2n}{n-2}}||_{H^{-1}} := \Gamma(u) \to 0$$

then $\delta(u) \to 0$, where $\delta(u)$ denotes the $\dot{H}^1(\mathbb{R}^n)$-distance of u from the manifold of sums of Talenti bubbles. In 2020 Figalli and Glaudo obtained the first quantitative version of Struwe's decomposition in lower dimensions, namely $\delta(u) \lesssim \Gamma(u)$ when $3 \le n \le 5$. In this talk, I will report the following nonlinear estimates:

$$\delta(u) \le C \begin{cases} \Gamma(u)\,|\log \Gamma(u)|^{\frac{1}{2}} & \text{if } n = 6, \\ |\Gamma(u)|^{\frac{n+2}{2(n-2)}} & \text{if } n \ge 7. \end{cases}$$

Furthermore, we show that this inequality is optimal. Extensions to Caffarelli-Kohn-Nirenberg inequalities, Harmonic Map Inequalities and 1/2-Harmonic Maps will also be discussed.

FRACTIONAL PERIODIC PROBLEMS WITH CRITICAL GROWTH

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In this talk, I will discuss the existence of 2π-periodic solutions to the following fractional critical problem:

$$\begin{cases} [(-\Delta_x + m^2)^s - m^{2s}]u = W(x)|u|^{2_s^*-2}u + f(x,u) & \text{in } (-\pi,\pi)^N \\ u(x + 2\pi e_i) = u(x) & \text{for all } x \in \mathbb{R}^N, \\ & i = 1,\dots,N, \end{cases}$$

where $s \in (0,1)$, $N \geq 4s$, $m \geq 0$, $2_s^* = \frac{2N}{N-2s}$ is the fractional critical Sobolev exponent, $W(x)$ is a positive continuous function, and $f(x,u)$ is a superlinear 2π-periodic (in x) continuous function with subcritical growth. When $m > 0$, the existence of a nonconstant periodic solution will be established by combining the Linking theorem and a suitable variant of the extension method in periodic setting. The case $m = 0$ will be studied through a limit procedure.

ON THE CONNECTION OF DIFFERENTIAL, DIFFERENCE, DELAY AND DYNAMIC EQUATIONS

Elena Braverman
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This is a joint work with Leonid Berezansky (Ben-Gurion University of the Negev, Beer-Sheva, Israel).

Solutions of autonomous scalar nonlinear ordinary differential equations usually experience monotone behaviour, while difference models can lead to oscillation. Delay equations in some sense combine properties of the two types of equations. For some types of nonlinear difference equations $x_n = f(x_{n+1})$, eventually monotone convergence to a unique equilibrium guarantees its global attractivity for an equation with a distributed delay [1]

$$x'(t) = r(t)\left[\int_{h(t)}^{t} f(x(s))d_sR(t,s) - x(t)\right].$$

This result cannot be automatically extended to systems [2]: the notion of a strong attractor of a vector difference equation associated with a nonlinear vector differential equation is required to guarantee stability of the delay system. The stability theorem is applied to compartment-type models of population dynamics with Nicholson's blowflies growth law and to Hopfield neural networks [3]. The results extend the theorem [1] that for a one-dimensional equation with

a distributed delay, delay-independent stability can be deduced from attractivity of an associated difference equation.

Difference equations can approximate solutions of differential equations and the denser the grid is, more accurate description of solutions behaviour can be given, in particular, non-oscillating character can be imitated. This also leads to an interesting question for equations on time scales: is the oscillation property monotone, for example, are there conditions such that non-oscillation of a delay equation on certain time scales leads to the same property on any finer time scale [4]?

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SHAPE OPTIMIZATION IN STOKES FLUIDS

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We analyse the question of minimizing the drag of an obstacle of prescribed volume in a viscous flow driven by the Stokes equation, provided that the contact between the obstacle and the fluid obeys a Navier law. Letting completely free the shape of the obstacle, we prove the existence of an optimal solution, possibly presenting lower dimensional features, and analyse its regularity. No a priori geometric constraints are imposed on the competing shapes, except a control on their total area. The analysis is carried in the framework of free discontinuity problems. A similar question for Navier-Stokes flows will be shortly commented.

STABILITY REGIONS FOR LINEAR FRACTIONAL AND DELAY DIFFERENTIAL EQUATIONS

Jan Čermák
Brno University of Technology, Czech Republic

In this contribution, we discuss forms and properties of stability regions for various types of linear autonomous differential equations that can be considered in a joint form

$$\mathrm{D}^{\alpha} y(t) = Ay(t - \tau(t)), \qquad t > 0. \tag{1}$$

Here, D^α means the Caputo derivative of a positive real order α, A is a constant real matrix and τ is a non-negative real function satisfying some additional properties.

Starting with the elementary case $\alpha = 1$ and τ being identically zero, we explore dependance of stability regions of (1) on a lag function τ as well as on a continuously changing derivative order α. We support these results by comments on asymptotic and oscillatory properties of (1) with a special emphasize put on similarities and dissimilarities between integer and fractional–order case. Besides, we consider (1) with several delay functions and mention some partial results also in this direction.

We intend to present these stability conditions in their optimal (i.e. non-improvable) and efficient form. Such descriptions are useful not only for theoretical reasons, but also in numerical analysis of differential equations and in some application areas. To illustrate this, we mention a simple consequence to control theory.

Finally, we are going to comment some related results of several great mathematicians connected with the history of the Czechoslovak Equadiff.

AN ELEMENTARY PROOF OF EXISTENCE AND UNIQUENESS FOR THE EULER FLOW IN UNIFORMLY LOCALIZED YUDOVICH SPACES

Gianluca Crippa
University of Basel

I will revisit Yudovich's well-posedness result for the 2-dimensional Euler equations. I will derive an explicit modulus of continuity for the velocity, depending on the growth in p of the (uniformly localized) L^p norms of the vorticity. If the growth is moderate at infinity, the modulus of continuity is Osgood and this allows to show uniqueness. I will also show how existence can be proved in (uniformly localized) L^p spaces for the vorticity. All the arguments are fully elementary, make no use of Sobolev spaces, Calderon-Zygmund theory, or Paley-Littlewood decompositions, and provide explicit expressions for all the objects involved. This is a joint work with Giorgio Stefani (SISSA Trieste).

NEW FINITE ELEMENTS FOR EXTREMELY HIGH-ORDER FEM

Patrick Farrell
University of Oxford

This is a joint work with P. D. Brubeck Martinez of the University of Oxford.

For problems with smooth solutions, high-order finite element methods offer very good convergence properties. Moreover, there exist optimal matrix-free algorithms for operator evaluation with high arithmetic intensity, arising from data locality, making them very attractive on modern parallel hardware architectures. Unfortunately, the conditioning of the stiffness matrix is severely affected

by the polynomial degree p of the approximation. In order to obtain practical high-order codes, we require good preconditioners.

Pavarino proved in 1993 [1] that an additive Schwarz method with vertex patches and a low-order coarse space gives a p-robust solver for symmetric and coercive problems. However, for very high polynomial degree it is not feasible to factorize (or even assemble) the matrices for each vertex patch. In this work we introduce a new H^1-conforming finite element on tensor product cells that under certain conditions yields *sparse* stiffness matrices for the H^1 Riesz map, enabling the use of direct solvers for each patch problem. We can thus afford to assemble and factorize the matrices for the vertex-patch problems for much higher polynomial degrees than previously possible. When the conditions for sparsity do not apply, the method can be employed as a preconditioner by approximating the problem with a suitable (separable) surrogate, in a manner that is provably p-robust.

We then extend the construction to new finite elements for the entire L^2 de Rham complex [2], enabling the fast solution of the $H(\mathrm{div})$ and $H(\mathrm{curl})$ Riesz maps, which often arise as inner problems in the use of block preconditioners for coupled systems of equations [3].

We demonstrate the approach by solving the Poisson equation, a $H(\mathrm{div})$-conforming interior penalty discretization of linear elasticity, and the Riesz maps for $H(\mathrm{div})$ and $H(\mathrm{curl})$, at $p = 15$ on three-dimensional unstructured meshes.

[1] L. F. Pavarino, *Additive Schwarz methods for the p-version finite element method.* Numer. Math. **66** (1993), 493–515.

[2] D. N. Arnold, Finite element exterior calculus. SIAM, Philadelphia, 2018.

[3] K.-A. Mardal and R. Winther, *Preconditioning discretizations of systems of partial differential equations.* Numer. Linear Algebra Appl. **18** (2011), 1–40.

NUMERICAL METHODS FOR CONSERVATION LAWS ON NETWORKS

Ulrik Fjordholm
University of Oslo, Oslo, Norway

We review some theory of conservation laws posed on a graph, and look at some recent results on well-posedness of entropy solutions via the convergence of a finite volume method. If time permits we will look at an application to flow in porous media. This is joint work with Nils Henrik Risebro and Markus Musch (UiO).

THE THIN FILM MUSKAT PROBLEM

Philippe Laurencot
Institut de Mathématiques de Toulouse, CNRS

The thin film Muskat problem describes the dynamics of the respective heights of two immiscible thin fluid layers with different densities and viscosities. It is a degenerate second-order parabolic system with a full diffusion matrix (cross-diffusion). Old and new results are presented, including the existence of weak solutions and their boundedness. For the Cauchy problem, the self-similar solutions are identified and their stability is shown. Joint works with A. Ait Hammou Oulhaj, C. Cances, C. Chainais-Hillairet, J. Escher and B.-V. Matioc.

ULAM STABILITY OF GENERALIZED LOGISTIC EQUATIONS

Masakazu Onitsuka
Department of Applied Mathematics, Okayama University of Science, Okayama, 700-0005, Japan

In this talk we consider the generalized logistic equation

$$y' = y\left(1 - y^{\alpha}\right), \tag{2}$$

where $\alpha > 0$. Recently, Popa et al. [1] proposed conditional Ulam stability for (2) with $\alpha = 1$. Conditional Ulam stability is a property that guarantees the difference between the approximate solution and the exact solution to be finite. The exact definition is as follows. Let $A \subseteq (0, \infty)$ and $B \subseteq \mathbb{R}$ be nonempty sets. Define the class

$$\mathcal{C}_B := \left\{ y \in C^1\left[0, T_y\right) : y(0) \in B, T_y > 0 \text{ with } T_y = \infty \text{ or } |y(t)| \to \infty \text{ as } t \nearrow T_y \right\}.$$

Note that $[0, T_y)$ refers to the maximal existence interval of $y(t)$. The nonlinear differential equation

$$y' = F(t, y) \tag{3}$$

is *conditionally Ulam stable* on $[0, \min\{T_y, T_\eta\})$ with A in the class $\mathcal{C}_B$ if there exists $L > 0$ such that for any $\varepsilon \in A$ and any approximate solution $\eta \in \mathcal{C}_B$ that satisfy $|\eta' - F(t, \eta)| \le \varepsilon$ for $t \in [0, T_\eta)$, there exists a solution $y \in \mathcal{C}_B$ of (3) such that $|\eta(t) - y(t)| \le L\varepsilon$ for $t \in [0, \min\{T_y, T_\eta\})$. We call such an L an *Ulam constant* for (3) on $[0, \min\{T_y, T_\eta\})$. If $A = (0, \infty)$ and $B = \mathbb{R}$, then this definition is exactly the same as that for the standard Ulam stability. See [2, 3, 4, 5, 6] for previous studies on standard and conditional Ulam stabilities. The main result in this talk is as follows.

Theorem 1 ([7]). Let $A = \left(0, \alpha(\alpha+1)^{-\frac{\alpha+1}{\alpha}}\right]$ and $B = \left[(\alpha+1)^{-\frac{1}{\alpha}}, \infty\right)$. Then (2) is conditionally Ulam stable on $[0, \infty)$ with A in the class $\mathcal{C}_B$. Furthermore, $L = \max\left\{(\alpha+1)\alpha^{-1}, (\alpha+1)\alpha^{-2}\right\}$ is an Ulam constant for (2) on $[0, \infty)$.

This result is extended as a theorem applicable to more generalized logistic equations.

[1] D. Popa, I. Raşa and A. Viorel, *Approximate solutions of the logistic equation and Ulam stability*, Appl. Math. Lett. 85 (2018), 64–69.
[2] D. R. Anderson and M. Onitsuka, *Hyers–Ulam stability for differential systems with* 2×2 *constant coefficient matrix*, Results Math. 77 (2022), Paper No. 136, 23 pp.
[3] Y. W. Nam, *Hyers–Ulam stability of loxodromic Möbius difference equation*, Appl. Math. Comput. 356 (2019), 119–136.
[4] M. Onitsuka, *Conditional Ulam stability and its application to the logistic model*, Appl. Math. Lett. 122 (2021), Paper No. 107565, 7 pp.
[5] M. Onitsuka, *Conditional Ulam stability and its application to von Bertalanffy growth model*, Math. Biosci. Eng. 19 (2022), no. 3, 2819–2834.
[6] M. Onitsuka and Iz. El-Fassi, *On approximate solutions of a class of Clairaut's equations*, Appl. Math. Comput. 428 (2022), Paper No. 127205, 13 pp.
[7] M. Onitsuka, *Approximate solutions of generalized logistic equation*, submitted.

NONLINEAR EIGENVECTOR PROBLEMS AND THE SIMULATION OF BOSE-EINSTEIN CONDENSATES

Daniel Peterseim
University of Augsburg

This talk is based on joint work with P. Henning (Ruhr University Bochum, Germany), R. Altmann and T. Stykel (University of Augsburg, Germany).

Stationary states of Bose-Einstein condensates can be modelled by an eigenvalue problem for a nonlinear partial differential operator – the Gross-Pitaevskii or non-linear Schrödinger equation. It is a representative of the larger class of nonlinear eigenvector problems arising in computational physics but also in data analysis. The talk discusses the numerical solution of such nonlinear eigenvalue problems by adapting techniques from Riemannian optimization, computational PDEs and multiscale modelling and simulation.

For the special case of the Gross-Pitaevskii equation, the numerical analysis and a series of numerical experiments demonstrate the ability of the resulting simulation methods to capture relevant physical effects of Bose-Einstein condensates such as eigenstate localization under disorder potentials and the formation of vortex lattices in fast rotating potential traps. The talk is completed by an outlook to the robust and efficient simulation of the condensate's dynamics.

[1] R. Altmann, D. Peterseim, T. Stykel, *Energy-adaptive Riemannian optimization on the Stiefel manifold.* Math. Model. Numer. Anal. (2022).

[2] R. Altmann, P. Henning, D. Peterseim, *Localization and delocalization of ground states of Bose-Einstein condensates under disorder.* SIAM J. Appl. Math. **82(1)** (2022), 330-358.

[3] R. Altmann, P. Henning and D. Peterseim, *Numerical homogenization beyond scale separation.* Acta Numer. **30(1)** (2021), 1-86.

[4] R. Altmann, D. Peterseim, *The J-method for the Gross-Pitaevskii eigenvalue problem.* Numer. Math. **148(3)** (2021), 575-610.

[5] P. Henning, D. Peterseim, *Sobolev gradient flow for the Gross-Pitaevskii eigenvalue problem: global convergence and computational efficiency.* SIAM J. Numer. Anal. **58(3)** (2020), 1744-1772.

[6] R. Altmann, P. Henning, D. Peterseim, *Quantitative Anderson localization of Schrödinger eigenstates under disorder potentials.* Math. Models Methods Appl. Sci. **30(5)** (2020), 917-955.

[7] R. Altmann, D. Peterseim, *Localized computation of eigenstates of random Schrödinger operators.* SIAM J. Sci. Comput. **41** (2019), B1211-B1227.

[8] H. Alaeian, M. Schedensack, C. Bartels, D. Peterseim, and M. Weitz, *Thermo-optical interactions in a dye-microcavity photon Bose-Einstein condensate.* New J. Phys. **19(11)** (2017), 115009.

[9] P. Henning, A. Målqvist, D. Peterseim, *Two-level discretization techniques for ground state computations of Bose-Einstein condensates.* SIAM J. Numer. Anal. **52(4)** (2014), 1525-1550.

ADAPTIVE FEM WITH QUASI-OPTIMAL COST FOR NONLINEAR PDES

Dirk Praetorius
TU Wien

We consider nonlinear elliptic PDEs with strongly monotone nonlinearity. We apply an adaptive finite element method

$$\boxed{\text{SOLVE \& ESTIMATE}} \longrightarrow \boxed{\text{MARK}} \longrightarrow \boxed{\text{REFINE}}$$

which steers the linearization as well as the iterative solution of the arising linear finite element systems. We prove that the proposed algorithm guarantees *full linear convergence*, i.e., linear convergence in each step, independently of the algorithmic decision for mesh-refinement, linearization, or algebraic solver step. For sufficiently small adaptivity parameters, this allows to mathematically guarantee *optimal convergence with respect to the overall computational work*, i.e., the quasi-error decays with optimal algebraic rate when plotted versus the cumulative computational time.

The talk is based on joint work [1, 2, 3].

[1] G. Gantner, A. Haberl, D. Praetorius, S. Schimanko, *Rate optimality of adaptive finite element methods with respect to the overall computational costs.* Math. Comp., 90 (2021), 2011–2040.

[2] A. Haberl, D. Praetorius, S. Schimanko, M. Vohralik, *Convergence and quasi-optimal cost of adaptive algorithms for nonlinear operators including iterative linearization and algebraic solver.* Numer. Math., 147 (2021), 679–725.

[3] P. Heid, D. Praetorius, T. Wihler, *Energy contraction and optimal convergence of adaptive iterative linearized finite element methods.* Comput. Methods Appl. Math., 21 (2021), 407–422.

DOUBLY NONLINEAR STOCHASTIC EVOLUTION EQUATIONS

Ulisse Stefanelli
Faculty of Mathematics, University of Vienna

I will review some recent results on doubly nonlinear parabolic SPDEs in Hilbert spaces [1, 2, 3], obtained in collaboration with Luca Scarpa (Politecnico di Milano, Italy).

Doubly nonlinear parabolic PDEs arise in combination with a variety of applications, including nonlinear diffusion, phase transition, and mechanics. In the deterministic case, existence, approximation, and long-time behavior results are obtained by variational methods.

The variational theory can be partly extended to the stochastic setting. I will comment on existence results based on regularization procedures. Both nonlinear viscous and degenerate rate-independent cases will be discussed.

[1] L. Scarpa, U. Stefanelli, *Doubly nonlinear stochastic evolution equations.* Math. Models Methods Appl. Sci. **30** (2020), 991–1031

[2] L. Scarpa, U. Stefanelli, *Doubly nonlinear stochastic evolution equations II.* Stoch. Partial Differ. Equ. Anal. Comput. To appear (2022). `arXiv:2009.08209`

[3] L. Scarpa, U. Stefanelli, *Rate-independent stochastic evolution equations: parametrized solutions.* Submitted (2021). `arXiv:2109.15208`

PERIODIC SOLUTIONS OF THE LORENTZ FORCE EQUATION

Pedro J. Torres
University of Granada

This is a joint work with Manuel Garzón (University of Granada, Spain), based on the recent papers [1, 2].

According to classical Electrodynamics, the motion of a slowly accelerated charged particle $q(t)$ in an electromagnetic field is ruled by the classical Lorentz Force equation (LFE), which is one the fundamental equations in Mathematical Physics and has its origin in the pioneering works of Poincaré and Planck. The dynamical system under study is

$$\frac{d}{dt}\left(\frac{\dot{q}(t)}{\sqrt{1-|\dot{q}(t)|^2}}\right) = E(t,q(t)) + \dot{q}(t)\times B(t,q(t)). \tag{4}$$

where $E:[0,T]\times\mathbb{R}^3\to\mathbb{R}^3$ and $B:[0,T]\times\mathbb{R}^3\to\mathbb{R}^3$ are the electric and magnetic field respectively, while the left-hand side denotes the relativistic acceleration of the particle, which implies the characteristic speed limitation of Special Relativity (here the speed of light is normalized to $c=1$). The electromagnetic field

(E, B) must be solution of Maxwell's equations for suitable charge and current densities.

The general aim of the talk is to consider a time-periodic dependence of the electromagnetic field (E, B) and then study sufficient conditions for the existence of periodic solutions of the LFE.

[1] M. Garzón, P.J. Torres, *Periodic solutions for the Lorentz force equation with singular potentials*, Nonlinear Analysis: Real World Applications Vol. 56 (2020), 103162

[2] M. Garzón, P.J. Torres, *Periodic dynamics in the relativistic regime of an electromagnetic field induced by a time-dependent wire*, submitted

Scientific program in details

MONDAY – JULY 11

9:00–9:15 **Opening Ceremony (Room 101 – aula)**

MONDAY – PLENARY LECTURES

Aula Chairman: Alessandro Fonda

9:15–10:10 **Stefan Siegmund** (Germany)
Maxwell's equations revisited - mental imagery and mathematical symbols

10:15–10:45 *Coffee break*

Chairman: Juncheng Wei

10:45–11:40 **Mária Lukáčová-Medviďová** (Germany)
Dissipative solutions for compressible fluid flows

MONDAY – INVITED LECTURES

Room 102 (ODE) Chairman: Pedro Torres

11:50–12:25 **Elena Braverman** (USA)
On the connection of differential, difference, delay and dynamic equations

12:30–14:00 *Lunch*

Room 104 (PDE) Chairman: Vincenzo Ambrosio

11:50–12:25 **Agniezska Świerczewska-Gwiazda** (Poland)
Onsager's conjecture for general conservation laws

12:30–14:00 *Lunch*

Room 106 (NAA) Chairman: Douglas Arnold

11:50–12:25 **Dirk Praetorius** (Austria)
Adaptive FEM with quasi-optimal cost for nonlinear PDEs

12:30–14:00 *Lunch*

MONDAY – ODE MINISYMPOSIA

Room 102 Keynote speaker: Jan Tomeček

ODE-11 Recent progress in boundary value problems for differential equations

14:00–14:25 **Jan Tomeček** (Czech Republic)
Multiple solutions of certain Dirichlet problems in billiard spaces

14:30–14:55 **Olena Atlasiuk** (Czech Republic)
Linear ordinary differential systems with generic inhomogeneous boundary conditions in Sobolev spaces

15:00–15:25 **Jan Andres** (Czech Republic)
Topological entropy and differential equations

15:30–15:55 **Milan Tvrdý** (Czech Republic)
Duality for Stieltjes integral equations

16:00–16:30 *Coffee break*

Room 302a Keynote speaker: Hideaki Matsunaga

ODE-01 Qualitative theory of delay differential and difference equations

14:00–14:25 **Junya Nishiguchi** (Japan)
Critical delay and stability for linear delay differential equations

14:30–14:55 **Kodai Fujimoto** (Japan)
Singular solutions of ordinary differential equations with $p(t)$-Laplacian

15:00–15:25 **Robert Hakl** (Czech Republic)
Periodic, permanent, and extinct solutions in population models

15:30–15:55 **Hideaki Matsunaga** (Japan)
Stability switches in linear delay differential equations

16:00–16:30 *Coffee break*

Room 302b Keynote speaker: Jelena Manojlović

ODE-08 Karamata theory of regular variation and its application to asymptotic theory of differential, difference and q-difference equations

14:00–14:25 **Jelena Manojlović** (Serbia)
Strongly monotone solutions of systems of nonlinear differential equations with rapidly varying coefficients

14:30–14:55 **Katarina Djordjević** (Serbia)
Application of the Karamata theory in the study of asymptotic properties of the half-linear q-difference equation

15:00–15:25 **Aleksandra B. Kapešić** (Serbia)
Decreasing solutions of cyclic systems of second-order Emden-Fowler type difference equations

15:30–15:55 **Vladimir Rasvan** (Romania)
Critical cases in neutral functional differential equations arising from hydraulic engineering

16:00–16:30 *Coffee break*

MONDAY – ODE CONTRIBUTED TALKS

Room 102 Chairman: Jaqueline Godoy Mesquita

16:30–16:45 **Renato Huzak** (Belgium)
Predator-prey slow-fast cycles and Hilbert's 16th problem

16:50–17:05 **Petr Zemánek** (Czech Republic)
Discrete symplectic systems and eigenfuctions expansion

17:10–17:25 **Luděk Nechvátal** (Czech Republic)
Linearized stability for fractional differential and difference equations

17:30–17:45 **Paolo Gidoni** (Czech Republic)
A topological degree theory for rotating solutions of planar systems

19:00 *Welcome party*

Room 302a Chairman: Anatoli Ivanov

16:30–16:45 **Jana Burkotová** (Czech Republic)
Bouncing solutions of generalized Lazer-Solimini equation

16:50–17:05 **Filip Ficek** (Poland)
Stationary solutions of semilinear Schröedinger equations with trapping potentials in supercritical dimensions

17:10–17:25 **István Balázs** (Hungary)
Global stability for price models with delay

17:30–17:45 **Jan Jekl** (Czech Republic)
Recent results in the theory of p-critical linear even-order difference equations

19:00 *Welcome party*

Room 302b Chairman: Teresa Faria

16:30–16:45 **Lucia Lopez-Somoza** (Spain)
Lower and upper functions method for even order boundary value problems

16:50–17:05 **Tomoharu Suda** (Japan)
Equivalence of ill-posed dynamical systems

17:10–17:25 **Marc Homs-Dones** (UK)
Simplest bifurcation diagram of vector fields on a torus

17:30–17:45 **Satyam Narayan Srivastava** (Israel)
Vallée-Poussin theorem for fractional functional differential equations

19:00 *Welcome party*

MONDAY – PDE MINISYMPOSIA

Room 104 Keynote speaker: Miroslav Bulíček

PDE-04 Open systems in PDE describing flows of fluids

14:00–14:25 **Miroslav Bulíček** (Czech Republic)
Convergence to equilibria for weak solutions of heat conducting non-Newtonian fluids

14:30–14:55 **Daniel Lear** (Czech Republic)
Traveling waves close to the Couette flow

15:00–15:25 **Josef Málek** (Czech Republic)
On rate-type viscoelastic fluids with stress diffusion and their large-data analysis

15:30–15:55 **Casey Rodriguez** (USA)
On elastic strain-limiting special Cosserat rods

16:00–16:30 *Coffee break*

Room 103 Keynote speaker: Philippe Souplet

PDE-08 Qualitative behavior in nonlinear parabolic problems

14:00–14:25 **Piotr Biler** (Poland)
Large global solutions of the parabolic-parabolic Keller-Segel system, and blowup for related toy models

14:30–14:55 **Phillipe Laurencot** (France)
TBA

15:00–15:25 **Carlos Esteve Yague** (UK)
Boundary behaviour for viscous and inviscid Hamilton-Jacobi equations

15:30–15:55 **Philippe Pierre Souplet** (France)
Diffusive Hamilton-Jacobi equations and their singularities

16:00–16:30 *Coffee break*

Room 309 Keynote speaker: Matteo Franca

PDE-11 Qualitative behavior of nonlinear Laplace and p-Laplace equations

14:00–14:25 **Matteo Franca** (Italy)
Ordering properties for radial solutions of p-Laplace equations

14:30–14:55 **Francesca Colasuonno** (Italy)
Two solutions to a p-Laplacian supercritical Neumann problem: existence and asymptotics

15:00–15:25 **Francesca Dalbono** (Italy)
A bifurcation phenomenon for the critical Laplace and p-Laplace equation in the ball

15:30–15:55 **Soohyun Bae** (Republic of Korea)
Asymptotic behavior of singular solutions of nonlinear elliptic equations

16:00–16:30 *Coffee break*

MONDAY – PDE CONTRIBUTED TALKS

Room 104 Chairman: Pavel Drábek

16:30–16:45 **Masaaki Mizukami** (Japan)
Blow-up in a two-species chemotaxis-competition system

16:50–17:05 **Tai Phuoc Nguyen** (Czech Republic)
Semilinear nonlocal elliptic equations involving measures

17:10–17:25 **Saadet Erbay** (Turkey)
Convergence of the nonlocal nonlinear equation to the nonlinear elasticity equation

17:30–17:45 **Karol Wojciech Hajduk** (Poland)
Towards global existence in the 3D chemorepulsion system

19:00 *Welcome party*

Room 103 Chairman: Phillipe Laurencot

16:30–16:45 **Matteo Rizzi** (Germany)
Normalised solutions to semilinear equations with potential

16:50–17:05 **Erika Maringová** (Austria)
On implicit constitutive relations to parabolic problems

17:10–17:25 **Igor Kossowski** (Poland)
Nonlocal heat equations with generalized fractional Laplacian

17:30–17:45 **Władysław Jan Klinikowski** (Poland)
Periodic solutions of nonlinear damped wave equations on $\mathbb{R}^N$

19:00 *Welcome party*

MONDAY – NAA MINISYMPOSIA

Room 106 Keynote speaker: Robert Nürnberg

NAA-09 Finite element methods for geometric PDEs

14:00–14:25 **Robert Nürnberg** (Italy)
A generalized DeTurck trick for anisotropic curve shortening flow

14:30–14:55 **Tim Binz** (Germany)
TBA

15:00–15:25 **Björn Stinner** (UK)
Convergent FE schemes using the Dirichlet energy for mesh smoothing

15:30–15:55 **Elena Bachini** (Germany)
An intrinsic finite element method for PDEs on surfaces

16:00–16:30 *Coffee break*

Room 310 Keynote speaker: Thomas Richter

NAA-10 Hybrid pde simulations using deep neural networks

14:00–14:25 **Thomas Richter** (Germany)
Hybridization of finite element and neural network simulations

14:30–14:55 **Alexander Heinlein** (Netherlands)
Surrogate models for computational fluid dynamics simulations using convolutional autoencoder neural networks and physical constraints

15:00–15:25 **Robert Jendersie** (Germany)
Enhancing a multigrid solver for the Navier-Stokes equations with deep learning

16:00–16:30 *Coffee break*

MONDAY – NAA CONTRIBUTED TALKS

Room 106 Chairman: Patrick Farrell

16:30–16:45 **Michal Beneš** (Czech Republic)
Normal and binormal motion of interacting curves in space

16:50–17:05 **Husnu Ata Erbay** (Turkey)
Error estimates of a semi-discrete numerical scheme for nonlocally regularized KdV-type equations

17:10–17:25 **Teresa Kunkel** (Germany)
Observer-based data assimilation for isothermal gas transport using distributed measurements

17:30–17:45 **Jiten C. Kalita** (India)
Computation of flow past cactus-shaped cylinders: A hybrid immersed interface approach

19:00 *Welcome party*

TUESDAY – JULY 12

TUESDAY – PLENARY LECTURES

Aula Chairman: Eduard Feireisl

9:00–9:55 **Douglas Norman Arnold** (USA)
TBA

10:00–10:25 *Coffee break*

TUESDAY – INVITED LECTURES

Room 102 (ODE) Chairman: Mihály Pituk

10:30–11:05 **Masakazu Onitsuka** (Japan)
Ulam stability of generalized logistic equations

11:10–11:45 **Jan Čermák** (Czech Republic)
Stability regions for linear fractional and delay differential equations

12:00–14:00 *Lunch*

Room 104 (PDE) Chairman: Agnieszka Świerczewska-Gwiazda

10:30–11:05 **Ulisse Stefanelli** (Austria)
Doubly nonlinear stochastic evolution equations

11:10–11:45 **Gianluca Crippa** (Switzerland)
An elementary proof of existence and uniqueness for the Euler flow in uniformly localized Yudovich spaces

12:00–14:00 *Lunch*

Room 106 (NAA) Chairman: Dirk Praetorius

10:30–11:05 **Barbara Wohlmuth** (Germany)
TBA

11:10–11:45 **Ulrik Skre Fjordholm** (Norway)
Numerical methods for conservation laws on networks

12:00–14:00 *Lunch*

TUESDAY – ODE MINISYMPOSIA

Room 102 Keynote speakers: Serena Matucci, Pavel Řehák

ODE-07 Asymptotic theory of differential and integral equations

14:00–14:25 **Serena Matucci** (Italy)
Existence and multiplicity of decaying solutions to BVP on the half-line for nonlinear equations with p-Laplacian

14:30–14:55 **Luisa Malaguti** (Italy)
Diffusion-convection reaction equations with sign-changing diffusivity

15:00–15:25 **Paola Rubbioni** (Italy)
Asymptotic stability of solutions of differential equations with delay

15:30–15:55 **Pavel Řehák** (Czech Republic)
Nonlinear Poincaré–Perron theorem

16:00–16:30 *Coffee break*

Room 302a Keynote speaker: Roberta Fabbri

ODE-05 Qualitative theory for linear Hamiltonian systems and nonautonomous dynamical systems

14:00–14:25 **Roberta Fabbri** (Italy)
Some results for nonautonomous linear Hamiltonian systems

14:30–14:55 **Peter Šepitka** (Czech Republic)
New comparison theorems for solutions of Riccati matrix differential equations without controllability condition

15:00–15:25 **Abel Garab** (Austria)
Absence of small solutions and existence of Morse decomposition for a cyclic system of delay differential equations

Abel Garab (Austria)
Absence of small solutions and existence of Morse decomposition for a cyclic system of delay differential equations

15:30–15:55 **Ana M. Sanz** (Spain)
Qualitative theory for monotone and sublinear non-autonomous finite-delay FDEs for an exponential ordering

16:00–16:30 *Coffee break*

Room 302b Keynote speaker: Agnieszka Malinowska

ODE-04 On consensus in multi-agent Systems

14:00–14:25 **Agnieszka B. Malinowska** (Poland)
Stability of multi-agents systems under DoS attacks

14:30–14:55 **Ewa Girejko** (Poland)
On impact of disturbance in the deployment problem of multi-agent system

15:00–15:25 **Dorota Mozyrska** (Poland)
Numerical simulations of fractional consensus approach in attitude dynamics modeling

15:30–15:55 **Malgorzata Wyrwas** (Poland)
Consensus of a fractional model in attitude dynamics

16:00–16:30 *Coffee break*

TUESDAY – ODE CONTRIBUTED TALKS

Room 102 Chairman: Milan Tvrdý

16:30–16:45 **Tomáš Kisela** (Czech Republic)
Oscillatory properties of fractional delay differential equations

16:50–17:05 **Giselle A. Monteiro** (Czech Republic)
On discontinuous sweeping processes and vanishing viscosity approximations

17:10–17:25 **Shuenn-Yih Chang** (Taiwan)
Problem-dependent formulas for solving stiff problems

17:30 *Poster session*

Room 302a Chairman: Josef Diblík

16:30–16:45 **Michal Veselý** (Czech Republic)
Perturbations of homogeneous linear difference systems with coefficient matrices from commutative groups

16:50–17:05 **Hiroshi Kajimoto** (Japan)
Ordinary differential equations derived from cluster integrals

17:10–17:25 **Jiřina Šišoláková** (Czech Republic)
Non-oscillation of linear and half-linear Euler type differential equations

17:30 *Poster session*

Room 302b Chairman: Feliz Minhós

16:30–16:45 **Jorge Rodríguez-López** (Spain)
Transversality conditions for discontinuous differential equations

16:50–17:05 **Martina Pavlačková** (Czech Republic)
Semilinear second-order differential inclusions in abstract spaces

17:10–17:25 **Natalia Dilna** (Slovak Republic)
D-stability of the initial value problem for symmetric nonlinear functional differential equations

17:30 *Poster session*

TUESDAY – PDE MINISYMPOSIA

Room 104 Keynote speaker: Antonín Slavík, Petr Stehlík

PDE-01 Spatially discrete evolution equations

14:00–14:25 **Hermen Jan Hupkes** (Netherlands)
Discrete mean curvature flows

14:30–14:55 **Vladimír Švígler** (Czech Republic)
Propagation reversal for bistable differential equations on trees

15:00–15:25 **Antonín Slavík** (Czech Republic)
Spatial maxima, unimodality, and asymptotic behavior of solutions to discrete diffusion equation

15:30–15:55 **Petr Stehlík** (Czech Republic)
Bifurcations in Nagumo equations on graphs

16:00–16:30 *Coffee break*

Room 103 Keynote speaker: Roman Shvydkoy

PDE-07 Hydrodynamics of collective behavior

14:00–14:25 **Roman Shvydkoy** (USA)
Global hypocoercivity of Fokker-Plank-Alignment models

14:30–14:55 **Daniel Lear** (Czech Republic)
Unidirectional flocks in collective dynamics

15:00–15:25 **Trevor M. Leslie** (USA)
Sticky Particle Methods for the 1D Euler Alignment System

15:30–15:55 **Jan Peszek** (Poland)
Heterogeneous gradient flows with applications to collective dynamics

16:00–16:30 *Coffee break*

TUESDAY – PDE CONTRIBUTED TALKS

Room 104 Chairman: Ulisse Stefanelli

16:30–16:45 **Pavel Drábek** (Czech Republic)
On Szegö–Weinberger inequalities for special type of domains

16:50–17:05 **Lukáš Kotrla** (Czech Republic)
Comparison principles in problems with p-Laplacian

17:10–17:25 **Jiří Benedikt** (Czech Republic)
Maximum principles for parabolic p-Laplacian problems

17:30 *Poster session*

Room 103 Chairman: George Avalos

16:30–16:45 **Jan Eisner** (Czech Republic)
Critical points for reaction diffusion system with unilateral conditions

16:50–17:05 **Andrii Khrabustovskyi** (Czech Republic)
Operator estimates for homogenization in perforated domains

17:10–17:25 **Sumit Arora** (India)
Finite-approximate controllability of fractional functional evolution equation via variational approach

17:30 *Poster session*

Room 309 Chairman: Casey Rodriguez

16:30–16:45 **Angela Bašić-Šiško** (Croatia)
Existence and uniqueness of a generalized solution to the one-dimensional flow and thermal explosion micropolar reactive real gas model

16:50–17:05 **Gaukhar Shaikhova** (Kazakhstan)
Integrable nonlocal AKNS equations

17:10–17:25 **Sunanda Saha** (India)
Time-dependent water-wave scattering by a bottom-mounted porous compound cylinder

17:30 *Poster session*

TUESDAY – NAA MINISYMPOSIA

Room 106 Keynote speaker: Klemens Fellner

NAA-03 Evolution differential equations with application to physics and biology II

14:00–14:25 **Klemens Fellner** (Austria)
Oscillatory behaviour of a nonlinear Becker-Döring type model for prion dynamics

14:30–14:55 **Michael Kniely** (Germany)
Global weak and renormalized solutions to a class of energy-reaction-diffusion systems

15:00–15:25 **Martin Brokate** (Germany)
Strong stationarity for an optimal control problem for a rate independent evolution

15:30–15:55 **Bao Quoc Tang** (Austria)
On dissipative reaction-diffusion systems

16:00–16:30 *Coffee break*

Room 310 Keynote speaker: Karen Veroy-Grepl

NAA-05 Informing physics-based models through data

14:00–14:25 **Karen Veroy-Grepl** (Netherlands)
TBA

14:30–14:55 **Han Cheng Lie** (Germany)
Overconfidence in numerical Bayesian inference

15:00–15:25 **Laura Scarabosio** (Netherlands)
Bayesian calibration and comparison of models of tumour cell dynamics

15:30–15:55 **Masoumeh Dashti** (UK)
Nonparametric Bayesian inference of discretely observed diffusions

16:00–16:30 *Coffee break*

Room 309 Keynote speaker: Max Jensen

NAA-07 Computational methods for fully nonlinear equations and applications

14:00–14:25 **Max Jensen** (United Kingdom)
Discretising boundary conditions of fully nonlinear equations

14:30–14:55 **Indranil Chowdhury** (Croatia)
On numerical schemes for fractional order Mean Field Games

15:00–15:25 **Dietmar Gallistl** (Germany)
Convergence of a regularized finite element discretization of the two–dimensional Monge–Ampère equation

15:30–15:55 **Iain Smears** (UK)
Adaptive methods for fully nonlinear PDE

16:00–16:30 *Coffee break*

TUESDAY – NAA CONTRIBUTED TALKS

Room 106 Chairman: Michal Beneš

16:30–16:45 **Petr Tomášek** (Czech Republic)
Numerical solution of Caputo fractional differential equations initial value problems

16:50–17:05 **Utku Kaya** (Germany)
Local pressure-corrections for incompressible flows

17:10–17:25 **Sunčica Sakić** (Czech Republic)
On the error analysis of the time-continuous Discontinuous Galerkin scheme for degenerate parabolic equations

17:30 *Poster session*

WEDNESDAY – JULY 13

WEDNESDAY – PLENARY LECTURES

Aula Chairman: Mária Lukáčová-Medviďová

8:30–9:25 **Juncheng Wei** (Canada)
Stability of Sobolev inequalities and related topics

9:30–10:00 *Coffee break*

WEDNESDAY – OTHER PROGRAM

10:00–11:55 MINISYMPOSIA (see below)

12:00 *Lunch*

13:15 *Trip – meeting*

13:30 *Trip – boarding*

13:40 *Trip – departure*

WEDNESDAY – ODE MINISYMPOSIA

Room 102 Keynote speaker: Mihály Pituk

ODE-03 Qualitative properties of ordinary and delay differential equations

10:00–10:25 **Mihály Pituk** (Hungary)
Explicit values of the oscillation bounds for linear delay differential equations

10:30–10:55 **Davor Dragičević** (Croatia)
Shadowing for nonautonomous differential equations

11:00–11:25 **Teresa Faria** (Portugal)
Permanence and stability for a Nicholson's equation with mixed monotonicities

11:30–11:55 **Tibor Krisztin** (Hungary)
Periodic and connecting orbits for Mackey–Glass type equations

Room 103 Keynote speaker: Alexander Domoshnitsky

ODE-02 Stability of functional differential equations

10:00–10:25 **Alexander Domoshnitsky** (Israel)
On stability of delay differential equations

10:30–10:55 **Anatoli F. Ivanov** (USA)
Global asymptotic stability and periodic solutions in scalar differential delay equations

11:00–11:25 **Irada A. Dzhalladova** (Czech Republic)
Dynamical system with the non-Markovian process: stability and optimization

11:30–11:55 **Cemil Tunç** (Turkey)
TBA

Room 309 Keynote speaker: Alberto Cabada

ODE-09 Topological and iterative methods on boundary value problems

10:00–10:25 **Alberto Cabada** (Spain)
Comparison results for local and nonlocal linear boundary value problems

10:30–10:55 **Sladana B. Dimitrijević** (Serbia)
The existence of a solution for nonlinear fractional differential equations where nonlinear term depends on the fractional and first order derivative of an unknown function

11:00–11:25 **Feliz Minhós** (Portugal)
On impulsive functional coupled systems of differential equations

11:30–11:55 **Mirosława Zima** (Poland)
Positive solutions for second order damped boundary value problems

WEDNESDAY – PDE MINISYMPOSIA

Room 104 Keynote speaker: Šárka Nečasová

PDE-03 Mathematical analysis: the interaction of fluids and solids

10:00–10:25 **Šárka Nečasová** (Czech Republic)
Existence of a weak solution to the problem of an interaction of compressible fluid with elastic structure

10:30–10:55 **Justin T. Webster** (USA)
Semigroup generation for Biot-Stokes interactions

11:00–11:25 **Boris Muha** (Croatia)
Fluid - Poroelastic Structure Interactions

11:30–11:55 **George Avalos** (USA)
Qualitative properties of a multilayered elasticity system - Stokes interaction

Room 302a Keynote speaker: Teresa Isernia

PDE-12 Nonlinear elliptic PDEs

10:00–10:25 **Teresa Isernia** (Italy)
Multiplicity and concentration results for some nonlinear Schrödinger equations with the fractional p-Laplacian

10:30–10:55 **Bartosz Bieganowski** (Poland)
Normalized ground states of the nonlinear Schrödinger equation with at least mass critical growth

11:00–11:25 **Laura Baldelli** (Poland)
Nonlinear elliptic critical problems in $\mathbb{R}^N$

11:30–11:55 **Ángel Crespo-Blanco** (Germany)
Parametric superlinear double phase problems with singular term and critical growth on the boundary

Room 302b Keynote speaker: Vít Průša

PDE-09 Complex dynamical systems in continuum mechanics

10:00–10:25 **Vít Průša** (Czech Republic)
Non-Linear stability and non-equilibrium thermodynamics – There and back again

10:30–10:55 **Angiolo Farina** (Czech Republic)
Mathematical modelling of viscoplastic flows

11:00–11:25 **Laurent Martin Witkowski** (Czech Republic)
On the role of arbitrary pollution effects on the stability of swirling free-surface flows

11:30–11:55 **Nicolas Boulle** (Czech Republic)
Bifurcation analysis of Rayleigh-Bénard convection using deflation

Room 310 Keynote speaker: Dan Goreac

PDE-10 Differential equations with random features and applications

11:00–11:25 **Dan Goreac** (China)
HJB approach to stochastic models of epidemics

11:30–11:55 **Eduard Rotenstein** (Romania)
Nonlinear Fokker-Planck equation on unbounded domain and featuring generalized reflecting boundary conditions

WEDNESDAY – NAA MINISYMPOSIA

Room 106 Keynote speaker: Martin Vohralík

NAA-01 Error control and adaptivity in numerical simulations

10:00–10:25 **Martin Vohralík** (France)
Error control and adaptivity in numerical simulations

10:30–10:55 **Tomáš Vejchodský** (Czech Republic)
A posteriori error bounds for eigenfunctions

11:00–11:25 **Philip Lukas Lederer** (France)
A note on asymptotically exact a posteriori error estimates for mixed Laplace eigenvalue problems

11:30–11:55 **Ani Miraçi** (Austria)
A-posteriori-steered h- and p-robust multigrid solvers

Room 310 Keynote speaker: Victor A. Kovtunenko

NAA-02 Evolution differential equations with application to physics and biology I

10:00–10:25 **Victor A. Kovtunenko** (Austria)
On solution of initial boundary value problems in hypoplasticity

10:30–10:55 **Tran Bao Ngoc** (Austria)
QSSA of the Michaelis-Menten reaction-diffusion system

THURSDAY – JULY 14

THURSDAY – PLENARY LECTURES

Aula Chairman: Barbara Kaltenbacher

9:00–9:55 **Alessandro Fonda** (Italy)
Generalizations of the Poincaré – Birkhoff Theorem for Hamiltonian systems

10:00–10:30 *Coffee break*

THURSDAY – INVITED LECTURES

Room 102 (ODE) Chairman: Elena Braverman

10:30–11:05 **Jean-Philippe Lessard** (Canada)
TBA

11:10–11:45 **Jaqueline Godoy Mesquita** (Brazil)
Linearized instability for neutral functional differential equations with state-dependent delays

12:00–14:00 *Lunch*

Room 104 (PDE) Chairman: Gianluca Crippa

10:30–11:05 **Dorin Bucur** (France)
Shape optimization in Stokes fluids

11:10–11:45 **Vincenzo Ambrosio** (Italy)
Fractional periodic problems with critical growth

12:00–14:00 *Lunch*

Room 106 (NAA) Chairman: Barbara Wohlmuth

10:30–11:05 **Daniel Peterseim** (Germany)
Nonlinear eigenvector problems and the simulation of Bose-Einstein condensates

11:10–11:45 **Patrick Farrell** (UK)
New finite elements for extremely high-order FEM

12:00–14:00 *Lunch*

ERC PRESENTATION

Room 102 Chairman: Josef Málek

16:30 ERC presentation

THURSDAY – ODE MINISYMPOSIA

Room 102 Keynote speaker: Josef Diblík

ODE-10 Advanced, delayed and mixed equations. Representation of solutions, boundedness, stability

14:00–14:25 **Josef Diblík** (Czech Republic)
Exponential stability of linear delayed equations

14:30–14:55 **Ferenc Hartung** (Hungary)
Differentiability of solutions with respect to parameters in a class of neutral differential equations with state-dependent delays

15:00–15:25 **Gergely Röst** (Hungary)
Hopf bifurcation made simple for some scalar DDEs

15:30–15:55 **Abel Garab** (Austria)
Sharp oscillation criteria for first order linear differential equations with variable delays

16:00–16:30 *Coffee break*

Room 103 Keynote speaker: Guglielmo Feltrin, Elisa Sovrano

ODE-06 Advances for problems with nonlinear differential operators

13:30–13:55 **Elisa Sovrano** (Italy)
Reactive-convective Perona-Malik equations: regular vs. nonregular wavefronts

14:00–14:25 **Maurizio Garrione** (Italy)
Nonlinear diffusions and wave fronts: some recent results

14:30–14:55 **Katarzyna Szymańska-Dębowska** (Poland)
Differential equations involving homeomorphism with nonlinear boundary conditions

15:00–15:25 **Eduardo Muñoz-Hernández** (Spain)
Nodal solutions in a class of Sturm-Liouville BVP's with nonnegative degenerate weights

15:30–15:55 **Guglielmo Feltrin** (Italy)
Periodic solutions to a perturbed relativistic Kepler problem

16:00–16:30 *Coffee break*

THURSDAY – ODE CONTRIBUTED TALKS

Room 302a Chairman: Jan Čermák

16:30–16:45 **Petr Hasil** (Czech Republic)
Riccati technique and conditional oscillation of second order equations

16:50–17:05 **Arun Kumar Tripathy** (India)
Oscillation criteria for 2-dim nonlinear neutral differential systems

17:10–17:25 **Irena Jadlovská** (Slovensko)
Kneser oscillation theorem for second-order half-linear delay differential equations

17:30–17:45 **Zuzana Pátíková** (Czech Republic)
Neutral half-linear differential equations and the modified Riccati technique

19:00 *Conference dinner*

Room 302b Chairman: Davor Dragičević

16:30–16:45 **Ignacio Marquez Albes** (Spain)
Second order Stieltjes derivatives and differential equations

16:50–17:05 **Mónika Polner** (Hungary)
Bifurcations of neural fields on the sphere

17:10–17:25 **Viera Štoudková Růžičková** (Czech Republic)
Discrete Riccati matrix equation and the order preserving property

17:30–17:45 **Gabriela Vážanová** (Czech Republic)
Asymptotic behavior of solutions to an advance-delay differential equation

19:00 *Conference dinner*

THURSDAY – PDE MINISYMPOSIA

Room 104 Keynote speaker: Milan Pokorný

PDE-06 Analysis of compressible multiphase systems

14:00–14:25 **Milan Pokorný** (Czech Republic)
Two-phase compressible/incompressible Navier–Stokes system with inflow-outflow boundary conditions

14:30–14:55 **Nilasis Chaudhuri** (UK)
Analysis of generalized Aw-Rascle system

15:00–15:25 **Cheng Yu** (USA)
Infinitely many solutions to the isentropic system of gas dynamics

15:30–15:55 **Nicola Zamponi** (Austria)
Nonisothermal Richards flow in porous media with cross diffusion

16:00–16:30 *Coffee break*

Room 302a Keynote speaker: Aneta Wróblewska-Kamińska

PDE-05 Analysis of multiscale problems in PDEs

14:00–14:25 **Aneta Wróblewska-Kamińska** (Poland)
Multiscale analysis, low Mach number limit: from compressible to incompressible system

14:30–14:55 **Matteo Caggio** (Czech Republic)
Low Mach number flows and dimension reduction in fluid mechanics

15:00–15:25 **Tomasz Debiec** (France)
Incompressible limit for a two-species tumour growth model

15:30–15:55 **Václav Mácha** (Czech Republic)
Low stratification of the complete Euler system

16:00–16:30 *Coffee break*

Room 302b Keynote speaker: Sebastian Schwarzacher

PDE-02 Analysis for fluid-structure interactions

14:00–14:25 **Sebastian Schwarzacher** (Czech Republic)
Contactless rebound of elastic bodies in a viscous incompressible fluid

14:30–14:55 **Barbora Benešová** (Czech Republic)
A variational approach to fluid structure interaction

15:00–15:25 **Richard Höfer** (France)
Homogenization of the Navier-Stokes equations in perforated domains in the inviscid limit

15:30–15:55 **Srdan Trifunović** (Serbia)
Time-periodic solutions to a compressible fluid and beam interaction problem

16:00–16:30 *Coffee break*

THURSDAY – PDE CONTRIBUTED TALKS

Room 104 Chairman: Dorin Bucur

16:30–16:45 **Marko Radulovic** (Croatia)
The effects of viscous dissipation on the Darcy–Brinkman flow

16:50–17:05 **Volodymyr Mikhailets** (Ukraine)
Parabolic boundary-value problems in generalized Sobolev spaces

17:10–17:25 **Tomomi Yokota** (Japan)
Stabilization in degenerate parabolic equations in divergence form and application to chemotaxis systems

17:30–17:45 **Phuoc-Truong Huynh** (Austria)
Semilinear nonlocal elliptic equations with source term and measure data

19:00 *Conference dinner*

Room 103 Chairman: Piotr Biler

16:30–16:45 **Tomáš Bárta** (Czech Republic)
Stokes problem with dynamic boundary conditions

16:50–17:05 **Miroslav Kolář** (Czech Republic)
TBA

17:10–17:25 **Dalibor Pražák** (Czech Republic)
On the 2nd order linear ODEs with singular terms

17:30–17:45 **Petr Pauš** (Czech Republic)
Analytical and numerical solution of curve dynamics modeling dislocation dynamics and topological changes

19:00 *Conference dinner*

Room 309 Chairman: Masaaki Mizukami

16:30–16:45 **Yuya Tanaka** (Japan)
Blow-up phenomena in a quasilinear chemotaxis system with logistic source

16:50–17:05 **Malte Kampschulte** (Czech Republic)
Variational methods for non-convex problems involving inertia

17:10–17:25 **Djamal Ait-Akli** (Algeria)
Initial-boundary value problem for second order hyperbolic operator with mixed boundary conditions

17:30–17:45 **Yutaro Chiyo** (Japan)
Behavior of solutions to a quasilinear attraction-repulsion chemotaxis system

19:00 *Conference dinner*

THURSDAY – NAA MINISYMPOSIA

Room 106 Keynote speaker: Robert Scheichl

NAA-04 Numerical homogenisation and multiscale methods

14:00–14:25 **Robert Scheichl** (Germany)
Multiscale spectral generalised finite element methods

14:30–14:55 **Jean Bénézech** (UK)
Scalable MS-GFEM applied to composite aero-structures

15:00–15:25 **Philip Freese** (Germany)
Super-localized orthogonal decomposition for convection-dominated diffusion problems

15:30–15:55 **Kathrin Smetana** (USA)
Randomized multiscale methods for heterogeneous nonlinear PDEs

16:00–16:30 *Coffee break*

Room 309 Keynote speaker: Karel Tůma

NAA-11 Mathematical models and numerical methods in solid mechanics

14:00–14:25 **Karel Tůma** (Czech Republic)
Phase-field model for evolution of martensitic microstructure in shape memory alloys: large-scale finite element simulations

14:30–14:55 **Pablo Alexei Gazca Orozco** (Czech Republic)
Numerical computations for a novel description of rate-type inelastic responses in solids

15:00–15:25 **Mohsen Rezaee Hajidehi** (Poland)
A coupled phase-field and crystal plasticity model for deformation twinning and plastic slip

15:30–15:55 **Miroslav Frost** (Czech Republic)
Numerical implementation of constitutive models of materials with strongly coupled dissipative processes

16:00–16:30 *Coffee break*

Room 310 Keynote speaker: Marie-Therese Wolfram

NAA-08 Structure preserving methods for evolution equations

14:00–14:25 **Marie-Therese Wolfram** (UK)
TBA

14:30–14:55 **Bertram Düring** (UK)
On a structure-preserving variational scheme for nonlinear diffusion equations

15:00–15:25 **Nora Marie Philippi** (Germany)
A structure preserving discretization scheme for gas transport in pipe networks

15:30–15:55 **Rafa Bailo** (UK)
TBA

16:00–16:30 *Coffee break*

THURSDAY – NAA CONTRIBUTED TALKS

Room 106 Chairman: Carola-Bibiane Schönlieb

16:30–16:45 **Miloslav Feistauer** (Czech Republic)
Theory and applications of the DGM in time dependent domains

16:50–17:05 **Vít Dolejší** (Czech Republic)
Discontinuous Galerkin method for nonlinear partial differential equations: goal-oriented error estimates

17:10–17:25 **Irina Raichik** (Israel)
A numerical method to solve Maxwell's equations in 3D singular geometry

17:30–17:45 **Scott Congreve** (Czech Republic)
Iterative discontinuous Galerkin finite element method for strongly monotone quasi-linear PDEs

19:00 *Conference dinner*

FRIDAY – JULY 15

FRIDAY – PLENARY LECTURES

Aula Chairman: Zuzana Došlá

9:00–9:55 **Barbara Kaltenbacher** (Austria)
Mathematics of nonlinear acoustics: modeling, analysis and inverse problems

10:00–10:30 *Coffee break*

FRIDAY – INVITED LECTURES

Room 102 (ODE) Chairman: Jan Andres

10:30–11:05 **Pedro J. Torres** (Spain)
Periodic solutions of the Lorentz force equation

Room 104 (PDE) Chairman: Šárka Nečasová

10:30–11:05 **Philippe Laurencot** (France)
The thin film Muskat problem

Room 106 (NAA) Chairman: Daniel Peterseim

10:30–11:05 **Carola-Bibiane Schönlieb** (UK)
Mathematical imaging: from differential equations to deep learning

FRIDAY – ODE CONTRIBUTED TALKS

Room 102 Chairman: Masakazu Onitsuka

11:20–11:35 **Swaroop Nandan Bora** (India)
New asymptotic stability conditions for linear time-varying fractional systems

11:40–11:55 **Maria Guadalupe Morales Macias** (Czech Republic)
Almost oscillatory fractional differential equations

12:00–12:15 **Vladimir Raichik** (Israel)
About sign-constancy of Green's functions of two-point impulsive boundary value problems

12:30–12:40 *Closing ceremony*

12:45 *Lunch*

Room 103 Chairman: Jan Tomeček

11:20–11:35 **Piotr Stefaniak** (Poland)
Periodic solutions to symmetric Newtonian systems in neighborhoods of orbits of equilibria

11:40–11:55 **Věra Krajščáková** (Czech Republic)
Multiplicity results for bouncing solutions of generalized Lazer-Solimini equation

12:00–12:15 **Michaela Zahradníková** (Czech Republic)
Fisher–Kolmogorov equation with discontinuous density dependent diffusionbulli

12:30–12:40 *Closing ceremony*

12:45 *Lunch*

FRIDAY – PDE CONTRIBUTED TALKS

Room 104 Chairman: Volodymyr Mikhailets

11:20–11:35 **Rakesh Arora** (Czech Republic)
Existence and regularity results for a class of parabolic problems with double phase flux of variable growth

11:40–11:55 **Buddhika Priyasad Sembukutti Liyanage** (Czech Republic)
The existence and dimension of the attractor for the 3D flow of a non-Newtonian fluid subject to dynamic boundary conditions

12:00–12:15 **Hana Levá** (Czech Republic)
Travelling wave solutions of the suspension bridge type equation

12:30–12:40 *Closing ceremony*

12:45 *Lunch*

FRIDAY – PDE+NAA CONTRIBUTED TALKS

Room 106 Chairman: Miloslav Feistauer

11:20–11:35 **Jiří Vala** (Czech Republic)
Numerical approaches to the modelling of fracture in quasi-brittle materials

11:40–11:55 **Jana Radová** (Czech Republic)
Identification of material parameters for Gao beam

12:00–12:15 **Michael Zelina** (Czech Republic)
On the uniqueness of the solution and finite-dimensional attractors for the 3D flow with dynamic boundary condition

12:30–12:40 *Closing ceremony*

12:45 *Lunch*

MONDAY, JULY 11

Plenary lectures

	Aula
9:00–9:15	*Opening Ceremony*
Chairman	Fonda
9:15–10:10	Siegmund
10:15–10:45	*Coffee break*
Chairman	Wei
10:45–11:40	Lukáčová-Medviďová

Invited lectures

	Room 102	**Room 104**	**Room 106**
	ODE SESSION	PDE SESSION	NAA SESSION
Chairman	Torres	Ambrosio	Arnold
11:50–12:25	Braverman	Swierczewska-Gwiazda	Praetorius
12:30–14:00	*Lunch*		

MONDAY, JULY 11

ODE minisymposia

	Room 102	**Room 302a**	**Room 302b**
	ODE MS-11	ODE MS-01	ODE MS-08
14:00–14:25	Tomeček*	Nishiguchi	Manojlović*
14:30–14:55	Atlasiuk	Fujimoto	Djordjević
15:00–15:25	Andres	Hakl	Kapešić
15:30–15:55	Tvrdý	Matsunaga*	Rasvan
16:00–16:30	*Coffee break*		

*Keynote speaker

ODE contributed talks

	Room 102	**Room 302a**	**Room 302b**
Chairman	Godoy Mesquita	Ivanov	Faria
16:30–16:45	Huzak	Burkotová	López-Somoza
16:50–17:05	Zemánek	Ficek	Suda
17:10–17:25	Nechvátal	Balázs	Homs-Dones
17:30–17:45	Gidoni	Jekl	Srivastava
19:00–	*Welcome party*		

MONDAY, JULY 11

PDE minisymposia

	Room 104	**Room 103**	**Room 309**
	PDE MS-04	PDE MS-08	PDE MS-11
14:00–14:25	Bulíček*	Biler	Franca*
14:30–14:55	Lear	Laurencot	Colasuonno
15:00–15:25	Málek	Esteve Yague	Dalbono
15:30–15:55	Rodriguez	Souplet*	Bae
16:00–16:30	*Coffee break*		

*Keynote speaker

PDE contributed talks

	Room 104	**Room 103**
Chairman	Drábek	Laurencot
16:30–16:45	Mizukami	Rizzi
16:50–17:05	Nguyen	Maringová
17:10–17:25	S. Erbay	Kossowski
17:30–17:45	Hajduk	Klinikowski
19:00–	*Welcome party*	

MONDAY, JULY 11

NAA minisymposia

	Room 106	**Room 310**
	NAA MS-09	NAA MS-10
14:00–14:25	Nürnberg*	Richter*
14:30–14:55	Binz	Heinlein
15:00–15:25	Stinner	Jendersie
15:30–15:55	Bachini	
16:00–16:30	*Coffee break*	

*Keynote speaker

NAA contributed talks

	Room 106
Chairman	Farell
16:30–16:45	Beneš
16:50–17:05	H. A. Erbay
17:10–17:25	Kunkel
17:30–17:45	Kalita
19:00–	*Welcome party*

TUESDAY, JULY 12

Plenary lectures

	Aula
Chairman	Feireisl
9:00–9:55	Arnold
10:00–10:30	*Coffee break*

Invited lectures

	Room 102	**Room 104**	**Room 106**
	ODE SESSION	PDE SESSION	NAA SESSION
Chairman	Pituk	Świerczewska-Gwiazda	Praetorius
10:30–11:05	Onitsuka	Stefanelli	Wohlmuth
11:10–11:45	Čermák	Crippa	Fjordholm
12:00–14:00	*Lunch*		

TUESDAY, JULY 12

ODE minisymposia

	Room 102	**Room 302a**	**Room 302b**
	ODE MS-07	ODE MS-05	ODE MS-04
14:00–14:25	Matucci*	Fabbri*	Malinowska*
14:30–14:55	Malaguti	Šepitka	Girejko
15:00–15:25	Rubbioni	Garab	Mozyrska
15:30–15:55	Řehák*	Sanz	Wyrwas
16:00–16:30	*Coffee break*		

*Keynote speaker

ODE contributed talks

	Room 102	**Room 302a**	**Room 302b**
Chairman	Tvrdý	Diblík	Minhós
16:30–16:45	Kisela	Veselý	Rodríguez-López
16:50–17:05	Monteiro	Kajimoto	Pavlačková
17:10–17:25	Chang	Šišoláková	Dilna
17:30–	*Poster session*		

TUESDAY, JULY 12

PDE minisymposia

	Room 104	**Room 103**
	PDE MS-01	PDE MS-07
14:00–14:25	Hupkes	Shvydkoy*
14:30–14:55	Švígler	Lear
15:00–15:25	Slavík*	Leslie
15:30–15:55	Stehlík*	Peszek
16:00–16:30	*Coffee break*	

*Keynote speaker

PDE contributed talks

	Room 104	**Room 103**	**Room 309**
Chairman	Stefanelli	Avalos	Rodriguez
16:30–16:45	Drábek	Eisner	Bašić-Šiško
16:50–17:05	Kotrla	Khrabustovskyi	Shaikhova
17:10–17:25	Benedikt	S. Arora	Saha
17:30–	*Poster session*		

TUESDAY, JULY 12

NAA minisymposia

	Room 106	**Room 309**	**Room 310**
	NAA MS-03	NAA MS-07	NAA MS-05
14:00–14:25	Fellner*	Jensen*	Veroy-Grepl*
14:30–14:55	Kniely	Chowdhury	Lie
15:00–15:25	Brokate	Gallistl	Scarabosio
15:30–15:55	Tang	Smears	Dashti
16:00–16:30	*Coffee break*		

*Keynote speaker

NAA contributed talks

	Room 106
Chairman	Beneš
16:30–16:45	Tomášek
16:50–17:05	Kaya
17:10–17:25	Sakić
17:30–	*Poster session*

WEDNESDAY, JULY 13

Plenary lectures

	Aula
Chairman	Lukáčová
8:30–9:25	Wei
9:30–10:00	*Coffee break*

ODE minisymposia

	Room 102	**Room 103**	**Room 309**
	ODE MS-03	ODE MS-02	ODE MS-09
10:00–10:25	Pituk*	Domoshnitsky*	Cabada*
10:30–10:55	Dragičević	Ivanov	Dimitrijević
11:00–11:25	Faria	Dzhalladova	Minhós
11:30–11:55	Krisztin	Tunç	Zima
12:00–13:15	*Lunch*		

*Keynote speaker

13:15	*Trip – meeting*
13:30	*Trip – boarding*
13:40	*Trip – departure*

WEDNESDAY, JULY 13

PDE minisymposia

	Room 104	**Room 302a**	**Room 302b**	**Room 310**
	PDE MS-03	PDE MS-12	PDE MS-09	PDE MS-10
10:00–10:25	Nečasová*	Isernia*	Průša*	
10:30–10:55	Webster	Bieganowski	Farina	
11:00–11:25	Muha	Baldelli	Martin Witkowski	Goreac*
11:30–11:55	Avalos	Crespo-Blanco	Boulle	Rotenstein
12:00–13:15	*Lunch*			

*Keynote speaker

NAA minisymposia

	Room 106	**Room 310**
	NAA MS-01	NAA MS-02
10:00–10:25	Vohralík*	Kovtunenko*
10:30–10:55	Vejchodský	Ngoc
11:00–11:25	Lederer	
11:30–11:55	Miraçi	
12:00–13:15	*Lunch*	

*Keynote speaker

13:15	*Trip – meeting*
13:30	*Trip – boarding*
13:40	*Trip – departure*

THURSDAY, JULY 14

Plenary lectures

	Aula
Chairman	Kaltenbacher
9:00–9:55	Fonda
10:00–10:30	*Coffee break*

Invited lectures

	Room 102	**Room 104**	**Room 106**
	ODE SESSION	PDE SESSION	NAA SESSION
Chairman	Braverman	Crippa	Wohlmuth
10:30–11:05	Lessard	Bucur	Petersein
11:10–11:45	Godoy Mesquita	Ambrosio	Farrell
12:00–13:30	*Lunch*		

THURSDAY, JULY 14

ODE minisymposia

	Room 102	**Room 103**
	ODE MS-10	ODE MS-06
13:30–13:55		Sovrano*
14:00–14:25	Diblík*	Garrione
14:30–14:55	Hartung	Szymańska-Dębowska
15:00–15:25	Röst	Muñhoz-Hernández
15:30–15:55	Garab	Feltrin*
16:00–16:30	*Coffee break*	

*Keynote speaker

ODE contributed talks

	Room 302a	**Room 302b**
Chairman	Čermák	Dragičević
16:30–16:45	Hasil	Marquez Albes
16:50–17:05	Tripathy	Polner
17:10–17:25	Jadlovská	Štoudková Růžičková
17:30–17:45	Pátíková	Vážanová
19:00–	*Conference dinner*	

	Room 102
Chairman	Málek
16:30	*ERC presentation*

THURSDAY, JULY 14

PDE minisymposia

	Room 104	**Room 302a**	**Room 302b**
	PDE MS-06	PDE MS-05	PDE MS-02
14:00–14:25	Pokorný*	Wróblewska-Kamińska*	Schwarzacher*
14:30–14:55	Chaudhuri	Caggio	Benešová
15:00–15:25	Yu	Dębiec	Höfer
15:30–15:55	Zamponi	Mácha	Trifunović
16:00–16:30	*Coffee break*		

*Keynote speaker

PDE contributed talks

	Room 104	**Room 103**	**Room 309**
Chairman	Bucur	Biler	Mizukami
16:30–16:45	Radulovic	Bárta	Tanaka
16:50–17:05	Mikhailets	Kolář	Kampschulte
17:10–17:25	Yokota	Pražák	Ait-Akli
17:30–17:45	Huynh	Pauš	Chiyo
19:00–	*Conference dinner*		

	Room 102
Chairman	Málek
16:30	*ERC presentation*

THURSDAY, JULY 14

NAA minisymposia

	Room 106	**Room 309**	**Room 310**
	NAA MS-04	NAA MS-11	NAA MS-08
14:00–14:25	Scheichl*	Tůma*	Wolfram*
14:30–14:55	Bénézech	Gazca Orozco	Düring
15:00–15:25	Freese	Rezaee Hajidehi	Philippi
15:30–15:55	Smetana	Frost	Bailo
16:00–16:30	*Coffee break*		

*Keynote speaker

NAA contributed talks

	Room 106
Chairman	Schönlieb
16:30–16:45	Feistauer
16:50–17:05	Dolejší
17:10–17:25	I. Raichik
17:30–17:45	Congreve
19:00–	*Conference dinner*

	Room 102
Chairman	Málek
16:30	*ERC presentation*

FRIDAY, JULY 15

Plenary lectures

	Aula
Chairman	Došlá
9:00–9:55	Kaltenbacher
10:00–10:30	*Coffee break*

Invited lectures

	Room 102	**Room 104**	**Room 106**
	ODE session	PDE session	NAA session
Chairman	Andres	Nečasová	Peterseim
10:30–11:05	Torres	Laurencot	Schönlieb

FRIDAY, JULY 15

Contributed talks

	Room 102	**Room 103**	**Room 104**	**Room 106**
	ODE SESSION	ODE SESSION	PDE SESSION	PDE+NAA SESSION
Chairman	Onitsuka	Tomeček	Mikhailets	Feistauer
11:20–11:35	Bora	Stefaniak	R. Arora	Vala
11:40–11:55	Morales Macias	Krajščáková	Sembukutti Liyanage	Radová
12:00–12:15	V. Raichik	Zahradníková	Levá	Zelina
12:30–12:40	*Closing ceremony*			
12:45–	*Lunch*			

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