

Nederlands Mathematisch Congres

2023

Scientific Days
11 & 12 April

Information & Registration
mathematischcongres.nl

Hotel
Van der Valk
Utrecht



Klaas Landsman
Radboud Universiteit



Eva Miranda
Universitat
Politécnica de Catalunya



Kavita Ramanan
Brown University



Éva Tardos
Cornell University



Sponsors

The organisers gratefully acknowledge support from:



Quantum
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Centrum Wiskunde & Informatica

Cover designed by Dick van der Toorn (NWO)

NMC 2023

Programme Booklet

Van der Valk Hotel Utrecht, The Netherlands

Organising committee:

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Barry Koren (voorzitter Koninklijk Wiskundig Genootschap)
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Riccardo Cristoferi (NDNS+, Radboud University)
Martin van Gijzen (TU Delft, Chair)
Federica Pasquotto (GQT, Leiden University)
Clara Stegehuis (STAR, University of Twente)

Word of Welcome

Dear participants,

Welcome at the Netherlands Mathematical Congress 2023, again in Utrecht.

We are glad to have a varied, well-filled program, with keynote lectures by:

- Eva Miranda
- Kavita Ramanan
- Spinoza Prize winner Klaas Landsman
- Éva Tardos, who will be awarded the Brouwer Medal

Multiple other prizes will be awarded:

- the NWO Stairway to Impact Award
- the Indagationes Mathematicae Best Paper Award
- the Stieltjes Prize
- the KWG PhD Prize
- the KWG Poster Prizes
- the Pythagoras Profielwerkstukprijzen

‘Traditional’ sessions will again be organized by:

- the four mathematics clusters DIAMANT, GQT, NDNS+ and STAR,
- the NWO Gravitation programs Networks and Quantum Software Consortium, and
- 4TU.AMI, European Women in Mathematics — The Netherlands and AI & Mathematics.

Besides the KWG Poster Prize competition, specifically for PhD students (and others) there will be:

- NWO workshops about career planning, acquiring funding and setting up a company
- a Speed dating session with companies and institutes such as ABN-AMRO, Amsterdam Data Collective, ASML, CBS, eScience Center, NWO, Probability BV, Rabobank and Vortech

Further, there will be the general assembly of the Royal Dutch Mathematical Society, and last but not least: ample opportunities for talking and working with colleagues and friends, and for enjoying good drinks and food!

We wish you a fruitful and pleasant congress!

Marieke Kranenburg (chair Organizing Committee NMC)

Barry Koren (chair Royal Dutch Mathematical Society)

Wil Schilders (director Platform Wiskunde Nederland)

General Information

Venue: Van der Valk Hotel Utrecht

Winthontlaan 4-6, 3526 KV Utrecht



With this new location we cater to the wishes of the visitor with respect to travel time to the conference. Just off the A12 motorway and within walking distance of a bus and tram stop, the hotel is easily accessible both by public transport and by car.

By public transport

From Utrecht CS (about 10 minutes)

- Bus lines: 65, 74 and 77 (every 5 minutes)
- Express tram lines 60 and 61

By car

Van der Valk Hotel Utrecht is located near the A12. Take exit 17 (Utrecht / Jaarbeurs / Kanaleneiland). Parking is possible at a reduced rate in the hotel parking garage.

Food and beverages

Lunches are included in the registration fee, as is the conference dinner.

Registration desk

Should you have any questions or encounter any problems, please contact the registration desk which will be open during early mornings and the breaks. The hotel registration desk is open full time for non-conference-related questions.

Stands

On the first floor in the foyer there will be stands of the following organisations:

- Epsilon Uitgaven
- NWO
- Optische Fenomenen
- Platform Wiskunde Nederland
- Vierkant voor Wiskunde



Programme NMC 2023

Tuesday 11 April 2023

Time	Location	Activity
9:00 - 10:00		Registration & Coffee/tea
10:00 - 10:10	Nieuwegracht 1+2	Opening session by KWG and NWO Barry Koren (Chair KWG) Christiane Klöditz (director NWO Domain Science)
10:10 - 11:10	Nieuwegracht 1+2	Keynote lecture: Eva Miranda (Universitat Politècnica de Catalunya) <i>chair: Álvaro del Pino Gómez</i>
11:10 - 11:30		Break
11:30 - 12:15	Nieuwegracht 1+2 Oudegracht 1	AI & Mathematics and PWN Committee Innovation <i>chair: Christoph Brune</i> General Assembly of the Royal Dutch Mathematical Society <i>chair: Barry Koren</i>
12:15 - 13:45	Foyer	Lunch Speed dating
13:30 - 15:00	Oudegracht 1 Oudegracht 2 Oudegracht 3 Nieuwegracht 2	Parallel sessions: STAR DIAMANT NDNS+ GQT
15:00 - 15:45		Break
16:00 - 16:15	Nieuwegracht 1+2	Poster session pitches
16:15 - 17:15	Nieuwegracht 1+2	Brouwer Medal: Éva Tardos (Cornell University) <i>chair: Joost Batenburg</i>
17:15 - 18:00	Nieuwegracht 1+2	European Women in Mathematics — The Netherlands <i>chair: Svetlana Dubinkina</i>
18:00 - 19:00		Drinks
19:00 - 21:00		Dinner
21:00 - 23:00		Open bar

Wednesday 12 April 2023

Time	Location	Activity
8:30 - 9:00		Registration & Coffee/tea
9:00 - 9:30	Nieuwegracht 1+2	What's cooking? * Announcements Tafel Wiskunde (Eric Cator) * Announcements PWN (Wil Schilders or Richard Boucherie) * Announcements eScience Center (Pablo Rodríguez-Sánchez) * Announcements NVvW (Heleen van der Ree) * CWI Research Semester Programme (Ton de Kok) * Announcements KWG (Barry Koren)
9:00 - 10:00	Oudegracht 1 Oudegracht 2 Oudegracht 3	Workshop for PhD students (and others): * Start your career (Margret Schmitter, VU Amsterdam) * Funding possibilities (Olivia Muthsam, NWO) * Start up (Arie Brouwer, Commit2Data)
9:30 - 10:00	Nieuwegracht 1+2	The Indagationes Mathematicae Best Paper Prize <i>chair: Jan van Neerven</i>
10:00 - 10:45	Nieuwegracht 1+2	Keynote lecture: Kavita Ramanan (Brown University) <i>chair: Bert Zwart</i>
10:45 - 11:15		Break
11:15 - 12:45	Oudegracht 1 Oudegracht 2 Oudegracht 3 Nieuwegracht 2	Parallel sessions: * NETWORKS * QSC * Pythagoras Prize * 4TU.AMI+
12:45 - 14:00		Lunch
14:00 - 14:45	Nieuwegracht 1+2	Stieltjes Prize 2021-2022: Freek Witteveen and Sophie Huiberts <i>chair: Odo Diekmann</i>
14:45 - 15:45	Nieuwegracht 1+2	KWG PhD Prize <i>chair: Martin van Gijzen</i>
15:45 - 16:15		Break
16:15 - 17:00	Nieuwegracht 1+2	Keynote lecture: Klaas Landsman (Radboud University) <i>chair: Hans Maassen</i>
17:00 - 17:30	Nieuwegracht 1+2	Prize giving ceremony: NWO Stairway to Impact Award, Indagationes Mathematicae Best Paper Prize, KWG PhD Prize, Stieltjes Prize <i>chair: Barry Koren</i>
17:30 - 18:30		Drinks

Tuesday, April 11

Keynote Lecture

10:10-11:00



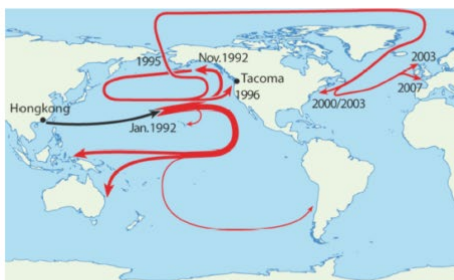
Eva Miranda (UPC Universitat Politècnica de Catalunya)

Where will the 29000 rubber ducks wash up? From Turing machines to Fluid Dynamics

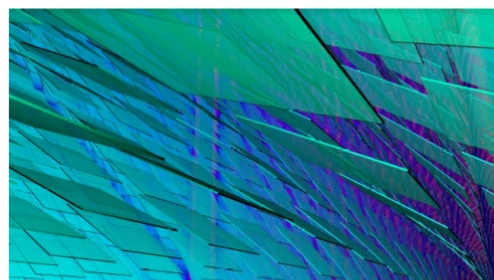
What kind of physics might be non-computational? (Penrose) Is hydrodynamics capable of performing computations? (Moore). Can a mechanical system (including a fluid flow) simulate a universal Turing machine? (Tao).

In 1992, 29000 rubber ducks were lost in the Pacific ocean during a storm. Some of the rubber ducks landed in Hawaii while others reached the east coast of the US and the British shores fifteen years later. These emblematic rubber ducks are known as the “friendly floatees” and their erratic trajectories were made famous by the work of an oceanographer, Ebbesmeyer, who models ocean currents on the basis of flotsam movements.

In this talk, I will use the friendly floatees as a metaphor for complexity and undecidability fluid dynamics. The existence of undecidable fluid paths is a consequence of the design of a Turing complete Euler flow. The proof combines techniques from Alan Turing with modern Geometry to construct a “Fluid computer” in dimension 3. Tao’s question was motivated by a research program to address the Navier–Stokes existence and smoothness problem. Could such a fluid computer be used to address the Millennium Prize problem?



The friendly floatees trajectories
(source: Wikipedia)



The standard contact structure (image
courtesy of Robert Ghrist)

Biography

Eva Miranda is a Full Professor at Universitat Politècnica de Catalunya in Barcelona and member of the Centre de Recerca Matemàtica-CRM. She is the director of the Laboratory of Geometry and Dynamical Systems. Distinguished with two consecutive ICREA Academia Prizes in 2016 and 2021, she was awarded a Chaire d'Excellence de la Fondation Sciences Mathématiques de Paris in 2017 and a Friedrich Wilhelm Bessel Prize by the Alexander Von Humboldt Foundation in 2022. Miranda is the recipient of the quadrennial François Deruyts Prize in 2022, a prize awarded by the Royal Academy of Belgium. She has been named the 2023 London Mathematical Society Hardy Lecturer.

Miranda's research is at the crossroad of Differential Geometry, Mathematical Physics and Dynamical Systems. More than a decade ago she pioneered the investigation of b-Poisson manifolds. These structures appear naturally in physical systems on manifolds with boundary and on problems in celestial mechanics such as the 3-body problem. More recently, she added to her research agenda some mathematical aspects of theoretical computer science in connection to Fluid Dynamics, building new bridges between these areas and contact geometry. Miranda's research strives to decipher the several levels of complexity in Geometry and Dynamics and to investigate new facets of their interaction.

Miranda is an active member of the mathematical community, a member of several international scientific panels and prize committees. She created an important school by supervising 10 Ph.D. theses and several postdocs. She has been chercheur affiliée at Observatoire de Paris and honorary doctor at CSIC. Among others, she served on the CRM Scientific Advisory Board. She is a member of the scientific committee at the Spanish Mathematical Society, a member of the Conseil d'Administration de l'Institut Henri Poincaré in Paris, and a member of the Mathematics Panel at the Spanish State Agency. She is also a member of the Scientific Commission Sciences Exactes et Naturelles of the Fund for Scientific Research FNRS.



Johannes Schmidt-Hieber (University of Twente)

Statistical learning in biological neural networks

Compared to artificial neural networks (ANNs), the brain learns faster, generalizes better to new situations and consumes much less energy. ANNs are motivated by the functioning of the brain, but differ in several crucial aspects. In particular, it is biologically implausible that the learning of the brain is based on gradient descent. In this talk we look at the brain as a statistical method for supervised learning. The main contribution is to relate the local updating rule of the connection parameters in biological neural networks (BNNs) to a zero-order optimization method.

The talk is based on [arxiv:2301.11777](https://arxiv.org/abs/2301.11777).

During the first day of the NMC all PhD students, postdocs, academic staff and also master students in the final stage of their studies are invited to have speed dates with possible employers like ABN AMRO, Amsterdam Data Collective, ASML, CBS, eScience Center, NWO, Probability B.V., Rabobank and Vortech. From 13:45 – 15:15 h. you can have speed dates with max four of these companies and organizations.

This event will offer you an invaluable opportunity to gain a better understanding of the variety of career paths. You are encouraged to talk about job opportunities and, traineeships, and to explore opportunities for collaboration.

More information about the participating companies and organizations can be found below. In case you are interested in a speed date, please indicate on the registration form with which companies you would like to talk or send an email with the preferred companies/organizations to contact@mathematischcongres.nl.



ABN AMRO is one of the three large Dutch banks and is active in Retail Banking (consumers), Private Banking, Commercial Banking (SMEs) and Corporate & Institutional Banking (large corporates & financial institutions). Our history dates back to the 18th century through the Nederlandsche Handel-Maatschappij. ABN AMRO has around 21,000 employees and is active around the globe.

The financial world has never been as dynamic as it is today. The time for you to join forces with us to make banking faster, easier and smarter is now. Technology is evolving at lightning speed. The drive of innovation has a major impact on the financial system. We need your talents to help make our bank future-proof! Whatever your interests or background, we challenge you to use your creativity to innovate the future. We offer a work environment that lets you explore your enterprising spirit and gives you the freedom to develop yourself, both professionally and personally. We want you to feel responsible for your work, because you are.



We are **Amsterdam Data Collective**. Together we realise the potential of data for a better future. Using data science to make a positive impact is what drives us. We initiate and contribute to the successful completion of the most impactful data science initiatives across the globe.

We bridge the gap between strategy and data science; however, data only becomes valuable when clients dare to let it shape their business, and trust us to join them on that journey. Data-driven organisations are efficient and confident; their leadership teams can anticipate change based on reliable, relevant and timely insights. The ADC community is growing quickly and aspires to maintain a culture in which consultants unleash their full potential. To help our

clients succeed, we attract people with a strong sense of ownership and develop them to become the brightest minds in business and analytics. By establishing a culture in which giving and receiving feedback is encouraged, we aim for optimal knowledge transfer and personal growth.

Are you ready to embrace data science with us?



ASML is the innovation leader and leading supplier to the world's fast-moving semiconductor industry, ASML's lithography and metrology systems are among the most complex machines ever conceived. Their extreme high performance is being continuously improved with data-rich modeling and sound physical insight.

You can be part of such a team of imaginative thinkers who create and drive ASML's products innovation ! Themes of interest include: mathematical physical modeling • parameter inference • calibration • information theory • machine learning • optimization • data-intensive and distributed computing.

netherlands



The Netherlands **eScience Center** is the national center for innovative software solutions in academic research. It was established as an independent foundation and aims to bridge the gap between digital technologies and scientific and scholarly inquiry. We employ over sixty Research Software Engineers who help researchers interpret results, make tools and methods reusable for the wider research community, and co-author research and methodological publications. We are based in Amsterdam and the engineers perform their project activities both remotely and at project locations.



In a society where the amount of information is growing explosively, free access to reliable and integral data is crucial. As the national statistical office, **CBS** produces reliable statistical information and data that provide insight into social issues, thus supporting the public debate, policy development and decision-making while contributing to prosperity, well-being and democracy.

Working at CBS

The office environment at CBS – with offices located in The Hague, Heerlen and on Bonaire – is a pleasant mix of government and business. You will find a very diverse group of employees who range widely in age, nationality, discipline and career. One thing all our employees have in common is their focus on the quality of our research results. Would you like to learn more and/or apply? Check out our current vacancies and/or current internships (in Dutch) on www.werkenbijhetcbs.nl



Each year, the **Dutch Research Council** (NWO) invests almost 1 billion euros in curiosity-driven research, research related to societal challenges and research infrastructure. NWO's core task is performed in the NWO domains, research institutes and regional bodies: encouraging quality and innovation in the sciences. Promoting scientific research and increasing scientific and social impact – in short, what makes NWO successful – depends entirely on the dedication, quality, enthusiasm and commitment of our employees. NWO is an employer that gives its employees the space to optimally use and develop their talent, where trust, pride and pleasant cooperation are a priority. Every day, we work towards creating an inclusive environment where employees can develop their talents and feel valued and involved. We are always on the lookout for academic and support staff (for example, financial, legal and HR), as well as communication and service facilities for NWO's offices in The Hague and Utrecht.



Probability & Partners is a fast-growing consultancy firm specialized in Risk Management for the financial sector. We serve banks, insurers, pension funds, asset managers, family offices, and FinTechs. We help our clients in many ways; from building- and validating complex models to the temporary fulfillment of (board level) positions. To ensure our work reflects the latest insights, we keep close ties with academia and perform internal research.

Risk taking is a central part of the business model of our clients. We help them to safeguard that these risks are taken responsibly and consciously. We believe that a diverse mix of people is required to excel in risk management. By combining former risk managers with seasoned consultants and academics, we are able to give high-quality advice. The result of our approach is that clients like to ask us for help with problems that are not straightforward, but require knowledge of a wide range of methods and a thorough understanding of the problem context. *Interested in learning more about us? Then please visit: <https://probability.nl/career/starters/>*



As a cooperative with millions of clients around the world, **Rabobank** has access to enormous amounts of data. But data needs the right people to process it and extract valuable insights from it. That is what we do within Data & Analytics. There is no field that is so closely

interwoven with every part of the bank. Working in Data & Analytics therefore means contributing to major social issues.

You develop innovations that improve the financial well-being of our customers. You contribute to the datafication of the food chain. Or you will ensure that Rabobank is and remains a data-driven, future-proof bank. And you will do all of this with a close team of highly motivated data professionals who help and challenge each other. Together you are part of a solid Data & Analytics community within Rabobank.

Be part of something bigger. Be part of Rabobank Data & Analytics.



VORtech supports its clients in developing computational software. With a team of around thirty scientific/computational software engineers, we work mostly for large companies, research institutes and government agencies. We work on applications in fields like technology, physics, and chemistry, on topics like air pollution, coastal water flow, chemical processes, geophysics, and power distribution.

What gets us out of bed in the morning is leveraging our expertise to make our clients' business more reliable, efficient, and resilient. We enjoy collaborating with other experts, both within VORtech and at our clients, learning and consulting and jointly creating wonderful results. Personal growth and mutual respect are central to our culture.

Software engineers at VORtech are stimulated to develop their own expertise, like high performance computing, data assimilation, machine learning or special coding skills. They typically work at multiple projects for multiple clients at the same time, learning in one place and applying that knowledge in other places.



*The Speed dating session is organised by **Math4NL**.*

Math4NL aims to strengthen the interaction between mathematicians and society. To accomplish this, Math4NL facilitates collaboration between mathematicians and industry. Math4NL is the contact centre for industry, societal organisations and mathematicians and, provides support for transferring mathematical knowledge to industry and the other way around.



Benjamin Gees (Universität Bielefeld)

Fluctuations in continuum and conservative SPDEs

Fluctuations are ubiquitous in real world contexts, ranging from thermal fluctuations in physical systems, to algorithmic stochasticity in machine learning, to fluctuations caused by small-scale weather patterns in climate dynamics. A systematic understanding of the interplay of stochasticity and complex dynamical behavior aims to unveil universal properties, irrespectively of the many details of the concrete systems at hand. In this talk, we will identify the class of conservative stochastic partial differential equations (CSPDEs) as universal fluctuating continuum models, and their analysis as a fruitful field for the discovery of new mathematical structures and methods. In particular, we will demonstrate how CSPDEs arise from fluctuating interacting particle systems, and, vice versa, how the analysis of CSPDEs can guide the mathematical insight into the nonequilibrium fluctuations of complex systems.



Leandro Chiarini (Utrecht University)

Scaling limits and fluctuations of discrete stochastic PDEs

In this talk, we will discuss central limit types of results for those discrete approximations of stochastic PDEs driven by random walks either on random environment or with heavy-tails. Furthermore, we will study couplings between the discrete and continuous stochastic PDEs that allow us to find non-trivial fluctuations around the limiting field. This is based on joint work with Wioletta Ruszel (Utrecht) and Milton Jara (Rio).



Mark Veraar (TU Delft)

Optimal rates for pathwise approximations of solutions to stochastic PDEs

In this talk I will explain some new convergence results for a class of stochastic PDEs. Typical examples for which the results are useful are hyperbolic stochastic PDEs. The main novelties are:

- the convergence rates are optimal up to a logarithmic factor
- the convergence is obtained for the whole paths

To prove the results new maximal inequalities for stochastic convolutions were required, which will also be discussed. Several examples will be discussed to illustrate the new phenomena.

The talk is based on joint work with Katharina Klioba.

DIAMANT

13:45-15:15



Olga Lukina (Leiden University)

Arboreal representations of Galois groups and Cantor dynamics

Arboreal representations of absolute Galois groups of number fields are given by groups of automorphisms of regular rooted trees, with the geometry of the tree determined by a polynomial which defines such a representation. Thus arboreal representations give rise to dynamical systems on a Cantor set, and are naturally a topic at the intersection of number theory, topological dynamics and geometric group theory. In the talk, I will briefly explain the construction of an arboreal representation, and how the fixed point properties of the action it defines are related to the questions about density of primes in certain non-linear recurrence relations. I will also give a brief overview of my recent results on classification of arboreal representations using invariants of topological

dynamics, and of joint results with Maria Isabel Cortez on the properties of Frobenius elements under arboreal representations, in relation to the conjecture by Boston and Jones.



Alberto Ravagnani (TU Eindhoven)

The Service Rate Region Polytope

In distributed data storage, information is stored across several servers with redundancy, in such a way that it can be accessed by various users simultaneously. It turns out that the set of access requests that a distributed data storage system can support are described by a polytope, called the service rate region of the system. This talk proposes an introduction to the service rate problem, mainly focusing on the geometric properties of the service rate region polytope and on their interpretation in information technology.

NDNS+

13:45-15:15



Marcello Seri (University of Groningen)

Geometric integration via the contact lenses

Geometric integrators are numerical schemes that, by construction, approximately preserve certain geometric invariants of the integrated flows.

In the talk we will present of a new family of geometric integrators for non-conservative systems defined in terms of contact geometry.

We will then show some of their properties and motivate their relevance on some examples from celestial mechanics and non-linear oscillators.



Robbin Bastiaansen (Utrecht University)

Fragmented tipping in a spatially heterogeneous world

Many climate subsystems are thought to be susceptible to tipping—and some might be close to a tipping point. The general belief and intuition, based on simple conceptual models of tipping elements, is that tipping leads to reorganization of the full (sub)system. Here, we explore tipping in conceptual, but spatially extended and spatially heterogeneous models. These are extensions of conceptual models taken from all sorts of climate system components on multiple spatial scales. By analysis of the bifurcation structure of such systems, special stable equilibrium states are revealed: coexistence states with part of the spatial domain in one state, and part in another, with a spatial interface between these regions. These coexistence states critically depend on the size and the spatial heterogeneity of the (sub)system. In particular, in these systems the crossing of a tipping point not necessarily leads to a full reorganization of the system. Instead, it might lead to a reorganization of only part of the spatial domain, limiting the impact of these events on the system's functioning.



Alethea Barbaro (TU Delft)

A contagion model for fearful crowds

What would you do if you were at a crowded event, and all of a sudden, you hear people screaming? Would you start pushing? Would you run for the exits? We all hear about the tragic sequelae of such situations in the news, yet most mathematical models for pedestrian dynamics fail to account for the emotional component of these situations. The models generally consider this to be a problem with purely physical components and constraints. In this talk, we will introduce an agent-based flocking model for crowd dynamics where every agent has an evolving emotional variable in

addition to a position and velocity. The emotion levels vary based on the emotions of nearby agents, and this, in turn, affects the agent's velocity. We will detail the agent-based model, show simulations, and then derive a corresponding kinetic equation.

GQT

13:45-15:15



Álvaro del Pino Gómez (Utrecht University)

Thurston's jiggling

In the mid 1970s, Thurston settled the existence problem for foliations of codimension 1 (showing that any manifold of vanishing Euler characteristic has such a foliation) and the classification problem for higher-codimension foliations. In this talk I will explain one of the ingredients of the proof, called jiggling.

If time allows, I will comment on some on-going work joint with A. Fokma and L. Toussaint generalising jiggling. Our main observation is that jiggling is the first example of an “h-principle without homotopical assumptions” and can indeed be related to other h-principle techniques, like convex integration.



Francesca Arici (Leiden University)

***Sfeermakers* or on sphere bundles in noncommutative geometry**

The theory of C^* -algebras offers an elegant setting for many problems in mathematics and physics. In view of Gelfand duality, their study is often referred to as non-commutative topology: general noncommutative C^* -algebras are interpreted as non-commutative spaces. Many classical geometric and topological concepts can be translated into operator algebraic terms, leading to the so-called noncommutative geometry (NCG) dictionary.

In this talk, I will describe how circle and sphere bundles, central objects in the development of algebraic topology, can be realised in terms of modules over operator algebras.



Oliver Lorscheid (Groningen University)

Moduli spaces in matroid theory

Families of matroids have appeared in different disguises during the last few decades: combinatorial flag varieties arise from flag matroids, Macphersonians appear as spaces of oriented matroids, Dressians consist of valuated matroids. With the advent of F1-geometry, we are able to understand these spaces from an algebro-geometric perspective as rational point sets of moduli spaces of (flag) matroids and place them into a larger landscape of geometric objects stemming from combinatorics. In this talk, I will give an impression of my joint works with Matthew Baker and with Manoel Jarra on the topic.

**Éva Tardos (Cornell University)**

The jury has decided to award the Brouwer Medal 2023 to Éva Tardos in recognition of her long-lasting contributions to the field of discrete mathematics, in particular in the areas of combinatorial optimization, approximation algorithms, and algorithmic game theory. We are impressed by the many contributions that Éva Tardos has made throughout her career, as a leading researcher shaping the research fields that she is active in. Her results have also impacted a broad range of application fields, ranging from operations research to network analysis. The jury would also like to acknowledge the exemplary skills and efforts of Éva Tardos in disseminating her knowledge, being a role model and mentor for a new generation of aspiring young researchers.

European Women in Mathematics – The Netherlands (EWM-NL) is the national association of women working in the field of mathematics in the Netherlands. Part of the goals of EWM-NL is to establish a framework of activities to support women in research in the Netherlands, and particularly early career researchers, to enter and establish careers in mathematics. With the NMC sessions we organize, we wish to give the opportunity to early career mathematicians to have a more in-depth and relaxed conversation with the invited speakers to the congress. After a brief presentation of the activities of EWM-NL, we invite our speakers to give a brief narration on the topics of how they chose for mathematics, how their professional career developed so far and close with two pieces of advice that they would have wished to have received in their early-career stage. The panel session is followed by questions from the attendees and discussion. In connection to this session, we publish a short interview of the speakers on our website: <https://www.ewmnl.nl/events/nmc-meetings/>

Wednesday, April 12

What's cooking?

9:00-9:30

- Announcements Tafel Wiskunde (Eric Cator)
- Announcements PWN (Richard Boucherie)
- Announcements eScience Center (Pablo Rodríguez-Sánchez)
- Announcements NVvW (Heleen van der Ree)
- CWI Research Semester Programme (Ton de Kok)
- Announcements KWG (Barry Koren)

Workshops for PhD Students

9:00-10:00

Workshop – Start you career!

Are you thinking about what you want to do after your PhD, but have you lost track of what options you have? What will be the next step in your career? Do you stay in academia or are you going to give it a try in industry or maybe something completely different? Career coach Margret Smitters lets you know what career options are available to you after your PhD and helps you figure out what you really want to do.

Workshop – Funding possibilities

Your academic career is about to start and you want to know what funding options you have? Then this workshop is for you. NWO policy officers will give you an overview about the most important funding instruments for young researchers and let you know which points are important when submitting your proposal.

Workshop – Start up

Do you have an idea you could start your own business with? Are you wondering what the first steps are on the way to creating your start-up and want to hear from the experience of others who already have their own start-up. Then this workshop is for you! We will inform you about basic steps that you need to take to start your own business and give you some insight into the experience of others.

The Indagationes Mathematicae Best Paper Prize

9:30-10:00

The Indagationes Mathematicae Best Paper Prize is a new annual prize, installed jointly by Elsevier and the KWG, of € 1000 for the best paper published in Indagationes Mathematicae in the preceding year. The first Indagationes Mathematicae Best Paper Prize will be awarded at the 2023 Dutch Mathematical Congress by Jan van Neerven, editor-in-chief of Indagationes Mathematicae and chair of the jury which further consists of the four subject editors Gunther Cornelissen, Monique Laurent, Michel Mandjes, and Mark Veraar. The laureate(s) will be invited for a short talk at the NMC about the winning paper.



Catharina Stroppel and Jens Eberhardt (University of Bonn)

Motivic Springer Theory

Convolution of functions arises in many mathematical areas, including probability, Fourier theory, differential equations etc. In this talk we will also convolve geometric objects, such as differential forms, homology classes or algebraic cycles. Inspired by work of Tonny Springer, we will explain how important algebraic structures such as symmetric groups or Hecke algebras can be constructed via convolution. Finally, we will discuss how motives, which are a universal invariant in algebraic geometry, can be used to unify various classical and modern approaches to geometric convolution algebras. We will show some favourable homological properties of these constructions.

Keynote lecture

10:00-10:45



Kavita Ramanan (Brown University)

Biography

Kavita Ramanan is the Roland George Dwight Richardson University Professor and Associate Chair at the Division of Applied Mathematics, Brown University. Her research interests lie in the area of probability theory and stochastic processes, including high-dimensional probability, interacting particle systems, large deviations, applications to asymptotic convex geometry and stochastic networks. Her research has received recognition in the form of an invited lecture at the International Congress of Mathematicians, a Clay Senior Scholarship, Vannevar Bush Faculty Fellowship, a Guggenheim Fellowship, the Newton Award, a Simons Fellowship, and the Erlang Prize from the INFORMS Applied Probability Society. She is an elected fellow of multiple societies including the AAAS, AMS, IMS, INFORMS and SIAM, and is an elected member of the American Academy of Arts and Sciences. She cares deeply about math communication and outreach, having initiated the SEAM (Social Equity and Applied Math) seminar series, founded a math outreach group called the Math CoOp, and organized the Mathematics-Sin-Fronteras lecture series.

NETWORKS

11:15-12:45



Wioletta Ruszel (Utrecht University)

Sandpile models on graphs with conductances

The sandpile model (aka chip-firing game) is a toy model for studying self-organized criticality. There has been a lot of activity and progress in understanding connections to spanning trees, Abelian groups, studying existence of infinite volume measures or avalanche size distributions of the model on different lattices.

In this talk we will discuss ongoing progress in studying the sandpile model on general graphs with conductances. We will introduce the notion of two-phase burning algorithm, minimal configurations and the transfer current matrix.

This is joint work with Cedric Boutillier (University Paris Sorbonne).



Tom van der Zanden (Maastricht University)

Efficiently Computing the Shapley Value of Connectivity Games in Low-Treewidth Graphs

Game-theoretic centrality measures are a powerful tool to identify key players in covert networks (that model, e.g., the interactions between suspected terrorists or criminals). Unfortunately, such measures are often NP-hard to compute and thus intractable, even for small graphs. We show that, for three connectivity games, their Shapely value can be efficiently computed if the underlying graph has low treewidth. Using this method, we are able to compute the Shapley Value for several graphs for which this was previously infeasible (including, notably, the 69-vertex graph of the terrorists involved in the 9-11 attacks studied in previous work on Shapley value-based centrality).



Wojciech Samotij (Tel Aviv University)

Large deviations in random graphs

Suppose that Y_1, \dots, Y_N are i.i.d. (independent, identically distributed) random variables and let $X = Y_1 + \dots + Y_N$. The classical theory of large deviations allows one to accurately estimate the probability of the tail events $X < (1-c)E[X]$ and $X > (1+c)E[X]$ for any positive c . However, the methods involved strongly rely on the fact that X is a linear function of the independent variables Y_1, \dots, Y_N . There has been considerable interest – both theoretical and practical – in developing tools for estimating such tail probabilities also when X is a nonlinear function of the Y_i . One archetypal example studied by both the combinatorics and the probability communities is when X is the number of triangles in the binomial random graph $G(n, p)$. I will discuss recent developments in the study of the tail probabilities of this random variable. The talk is based on joint works with Matan Harel and Frank Mousset and with Gady Kozma.

**Lisa Kohl (CWI)****Secure computation with silent preprocessing from learning parity with noise**

Protocols for secure multi-party computation (SMPC) dating back to the 1980's allow two or more parties to securely evaluate any (efficiently computable) function on their private inputs without revealing anything beyond the function output. Unfortunately, these generic approaches introduce large overheads, rendering them infeasible for use in practice. The making of to date constructing protocols for secure computation that are efficient enough to run in practice remains a challenging task.

In this talk, I will give an overview of latest developments in the line of work on pseudorandom correlation generators, which allow secure computation with silent preprocessing, where a communication-efficient and input-independent preprocessing phase is followed by a light-weight online phase. The security of our protocols relies on (variants of) the learning parity with noise assumption, which resists all known classical and quantum attacks.

Based on joint works with Elette Boyle, Geoffroy Couteau, Niv Gilboa, Yuval Ishai, Nicolas Resch, Peter Rindal and Peter Scholl.

**Casper Gyurik (Leiden University)****Quantum algorithms and the homology problem**

Recently, a lot of work has been done studying the computational aspects of the problem of determining Betti numbers of simplicial complexes (i.e., the homology problem), with a particular focus on quantum algorithms. In this talk I will provide an overview of the recent results regarding the computational aspects of the homology problem, both from a (quantum) algorithmic perspective as well as a computational complexity perspective.



Gayane Vardoyan (TU Delft)

Developing a Framework for Quantum Network Utility Maximization

Network Utility Maximization (NUM) is a powerful mathematical framework that can be used to design and analyse classical communication protocols. NUM has enabled the development of distributed algorithms for solving the resource allocation problem, while at the same time providing certain guarantees, e.g., that of fair treatment, to the users of a network. In this talk, I will discuss our recent work on extending the notion of NUM to quantum networks, and introduce three quantum utility functions – each incorporating a different entanglement measure. The aim of the study is both to gain an understanding of some of the ways in which quantum users may perceive utility, as well as to explore structured and theoretically-motivated methods of simultaneously servicing multiple users in distributed quantum systems. Using our quantum NUM constructions, we develop an optimization framework for networks that use the single-photon scheme for entanglement generation, which enables us to solve the resource allocation problem while exploring rate-fidelity tradeoffs within the network topologies that we consider. We find that our utility functions result in contrasting behaviors which provide some ideas regarding the suitability of quantum network utility definitions to different quantum applications.

4TU.AMI

11:15-12:45



Luc Florack (TU Eindhoven)

A Geometric Framework for the Human Structural Connectome

The human brain is an intriguing piece of evolutionary engineering and probably the most complex system mankind has ever endeavored to investigate. The 21st grand challenge to unravel its structure and function is known in the trade as ‘connectomics’. It is a complex enterprise that requires a transdisciplinary and multiscale approach. In this talk I focus on the structural connectome, i.e. the collection of maps of nerve bundles (‘tracts’) interconnecting functional regions in the brain. At the

level of resolution accessible by state-of-the-art magnetic resonance imaging (MRI) such maps can be reconstructed from a protocol known as diffusion weighted (magnetic resonance) imaging via an ill-posed inverse problem known as ‘tractography’. A geometric framework based on a data induced Riemannian or Finslerian metric appears quite promising.



Martin van Gijzen (TU Delft)

Imaging algorithms for low-field MRI

Hydrocephalus is a potentially fatal condition that affects thousands of children each year in Uganda alone. For surgical intervention and follow-up treatment imaging of the brain is needed. The preferred technique for this is MRI. MRI systems, however, are expensive and out of reach for the vast majority of the population in Uganda. In order to provide a sustainable diagnostic tool an interdisciplinary team of researchers from the Netherlands, the USA, and Uganda is developing an inexpensive and easy-to-use MRI system of sufficient quality to diagnose hydrocephalus. Since the signals obtained with the scanner are of low quality, advanced mathematical techniques are needed to compute images of sufficient quality. The presentation will first give an overview of the project and will then discuss some of the mathematical techniques that can be used to improve the image quality.



George van Voorn (Wageningen University & Research)

Health economic mathematical models and their validation

Mathematics plays an important role in health economics. The costs of Dutch basic health care were 48,6 billion euro in 2021, while costs for long-term care increased to 25,7 billion euro (ZorgInstituut Nederland, 2022). Policy makers face decisions about which medical drugs and interventions they reimburse and which ones not. In the Netherlands and elsewhere, pharmaceutical companies can

apply for reimbursement of their developmental costs for new drugs and interventions based on cost effectiveness reports they file. These reports are commonly accompanied by mathematical models to calculate cost effectiveness. Model validation is needed to evaluate whether a model and its output is credible and relevant. But while model validation is desirable, studies towards the quality of health economic models reported that many models used in reimbursement reports contained important flaws. In this presentation I will talk about developments of the last decade regarding the models used in health economic decision making and their validation, aimed at improving the credibility and applicability of these models.



Richard Boucherie (University of Twente)

Dynamic assignment of capacity and fair balancing of COVID-19 patients over hospitals

We introduce models that support dynamic fair balancing of COVID-19 patients over hospitals in a region and across regions. Patient flow is captured in an infinite server queueing network. Input for the model is an accurate real-time forecast of the number of COVID-19 patients hospitalised in the ward and the Intensive Care Unit of the hospitals based on the predicted inflow of patients, their Length of Stay and patient transfer probabilities among ward and ICU.

For given number of available beds, we introduce a dynamic load balancing model for assignment of patients to hospitals within a region, and a stochastic program for allocation of patients across regions. Subsequently, we consider optimal up- and downscaling of capacity for COVID-19 patients leaving maximum capacity for regular (non-COVID) patients.

We illustrate our models using data from the second COVID-19 peak from hospitals' data warehouses and regional infection data as recorded in the Netherlands.



Sjaak van der Pouw (Van Vliet Diagnostics and MedTech at Work)

Can Mathematics help to improve quality and lower the cost of Healthcare ?

In many hospitals, the use of innovative medical technologies is more a replacement decision than a conscious investment choice to make the healthcare system run smarter and more effectively. In many cases, based on an established pattern of thinking, a medical technological system is replaced.

While a lot of profit can be achieved if, in addition to the replacement, the impact that a medical technological development can have on the entire work process within a care department, or even within the entire health care system, is also considered.

Insightful mathematical models are often lacking to show users the impact that a medical technological innovation can bring to the healthcare process and what benefits can be achieved with scarce goods such as labour, energy and raw materials.

In my overview I show a number of recent cases in which there are opportunities for mathematicians to make their contributions to the design of a sustainable care system.

Parallel session 4

11:15-12:45

Pythagoras Prize

Stieltjes Prize Award 2021-2022

14:00-14:45

The jury for the Stieltjes Prize met on 8 December 2022 to award the prize for the best mathematical dissertation published in the academic year 2021-2022. A total of 74 dissertations were assessed. The jury was impressed by the high level of the research performed. The quality of no less than 7 theses was such that winning the prize would be deserved. Hence difficult choices had to be made. After the first round of discussion, 4 dissertations remained, all of them of impressive quality and great originality. After an extensive second round of discussion, two dissertations remained. Both of these are of extraordinary quality, but otherwise they are rather different. The jury therefore decided to award the Stieltjes Prize to Freek Witteveen (University of Amsterdam) and Sophie Huiberts (CWI and Utrecht University).



Jeroen Witteveen (University of Copenhagen)

The mathematics of tensor network quantum states

Many-body quantum states suffer from a dimensionality curse: the number of parameters needed to describe a state scales exponentially with the system size. The idea of tensor network states is to parametrize quantum states 'locally' in a way that matches ground states of local Hamiltonians. This idea has been very successful, both in numerical methods as well as a theoretical tool to understand phases of matter. In this talk I will present some of the fascinating mathematical questions that arise in the study of tensor networks.



Sophie Huiberts (Columbia University)

Theoretical analysis of (integer) linear programming

Integer programming provides a powerful abstraction, capable of expressing many practical problems. Even though the integer programming problem is NP-Hard, modern software can solve practical instances extremely well. In this talk, I will highlight a number of aspects where theoretical progress has been made towards understanding the performance of state-of-the-art techniques.

KWG PhD Prize

14:45-15:45

Every year, the Dutch Royal Mathematical Society (KWG) invites several PhD candidates to present their research at the Dutch Mathematical Congress (NMC). A jury of mathematicians from various fields chooses a winner who receives, besides the prestige attached to winning, a floating trophy and a monetary reward of 1000 euro. The jury, chaired by Prof. Martin van Gijzen, selected the following 4 candidates:

- Anina Gruica (Eindhoven University of Technology)
- Leonardo Garcia-Heveling (Radboud University)
- Luis Felipe Vargas (CWI)
- Perfect Y. Gidisu (Eindhoven University of Technology)



Anina Gruica (Eindhoven University of Technology)

The Density of Maximum-Rank-Distance Codes

This talk focuses on rank-metric codes, which are linear spaces of matrices over a finite field F_q in which every nonzero matrix has rank at least d (the minimum distance of the code). Originally introduced by Delsarte for combinatorial interest, in the last few decades rank-metric codes have been

extensively studied in connection with applications in information theory and several areas of pure and applied mathematics.

A central open problem in coding theory is to count the number of rank-metric codes having maximum dimension for a certain minimum distance. These codes are called maximum-rank-distance (MRD) codes. In this talk, I will address this problem from an asymptotic viewpoint, focusing on the density of MRD codes as the field size q tends to infinity.

This instance of the problem has been studied using various different approaches, but none of the techniques proposed so far was enough to determine whether MRD codes are sparse or dense (or neither) as the field size grows. I will explain how this problem can be solved using a combinatorial approach based on the parameters of certain bipartite graphs, proving in particular that MRD codes are (very) sparse for large q .



Leonardo Garcia-Heveling (Radboud University)

From spacetime to metric spaces

General relativity describes gravity through the geometry of spacetime. A big open problem is how to compare different spacetimes. For example: in which sense is a vacuum spacetime close to a spacetime containing only a small amount of mass?

At the heart of this problem lies the fact that spacetimes are manifolds equipped with a metric tensor of Lorentzian signature $(-+++)$. The minus sign is there to single out one direction as the time direction. Such a Lorentzian metric is not positive definite, and therefore we cannot apply the usual notions of closeness between metric spaces, like the Gromov-Hausdorff distance. Sormani-Vega (2016) proposed to address this by equipping each spacetime with its so-called null distance, which is positive definite. For this approach to succeed, the null distance has to encode the physically relevant information about the spacetime.

In this talk, I will explain how indeed an important physical condition on the spacetime, global hyperbolicity, is encoded in its null distance. Global hyperbolicity is the condition that guarantees well-posedness for the Einstein equations of general relativity. I will show that it is equivalent to completeness of the null distance, the usual requirement that every Cauchy sequence has a limit.



Luis Felipe Vargas (CWI)

Sums of squares, copositive matrices and the stability number of a graph

The connection between nonnegative polynomials and sums of squares has been much studied in the last two centuries. In 1888, Hilbert proved that there exist nonnegative polynomials that cannot be written as a sum of squares of other polynomials. Other types of certificates for nonnegativity involving sums of squares of polynomials have been studied. In 1995, Reznick showed that, for any positive definite form f , there exists an integer r for which $(\sum_{i=1}^n x_i^2)^r f$ is a sum of squares of polynomials. In general, the 'positive definite' condition is necessary.

In this lecture, we study the existence of these Reznick-type positivity certificates for nonnegative forms (possibly with zeros) in the context of copositive matrices and their applications to the Stable Set Problem. A matrix is copositive if an associated quartic form is positive semidefinite. Thus, we study copositive matrices for which the associated quartic form admits a Reznick-type certificate. As main results, we characterize the matrix sizes for which this certificate always exists, and we show that this certificate exists for a broad class of copositive matrices arising from graphs. This last result implies the finite convergence of a semidefinite hierarchy for approximating the stability number of a graph.



Perfect Y. Gidisu (Eindhoven University of Technology)

Generalized CUR-type factorizations for large-scale matrices

A CUR factorization is a type of low-rank matrix decomposition that approximates a given matrix using a small subset of its rows and columns as bases for its row and column spaces. Unlike traditional low-rank decompositions, which use orthonormal bases, a CUR factorization offers advantages such as preserving sparsity and non-negativity, improved data interpretation, and reduced storage requirements. Mathematically, we aim to solve a combinatorial problem where we select k rows and columns from the matrix A to construct an $m \times k$ matrix C and a $k \times n$ matrix R . The goal is to minimize the error $\|A - CUR\|_{2,F}$ over all possible choices for C and R , with the matrix U being the solution to the optimization problem $U = \operatorname{argmin}_{\tilde{U} \in \mathbb{R}^{k \times k}} \|A - C\tilde{U}R\|_{2,F}$. An exact solution to this

problem is intractable, so researchers seek efficient mathematical methods that yield a solution not worse than the optimal by some factor, i.e., $\|A - CUR\|_{2,F} \leq \eta \cdot \|A - A_k\|_{2,F}$, where A_k is the optimal rank- k approximation. However, finding deterministic algorithms that result in a modest factor is still an open problem. We have developed efficient algorithms that seek to minimize η while also extending the CUR factorization to multiple matrices.

Keynote lecture

16:15-17:00



Klaas Landsman (Radboud University)

In praise of (good) definitions

Good definitions are a central ingredient of good mathematics (as well as of good philosophy). We trace the origin of this concept back to Socrates and Plato, draw attention to their importance in Newton's Principia from 1687 and in early modern science in general, and move on to the 20th century. Here we find highlights ranging from Hilbert to Penrose. Apart from history and examples, also the nature of good definitions will be analyzed. If we are to instill the virtues of mathematical thinking into science, or even into thought in general, this aspect of mathematical precision seems on a par with the concept of proof. Thus the fact that definitions are usually introduced without much context or explanation, even to students of mathematics, (as are proofs, except in formal logic), needs to be remedied. This talk is a first attempt to do just that.

Biography

Prof.dr. NP (Klaas) Landsman} has been Professor of Mathematical Physics since 2001, initially at the University of Amsterdam and since 2004 at Radboud University in Nijmegen. His PhD in theoretical physics (from the University of Amsterdam) dates from 1989, after which he spent the years 1989-1997 at the University of Cambridge (with one year, 1993-94, at the University of Hamburg). He is a former EPSRC Advanced Research Fellow (UK), Alexander von Humboldt Fellow (Germany), KNAW Research Fellow (Netherlands) and NWO Pioneer (ditto). In 2011 he received a TOP-GO award from NWO. He is a member of both the KNAW (2019) and the KHMW (2021). In 2020 he won the FQXi Essay Contest 2019-2020 on Undecidability, Unpredictability and Unpredictability, and in 2022 he won the Spinoza Prize (the highest scientific award in the Netherlands). Besides his core work in theoretical physics and mathematical physics, he is also active in pure mathematics and in the history and philosophy of physics. Until now he has mainly worked on the mathematical and philosophical foundations of quantum theory and general relativity, but he is currently moving towards statistical mechanics and the thermodynamics of black holes. He has authored four scholarly monographs, two popular science books, nearly one hundred peer-reviewed papers and book chapters, and nearly 50 popular articles and opinion articles in newspapers. Landsman has trained 15 PhD students and 30 Master's students and many of his former students work in academia. He was co-founder of the Institute for Mathematics, Astrophysics and Particle Physics (IMAPP) at Radboud University Nijmegen,

of the national mathematics cluster Geometry and Quantum Theory (GQT), of the Dutch Institute for Emergent Phenomena (DIEP), and of the National Science Agenda route Building Blocks of Matter and Foundations of Space and Time, all of which still thrive. He is currently working on the construction of a Radboud Center for Natural Philosophy.