Sponsoren

De vijftigste editie van het Nederlands Mathematisch Congres wordt mede mogelijk gemaakt door: **Koninklijk Wiskundig Genootschap, Technische Universiteit Delft, Universiteit Leiden, 3TU-AMI, NWO, Elsevier, Philips, Shell, Stichting Compositio, Timman Stichting, VORtech;**

en door de NWO clusters: **DIAMANT, GQT, NDNS+, STAR.**

50STE NEDERLANDS MATHEMATISCH CONGRES

NMC 2014

onder auspiciën van het Koninklijk Wiskundig Genootschap

16 – 17 april 2014
TUD

Inhoud

1 Congrescommissie

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Geschiedenis	Fokko Jan Dijksterhuis (UT)

2 Voorwoord

Namens het organisatiecomité wil ik u van harte welkom heten op het vijftigste Nederlands Mathematisch Congres. Ook heet ik u van harte welkom op de Technische Universiteit Delft, bij de faculteit Elektrotechniek, Wiskunde en Informatica (EWI), en met name bij de afdeling Toegepaste Wiskunde, ook wel bekend als DIAM, Delft Institute of Applied Mathematics. Wij zijn verheugd dat u de weg naar de TUD en onze afdeling heeft weten te vinden.

Het is de vijftigste keer dat het congres georganiseerd wordt en de vijfde keer dat het congres in Delft plaatsvindt. Eerder vond het congres ook plaats in Delft in 1970, 1983, 1992 en 2006.

Inmiddels staan we nu dus voor het vijftigste congres en zijn we er zeer trots op dat we dit in Delft mogen organiseren. Dat doen we overigens niet alleen; we worden geholpen door onze collega's van het Mathematisch Instituut van de Universiteit Leiden. Volgend jaar vindt het congres in Leiden plaats en zullen wij vanuit Delft ons steentje aan de organisatie bijdragen.

Het organisatiecomité heeft zijn best gedaan om een breed programma samen te stellen. Het congres is immers de jaarlijkse bijeenkomst van alle wiskundigen in Nederland.

Wij zijn zeer vereerd dat de driejaarlijkse Brouwermedaille uitgereikt zal worden tijdens het congres in Delft. De medaille is 14 keer eerder uitgereikt. Deze keer zal John Mather (Princeton) de medaille in ontvangst nemen voor zijn belangrijke werk op het gebied van de dynamische systemen. Henk Broer zal het laudatio uitspreken en André Ran zal als voorzitter van het KWG de medaille overhandigen.

Na de overhandiging is er een feestelijke receptie voor alle congresgangers en kan men de laureaat feliciteren. Tijdens de receptie vieren we tevens het vijftigjarige jubileum van het NMC. Herman te Riele zal in zijn lezing op donderdag verder ingaan op de geschiedenis van het NMC.

Ook zal tijdens het congres de Beegerlezing gehouden worden. Deze lezing vindt tweejaarlijks plaats tijdens het NMC en gaat telkens over een onderwerp uit de algoritmische getaltheorie. Dit jaar zal de lezing gehouden worden door Daniele Micciancio (San Diego).

Een goede gewoonte is de uitreiking van de Philips Wiskunde prijs voor de beste presentatie door een promovendus. Een zestal geselecteerde promovendi zal een presentatie geven voor een deskundige jury onder voorzitterschap van Michel Dekking. De jury zal in haar oordeel met name letten op de helderheid van de presentatie. Aan het einde van het congres zal de winnaar bekendgemaakt worden en de trofee en een geldbedrag aan de winnaar overhandigd worden door Rob Fastenau, decaan van EWI.

Naast al deze prijzen en erkenningen zijn er lezingen door vier hoofdsprekers, te weten Monique Laurent, Volker Mehrmann, Felix Otto en Aad van der Vaart. Hun expertise strekt zich uit over verschillende delen van de wiskunde en biedt daardoor een mooi en breed aanbod aan onderwerpen.

In een aantal parallelle sessies worden lezingen gehouden door wiskundigen afkomstig van Nederlandse universiteiten, te weten Bas Edixhoven, Remco van der Hofstad, Erik Koelink, Sergey Shadrin en Hans Zwart. Ook bij hen is het aanbod aan onderwerpen zeer ruim, zodat er voor elk wat wils is.

Tenslotte zijn er minisymposia, o.a. door de wiskundeclusters, voor leraren over onderwijs, over financiële wiskunde, numerieke wiskunde en geschiedenis.

De jaarlijkse ledenvergadering van het Koninklijk Wiskundig Genootschap vindt plaats in de lunchpauze op de tweede dag. Onder andere zal daar een bestuurswisseling aan de orde zijn.

Door middel van een aantal stands wordt de congresgangers de mogelijkheid geboden om kennis te nemen van allerlei zaken die de wiskunde aangaan.

Het Nederlands Mathematisch Congres 2014 is mogelijk gemaakt door een aantal sponsors die wij hartelijk danken voor hun ondersteuning.

Wij wensen u allen een goed congres toe.

Namens het organisatiecomité,

Jacob van der Woude

3 Algemene informatie

1. Locatie. Het Nederlands Mathematisch Congres 2014 vindt plaats in het EWI gebouw van de faculteit Eletrotechniek, Wiskunde en Informatica van de Technische Universiteit Delft. Het gebouw ligt op de campus van de TUD en is herkenbaar als hoogste gebouw aldaar. Het adres van het gebouw is Mekelweg 4, 2628 CD, Delft (gebouw 36). Het EWI gebouw ligt op 30 minuten loopafstand van NS station Delft en op 15 minuten loopafstand van NS station Delft Zuid. Vanaf NS station Delft is het gebouw tevens te bereiken met

- **bus 40** (richting Rotterdam CS, uitstappen bij halte **Cornelis Drebbelweg**)
- **bus 69** (richting TU Zuid, uitstappen bij halte **Stieltjesweg**)
- **bus 121** (richting Zoetermeer, Centrum West, uitstappen bij halte **Aula**)

Automobilisten die via de A13 (Den Haag-Rotterdam) komen, kunnen het beste afslag 10, **Delft Zuid**, nemen, vervolgens de afslag **TU-wijk**, en de borden volgen richting **P. Elektro**. Aan de achterzijde van het EWI gebouw is plek om te parkeren (Feldmannweg).

2. Congresbalie. De congresbalie bevindt zich in de hal van het EWI gebouw direct tegenover de hoofdingang. De balie is geopend woensdag 16 april vanaf 9:00 uur en donderdag 17 april vanaf 8:30 uur. Daar kunt u terecht voor de registratie. U ontvangt dan het congresmapje, badge, etc. Ook voor vragen kunt u bij de balie terecht. Daar kunt u tevens eventuele berichten voor congresdeelnemers en mededelingen over het programma vinden.

3. Plaats van de voordrachten. De hoofdvoordrachten en de opening en sluiting van het congres vinden plaats in zaal Ampère, de grootste zaal van het EWI gebouw. De hoofdingang van deze zaal bevindt zich op de begane grond. Tevens is er een ingang op de eerste verdieping. Deze ingang is bereikbaar via de trap, maar ook via de lift in de hal van het EWI gebouw. Voor de overige voordrachten zullen naast zaal Ampère ook zaal Boole met een ingang op de begane grond en de eerste verdieping (ook bereikbaar via de lift) en de zalen Chip, D@ta en Pi gebruikt worden. Deze laatste zalen hebben de ingang op de verdieping tussen de begane grond en de eerste verdieping. Deze zalen zijn bereikbaar via een trap, maar ook via de lift en een traplift. De locatie van alle zalen is met bewegwijzering aangegeven.

4. Koffie, thee, lunch. Koffie en thee worden geserveerd tijdens de pauzes in de gang op de begane grond naar de zalen Ampère en Boole. De lunch wordt geserveerd in de restaurant op de eerste verdieping. Ook deze locatie is met bewegwijzering aangegeven.

5. Stands. In de gang op de begane grond naar de collegezalen Ampère en Boole zullen stands staan van de volgende organisaties:

- Elsevier
- Epsilon
- Kangoeroe
- KWG
- Optische Fenomenen
- PWN

6. Receptie. Na afloop van de Brouwerlezing op woensdag 26 april vindt een receptie plaats ter ere van de laureaat, maar tevens om het vijftigjarig jubileum van het congres te vieren. De receptie vindt plaats in de centrale ruimte van het EWI gebouw.

7. Links naar meer informatie. Zie:

- `http://www.wiskgenoot.nl`
- `http://www.ewi.tudelft.nl`
- `Nederlands-Mathematisch-Congres`

4 Programma

Woensdag 16 april

9:00–10:15	*Ontvangst en inschrijving*	Foyer
10:15–10:30	*Opening* door Rector Magnificus van TUD	Ampère
10:30–11:20	*Plenaire voordracht*: **Volker Mehrmann (TU Berlin)** Numerical solution of eigenvalue problems for partial differential equations: From real world applications to new theory	Ampère
11:20–11:50	*Pauze*	
11:50–12:40	*Parallelle lezingen*	
	***Beegerlezing*: Daniele Micciancio (San Diego)** Sphere packings, lattice algorithms and NP-hardness	Chip
	Remco van der Hofstad (TU/e) Recent progress in high-dimensional percolation	Pi
	Sergey Shadrin (UvA) Integrable hierarchies and enumerative geometry	D@ta
12:40–13:40	*Lunch*	
	Parallelle sessies (A1)	
13:40–14:40	DIAMANT	Ampère
13:40–14:40	NDNS+	Boole
13:40–14:40	Leraren	Chip
13:40–14:40	Numerieke lineaire algebra	D@ta
13:40–14:40	Finance	Pi
14:40–15:00	*Pauze*	
	Parallelle sessies (B1)	
15:00–16:00	DIAMANT	Ampère
15:00–16:00	NDNS+	Boole
15:00–16:00	Leraren	Chip
15:00–16:00	Modellering	D@ta
15:00–16:00	Finance	Pi
16:10–16:20	Laudatio door Henk Broer	Ampère
16:20–17:10	***Brouwerlezing*: John Mather (Princeton)** Dynamics of area preserving mappings: Gateway to hamiltonian dynamics	
17:10–17:15	Uitreiking Brouwermedaille door André Ran	
17:15–18:45	*Receptie*	Foyer

Donderdag 17 april

9:00–9:30	**Herman te Riele (CWI):** 50 jaar NMC	Ampère
9:30–10:20	*Plenaire voordracht*: **Monique Laurent (CWI, UvT)** Optimization over polynomials with sums of squares and moments	Ampère
10:30–11:20	*Parallelle lezingen*	
	Hans Zwart (UT) Control theory for vehicular platoons	D@ta
	Erik Koelink (RUN) A thousand titles for a NMC-lecture	Chip
	Bas Edixhoven (UL) Some elliptic curves from the real world	Pi
11:20–11:50	*Pauze*	
11:50–12:40	*Plenaire voordracht*: **Aad van der Vaart (UL)** Bayesian statistical inference in high dimensions	Ampère
12:40–13:40	*Lunch*	
13:00–13:40	*KWG jaarvergadering*	Zaal Pi
	Parallelle sessies (A2)	
13:40–14:40	STAR	Chip
13:40–14:40	AIO presentaties (Philipsprijs)	Boole
13:40–14:40	Energie	D@ta
13:40–14:40	Geschiedenis	Pi
14:40–15:00	*Pauze*	
	Parallelle sessies (B2)	
15:00–16:00	STAR	Chip
15:00–16:00	AIO presentaties (Philipsprijs)	Boole
15:00–16:00	Industrie	D@ta
15:00–16:00	Geschiedenis	Pi
16:10–17:00	*Plenaire voordracht*: **Felix Otto (Leipzig)** Towards a quantitative theory of stochastic homogenization	Ampère
17:00–17:15	Uitreiking Philipsprijs – Afsluiting	Ampère

Parallelle sessies (A1)

Woensdag 16 april (13:40 – 14:40)

DIAMANT clustersessie (A1)	**Zaal Ampère**
13:40–14:40	**Alberto del Pia (IBM Watson Research Center)** On cutting planes for mixed integer linear programming

NDNS+ clustersessie (A1)	**Zaal Boole**
13:40–14:10	**Tristan van Leeuwen (CWI)** A penalty method for large-scale inverse problems
14:10–14:40	**Christoph Brune (UT)** Nonlinear reconstruction for inverse problems in 4d imaging

Leraren (A1)	**Zaal Chip**
13:40–14:40	**Kenneth Ruthven (Cambridge)** Incorporating digital technologies into school mathematics

Numerieke lineaire algebra (A1)	**Zaal D@ta**
13:40–14:00	**Mike Botchev (UT)** Large scale matrix functions with Krylov subspaces
14:00–14:20	**Folkert Bleichrodt (CWI)** SDART: an algorithm for discrete tomography from noisy projections
14:20–14:40	**Alex Sangers (TUD)** The eigenvectors corresponding to the second eigenvalue of the Google matrix and their relation to link spamming

Finance (A1)	**Zaal Pi**
13:40–14:40	**Andre Lucas (VU)** Systemic financial risk measurement using new time varying parameter models

Parallelle sessies (B1)

Woensdag 16 april (15:00 – 16:00)

DIAMANT clustersessie (B1)	**Zaal Ampère**
15:00–16:00	**Daniel Dadush (New York)** Short paths on the Voronoi graph and the closest vector problem with preprocessing

NDNS+ clustersessie (B1)	**Zaal Boole**
15:00–15:30	**Alef Sterk (RUG)** Extreme value statistics for dynamical systems
15:30–15:45	**Corine Meerman (UL)** Stability of morphodynamical equilibria in tidal basins
15:45–16:00	**Patrick van Meurs (TU/e)** Upscaling of particle systems

Leraren (B1)	**Zaal Chip**
15:00–16:00	**Roland van der Veen (UvA)** De wiskunde achter rotaties

Modellering (B1)	**Zaal D@ta**
15:00–15:20	**Daniel Koppenol (TUD)** Determination of the mechanism behind the formation of spatio-temporal hexagonal activity patterns in a model neuronal network
15:20–15:40	**Lisanne Rens (CWI)** Mathematical modeling of mechanical cell-extracellular matrix interactions during angiogenesis
15:40–16:00	**Sander Hille (UL)** Uncovering the secrets of hormone transport in plants by combining modeling and experiments

Finance (B1)	**Zaal Pi**
15:00–15:30	**Ramon van den Akker (UvT)** Semiparametric Gaussian copula models: geometry and efficient rank-based estimation
15:30–16:00	**Diego Garlaschelli (UL)** Early-warning signals of topological collapse in interbank networks

Parallelle sessies (A2)

Donderdag 17 april (13:40 – 14:40)

STAR clustersessie (A2)	**Zaal Chip**
13:40–14:40	**Alan Hammond (Oxford)** Exceptional times in dynamical percolation, and the Incipient Infinite Cluster

AIO presentaties – Philipsprijs (A2)	**Zaal Boole**
13:40–14:00	**Eric Siero (UL)** Singularly perturbed reaction diffusion systems with a changing parameter
14:00–14:20	**Roberta Anna Iseppi (RUN)** Ghost fields: non-existing particles or existing geometric properties?
14:20–14:40	**Aida Abiad (UvT)** Are almost all graphs determined by their spectrum?

Energie (A2)	**Zaal D@ta**
13:40–14:00	**Johann Hurink (UT)** Planning in smart grids
14:00–14:20	**Dimitri Jeltsema (TUD)** Reactive power under non-sinusoidal conditions
14:20–14:40	**Arjan van der Schaft (RUG)** Modeling and control of power networks

Geschiedenis van de wiskunde (A2)	**Zaal Pi**
13:40–14:10	**Jan Aarts (TUD)** When every second counts
14:10–14:40	**Wijnand Rekers (VU)** Wiskunde voor Delft

Parallelle sessies (B2)

Donderdag 17 april (15:00 – 16:00)

STAR clustersessie (B2)	**Zaal Chip**
15:00–15:30	**Bas Kleijn (UvA)** Bayesian testability and consistency
15:30–16:00	**Markus Heydenreich (UL)** Sharp phase transition and desertification

AIO presentaties – Philipsprijs (B2)	**Zaal Boole**
15:00–15:20	**Nela Lekić (UM)** Treewidth in phylogenetics
15:20–15:40	**Krzysztof Dorobisz (UL)** Deforming group representations
15:40–16:00	**Moritz Schauer (TUD)** Flight path of a moth

Industrie (B2)	**Zaal D@ta**
15:00–15:20	**Jok Tang (VORtech)** Mathematical formulation of a multi-year portfolio optimization problem for TenneT
15:20–15:40	**Bernard Meulenbroek (TUD)** Flow problems in geophysics
15:40–16:00	**Joep Evers (TU/e)** Effective water storage as flood protection

Geschiedenis van de wiskunde (B2)	**Zaal Pi**
15:00–15:30	**Jeroen Spandaw (TUD)** Bepaling van de afstand tot en grootte van de zon en de maan door Aristarchos van Samos
15:30–16:00	**Yvonne Ruckstuhl (TUD)** The Archimedes Palimpsest

5 Toelichting op bepaalde programma onderdelen

5.1 Brouwerlezing en Brouwermedaille

∗ 16 april, 16:10–17:00 Zaal Ampère

Luitzen Egbertus Jan Brouwer (1881-1966) was één van de belangrijkste Nederlandse wiskundigen. In 2007 heeft TNT Post zelfs een postzegel met zijn beeltenis uitgebracht. Kort na het overlijden van Brouwer heeft het Koninklijk Wiskundig Genootschap (KWG), samen met de Koninklijke Nederlandse Akademie van Wetenschappen (KNAW), de Brouwerprijs ingesteld. Eens per drie jaar selecteert een commissie van het KWG daartoe een belangrijk deelgebied in de wiskunde. Een speciale commissie selecteert vervolgens een excellente wiskundige in het betreffende deelgebied. De laatste wordt uitgenodigd tijdens het eerstvolgend Nederlands Mathematisch Congres een voordracht over zijn of haar vakgebied te geven die toegankelijk is voor een algemeen wiskundig gehoor. Na afloop wordt de laureaat de Brouwermedaille met bijbehorende oorkonde uitgereikt.

Voor 2014 betreft dit het vakgebied van de dynamische systemen. Het KWG heeft de Brouwermedaille 2014 toegekend aan de Amerikaanse wiskundige John N. Mather (1942), verbonden aan Princeton University. Mather is een veelzijdig en buitengewoon invloedrijk wiskundige wiens werkterrein ligt in het vakgebied dynamische systemen. In het bijzonder betreft dit singulariteitentheorie en de Hamiltoniaanse dynamica, waar hij met gebruik van variationele methoden baanbrekend werk deed aan de zwakke Kolmogorov-Arnold-Moser theorie en de theorie van Arnold-diffusie. Zijn werk heeft toepassingen in onder andere de populatiedynamica en bij het efficiënt bijsturen van satellieten onder gebruikmaking van de zwaartekracht. Mather is lid van de United States National Academy of Sciences.

De Brouwerprijs is de meest prestigieuze Nederlandse wiskundeprijs, die ook internationaal in hoog aanzien staat. Een overzicht van de laureaten:

- 1970 R. Thom (topologie)
- 1973 A. Robinson (grondslagen van de wiskunde)
- 1978 A. Borel (Lie groepen)
- 1981 H. Kesten (waarschijnlijkheidsrekening)
- 1984 J. Moser (analyse)
- 1987 Y. Manin (getaltheorie)
- 1990 W.M. Wonham (control theory)
- 1993 L. Lovász (discrete wiskunde)
- 1996 W. Hackbusch (numerieke wiskunde)
- 1999 G. Lusztig (algebra)
- 2002 M. Aizenman (mathematische fysica)

- 2005 L. Birgé (mathematische statistiek)
- 2008 P.A. Griffiths (meetkunde)
- 2011 K. Plofker (geschiedenis)

De ceremonie rondom de Brouwermedaille bestaat uit een laudatio door de Groningse wiskundige Henk Broer (voorzitter van de jury), de Brouwerlezing door John Mather en de overhandiging van de Brouwermedaille door KWG-voorzitter André Ran.

5.2 Beegerlezing

∗ 16 april, 13.40–14.40 Zaal Chip

De Nederlandse wiskundige Nicolaas George Wijnand Henri Beeger (1884–1965) promoveerde in 1916 bij Willem Kapteyn en Jan de Vries op een proefschrift over Dirichletreeksen. Hij was tot zijn 65ste werkzaam als wiskundeleraar. Daarnaast schreef hij ongeveer dertig artikelen en een groot aantal recensies op het gebied van de elementaire en de algebraïsche getaltheorie. Een van zijn laatste publicaties was een tabel van de priemgetallen in het elfde miljoen. Na zijn pensionering zette hij een uitgebreide correspondentie op met andere wiskundigen zoals Gloden, Golubev, Ferrier, Bianchini en Lehmer. Beeger had goede contacten met het Mathematisch Centrum te Amsterdam (o.a. met Duparc en Kruyswijk), waaraan hij ook een deel van zijn nalatenschap heeft vermaakt. Elke twee jaar wordt ter nagedachtenis van Beeger iemand met grote verdiensten op het gebied van de algoritmische getaltheorie uitgenodigd voor het geven van een 'Beegerlezing'. Eerdere Beegersprekers waren:

- Carl Pomerance (1992)
- Hugh Williams (1994)
- John Horton Conway (1996)
- Hendrik Lenstra (1998)
- Peter Borwein (2000)
- Bjorn Poonen (2002)
- Manjul Bhargava (2004)
- Manindra Agrawal (2006)
- Dan Bernstein (2008)
- Florian Luca (2010)
- Yuri Bilu (2012)

Dit jaar zal de Beegerlezing gehouden worden door Daniel Micciancio (San Diego).

5.3 Philips Wiskundeprijs voor promovendi

∗ 17 april, 13.40–14.40 en 15:00–16:00 Zaal Boole

Ook dit jaar zal de Philips Wiskundeprijs voor promovendi toegekend worden. Tijdens een speciaal mini-symposium op donderdag 17 april 2014 krijgen zes uitgekozen promovendi de gelegenheid gedurende maximaal 20 minuten (inclusief vragen) over hun werk te vertellen. Uit de verschillende voordrachten zal een deskundige jury de beste selecteren. De prijs, bestaande uit een wisseltrofee en een geldbedrag, zal op donderdagmiddag aan de winnende promovendus of promovenda worden overhandigd. De jury staat dit jaar onder voorzitterschap van Michel Dekking (TUD). De voordrachten moeten gericht zijn op een algemeen wiskundig publiek. Een belangrijk criterium voor de toekenning van de prijs is dan ook dat de voordracht voor niet-specialisten begrijpelijk moet zijn. De kandidaten dienen promovendi op het gebied van de wiskunde te zijn aan een Nederlandse instelling en nog niet gepromoveerd op 17 april 2014.

5.4 Jaarvergadering Koninklijk Wiskundig Genootschap

∗ 17 april, 13:00–13:40 (tijdens de lunchpauze) Zaal Pi

Het NMC 2014 vindt plaats onder auspicieën van het Koninklijk Wiskundig Genootschap (KWG). Het KWG is een landelijke vereniging van beoefenaars van de wiskunde en iedereen die de wiskunde een warm hart toedraagt.

De vereniging is in 1778 opgericht en is 's werelds oudste nationale wiskundegenootschap. Het genootschap heeft als doel de wiskunde te bevorderen en haar beoefening en toepassingen aan te moedigen. Daarnaast vertegenwoordigt het KWG de Nederlandse wiskundige gemeenschap in binnen- en buitenland.

Volgens de traditie is het NMC de gelegenheid waar veel leden van het KWG elkaar ontmoeten, terwijl de jaarlijkse ledenvergadering van het KWG altijd tijdens dit congres wordt gehouden. Dit jaar staat de 237ste Algemene Ledenvergadering gepland op donderdag 14 april, tussen 13:00 en 13:40 uur in zaal Pi van het EWI gebouw.

6 Samenvattingen plenaire voordrachten

Numerical solution of eigenvalue problems for partial differential equations: From real world applications to new theory

Volker Mehrmann (TU Berlin)

∗ 16 april, 10:30–11:20 Zaal Ampère

Abstract: Eigenvalue problems for partial differential operator are still a major challenge in all areas of science and engineering. Motivated from the real world problem of figuring out the reason for the squeaking behavior of disk brakes and how to modify the brake to remove these noises, we study the numerical solution of eigenvalue problems for partial differential equations via (adaptive) finite element methods. We will show that it is possible to balance the discretization errors and the errors in the linear algebra methods and that convergence, efficiency and reliability of the adaptive method can be proved. This leads to a very efficient method once the solution of the problem can be well approximated from a low dimensional subspace in the first place. This is e.g. the case for elliptic PDE eigenvalue problem nut not necessarily for non-selfadjoint problems as the one arising in disk brake noise analysis, where the conditioning of the eigenvalue/eigenvector has to be considered as well. We will discuss several open questions as well.

Brouwerlezing: Dynamics of Area Preserving Mappings: Gateway to Hamiltonian Dynamics

John Mather (Princeton)

∗ 16 april, 16:10 –17:00 Zaal Ampère

Abstract: Poincare created the theory of dynamical systems and studied the dynamics of area preserving mappings. Much of what is known about Hamiltonian dynamics can be illustrated in the case of area preserving mappings; indeed for many results in Hamiltonian dynamics, the main difficulty appears already in the case of area preserving mappings. In this talk, I will discuss a few of my favorite results and problems in these subjects, from Poincare's time to the present. No knowledge of dynamical systems will be assumed.

50 jaar NMC

Herman te Riele (CWI)

∗ 17 april, 9:00 –9:30 Zaal Ampère

Abstract: Dit jaar wordt het Nederlands Mathematisch Congres (NMC) voor de 50e keer gehouden, in Delft dus. Het eerste vond plaats aan de toenmalige Technische Hogeschool Twente in Enschede, in 1965. Het congres werd tweemaal in België georganiseerd: in 1996 in Antwerpen (i.s.m. de zusterverenigingen uit de V.S., België en Luxemburg) en in 2005 in Gent (i.s.m. die uit Frankrijk, België en Luxemburg). In deze vroege voordracht zult u hopelijk aangenaam gewekt worden aan de hand van enkele hoogtepunten uit de geschiedenis van het NMC.

Optimization over polynomials with sums of squares and moments

Monique Laurent (CWI, UvT)

∗ 17 april, 9:30 –10:20 Zaal Ampère

Abstract: Minimizing a polynomial function over a domain defined by polynomial inequalities models broad classes of hard problems from combinatorics, geometry and optimization. New algorithmic approaches have emerged recently for computing the global minimum, by combining tools from real algebra (sums of squares of polynomials) and functional analysis (moments of measures) with semidefinite optimization. Sums of squares are used to relax positive polynomials, combining an old idea of Hilbert with the recent algorithmic insight that they can be checked efficiently with semidefinite optimization. The dual approach revisits the classical moment problem and leads to algorithmic methods for checking optimality and extracting global minimizers.

In the talk we will give an introduction to the general methodology, illustrate it on selected examples, and discuss possible extensions in particular to polynomials in noncommutative variables that occur naturally in quantum information.

Bayesian statistical inference in high dimensions

Aad van der Vaart (UL)

∗ 17 april, 11:50 –12:40 Zaal Ampère

Abstract: Last year we celebrated the 250th birthday of the presentation of the first paper on Bayesian statistical inference, written by Thomas Bayes, but presented two years after his death. The Bayesian way of thinking was later rediscovered by Laplace, used by Gauss to derive the method of least squares, and was central to statistics until Fisher in the 1920/30s criticised it and suggested maximum likelihood as a better idea. Some say that there are now two paradigms in statistics, the Bayesian one, and the Fisherian one, which strangely enough is referred to as the classical one. There is certainly a difference in philosophy, but for most of the simple statistical models that were popular in the 20th century the difference in outcome is minor. Since the end of the last century complex models and Bayesian methods have both gained popularity in statistics. The purpose of this talk is to connect these two not really related strands in statistics. Complex models have parameters that are high-dimensional vectors, or even functions that range over an infinite-dimensional function space. They arise naturally in modern (big) data settings. The Bayesian method consists of assigning a (prior) probability distribution to such parameters, and updating this using the available data, by standard probability rules. Mathematically and computationally this is more challenging than Bayes could foresee in the 1750s, but conceptually there is nothing new. This is the charm of the method. In the talk we try to make the point that the results of the method can open new vistas, if applied with the right prior distributions in modern settings. Of course, we try to do this for a general mathematical audience.

Towards a quantitative theory of stochastic homogenization

Felix Otto (Leipzig)

$*$ 17 april, 11:50 –12:40 Zaal Ampère

Abstract: In many applications, one has to solve an elliptic partial differential equation with coefficients that vary on a length scale much smaller than the domain size. We are interested in a situation where the coefficients are characterized in *stochastic* terms: Their statistics are assumed to be translation invariant and to decorrelate over large distances. As is known by qualitative theory, the solution operator behaves – on large scales – like the solution operator of an elliptic problem with *homogeneous* deterministic coefficients!

We are interested in several *quantitative* aspects, the first one being: How close is the actual solution to the homogenized one? We give an optimal answer in terms of the quenched Green's function, and point out the connections with elliptic regularity theory (input from Nash's theory, a new outlook on De Giorgi's theory).

We are also interested in the quantitative ergodicity properties for the process called "the environment as seen from the particle". We give an optimal estimate that relies on a link with (the Spectral Gap for) another stochastic process on the coefficient fields, namely heat-bath Glauber dynamics. This connection between statistical mechanics and stochastic homogenization has previously been used in opposite direction (i. e. with qualitative stochastic homogenization as an input).

Theory provides a formula for the homogenized coefficients, based on the construction of a "corrector", which defines harmonic coordinates. This formula has to be approximated in practise, leading to a random and a systematic error. If time permits, we point out optimal estimates of both.

This is joint work with A. Gloria, S. Neukamm, and D. Marahrens.

7 Samenvattingen parallelle lezingen

Beegerlezing: Sphere packings, lattice algorithms and NP-hardness
Daniele Micciancio (San Diego)
∗ 16 april, 11:50–12:40 Zaal Chip

Abstract: How many non-overlapping unit spheres can be packed within a given region of space? How many non-overlapping unit spheres can be arranged so that they all touch another given unit sphere? Variants and generalizations to n-dimensional space of these classic mathematical questions naturally occur in several areas of computer science. In this talk I will describe how these questions arise in the computational study of point lattices, and, in particular, in the algorithmic solution of the shortest vector problem (SVP), the computational problem at the core of modern lattice based cryptography. As we will see, these classic geometric problems play a fundamental role both in the design and analysis of some of the fastest SVP algorithms known to date, and also in establishing computational hardness results for SVP.

Recent progress in high-dimensional percolation
Remco van der Hofstad (TU/e)
∗ 16 april, 11:50–12:40 Zaal Pi

Abstract: It is now 25 years ago that Hara and Slade published their seminal work on the mean-field behavior of percolation in high-dimensions, showing that at criticality there is no percolation and identifying several percolation critical exponents. The main technique used is the lace expansion, a perturbation technique that allows us to compare percolation paths to random walks based on the idea that faraway pieces of percolation paths are almost independent in high dimensions. In the past few years, a number of novel results have appeared for high-dimensional percolation. I intend to highlight the following topics:

1. The recent computer-assisted proof, with Robert Fitzner, that identifies the critical behavior of nearest-neighbor percolation above 14 dimensions using the so-called Non-Backtracking Lace Expansion (NoBLE). While these results are expected to hold above 6 dimensions, the previous and unpublished proof by Hara and Slade only applied above 18 dimensions;

2. The identification of arm exponents in high-dimensional percolation in two works by Asaf Nachmias and Gady Kozma, using a clever and novel difference inequality argument;

3. The finite-size scaling for percolation on a high-dimensional torus, where the largest connected components share many features to the Erdös-Renyi random graph. In particular substantial progress has been made concerning percolation on the hypercube, where in joint work with Asaf Nachmias we have managed to avoid the lace expansion altogether;

4. Depending on time, I may also discuss the upper critical dimension of long-range percolation and scaling limits of percolation paths in work by Chen and Sakai, as well as with Heydenreich and Hulshof.

Integrable hierarchies and enumerative geometry
Sergey Shadrin (UvA)
∗ 16 april, 11:50–12:40 Zaal D@ta

Abstract: I am going to begin with an overview of a modern setup for enumerative geometry know as Gromov-Witten theory, with a focus on universal properties of enumerative questions for all possible varieties. It happens that some universal generating function for solution of the enumerative problems is always a solution of some integrable hierarchy of partial differential equation (which depends on the target variety) of the same type at the Korteweg-de Vries hierarchy, and this is going to be the main topic for my talk.

Control theory for vehicular platoons
Hans Zwart (UT)
∗ 17 april, 10:30 –11:20 Zaal D@ta

Abstract: With the increasing traffic there is a demand for intelligent transportation systems. Cooperative Adaptive Cruise Control is one of these systems. It allows, among others, for automatic short distance following. In this presentation we show how such a controller can be designed. Surprisingly, the design becomes simpler when the string of vehicle is assumed to be infinitely long. In that situation, the string of vehicle is spatially invariant, i.e., the number of an individual vehicle is not important, only his position with respect to its neighbors have to be taken into account. For a spatially invariant system, Fourier transform is applied which gives a (parametrized) finite-dimensional system. Controller design has become relatively simple, since finite-dimensional techniques can be used. For the specific example of a vehicular platoon we show how a linear quadratic optimal controller is design, and how it could be implemented in this string of vehicles. Furthermore, we show which mathematical questions remain open until now.

A thousand titles for a NMC-lecture
Erik Koelink (RUN)
∗ 17 april, 10:30 –11:20 Zaal Chip

Abstract: The Nederlands Mathematisch Congres is celebrating its 50th anniversary in Delft this year, and the role of a NMC has changed quite bit over the years. Similarly, the role of a mathematician has changed quite a bit and nowadays involves teaching, PR, organising workshops/meetings/conferrences (like the NMCs), directorship/politics and last but not least being a mathematician trying to understand what is going in some parts of mathematics.

Some elliptic curves from the real world

Bas Edixhoven (UL)

∗ 17 april, 10:30 –11:20 Zaal Pi

Abstract: Elliptic curves are very important in my work in number theory and arithmetic geometry, and so it makes me happy to encounter them as well in other areas of mathematics, and even outside mathematics. In this non-technical lecture, that will be accessible to master students in mathematics, I will give a few examples of elliptic curves showing up in plane geometry (Poncelet), in Escher's "Print Gallery" (de Smit and Lenstra), in classical mechanics (Euler), and in the Guggenheim museum in Bilbao (minimal art by Richard Serra). The first three examples are well known, but the last one appears to be new.

8 Samenvattingen voordrachten parallelle sessies

8.1 DIAMANT (A1/B1)

On cutting planes for mixed integer linear programming

Alberto del Pia (IBM Watson Research Center)

∗ 16 april, A1, 13:40–14:40 Zaal Ampère

Abstract: This talk gives an introduction to a recently established link between the geometry of numbers and mixed integer linear optimization. The main focus is to provide a review of families of lattice-free polyhedra and their use in a disjunctive programming approach. The use of lattice-free polyhedra in the context of deriving and explaining cutting planes for mixed integer programs is not only mathematically interesting, but it leads to some fundamental new discoveries, such as an understanding under which conditions cutting planes algorithms converge finitely. These theoretical results suggest the possibility that cutting planes from special families of lattice-free polyhedra could give rise to numerically efficient novel algorithms.

Short paths on the Voronoi graph and the closest vector problem with preprocessing

Daniel Dadush (New York)

∗ 16 april, B1, 15:00–16:00 Zaal Ampère

Abstract: The closest vector problem (CVP) on lattices (i.e. given an n dimensional lattice L with basis B and target point t, find a closest lattice point in L to t) is fundamental NP-hard problem with applications in coding, cryptography and optimization. In this talk, we will consider the preprocessing version of CVP (CVPP), an important variant of CVP, where we allow arbitrary time to preprocess the lattice before answering CVP queries.

In breakthrough work, Micciancio and Voulgaris (STOC 2010) gave the first single exponential time algorithm for CVP under the l_2 norm based on Voronoi cell computations. More precisely, after a preprocessing step requiring $\tilde{O}(2^{2n})$ time, during which they compute the Voronoi cell of L (the set of points closer to the origin than to any other point in L), they show that additional CVP queries (i.e. CVPP) can be solved in $\tilde{O}(2^{2n})$ time.

For our main result, we show that given the Voronoi cell V of L as preprocessing, CVP on any target t can be solved in expected $\tilde{O}(2^n)$ time. As our main technical contribution, we give a new randomized procedure that starting from any close enough lattice point to the target t, follows a path in the Voronoi graph of L (i.e. x, y in L are adjacent if $x + V$ and $y + V$ share a facet) to the closest lattice vector to t of expected polynomial size. In contrast, the path used by MV algorithm is only known to have length bounded by $\tilde{O}(2^n)$. Furthermore, for points x, y in L, we show that the distance between x and y in the Voronoi graph is within a factor n of $\|x - y\|_V$ (norm induced by the Voronoi cell), which is best possible. For our analysis, we rely on tools from high dimensional convex geometry. No background in convex geometry or lattices will be assumed.

Time permitting, I will describe related results and open questions about paths on more general lattice Cayley graphs.

Based on joint work with Nicolas Bonifas (Ecole Polytechnique & IBM).

8.2 NDNS+ (A1/B1)

A penalty method for large-scale inverse problems

Tristan van Leeuwen (CWI)

∗ 16 april, A1, 13:40–14:10 Zaal Boole

Abstract: Inverse problems are ubiquitous in science and engineering. Applications include seismic and medical imaging, non-destructive testing and remote sensing. These inverse problem can be cast as an optimization problem with PDE constraints. Due to the typical scale of the problems, Lagrange multiplier methods are not feasible since they require storage of the state and control variables as well as the multipliers. On the other hand, so-called reduced methods that explicitly eliminate the constraints by solving the PDEs are computationally very expensive and arguably exacerbate the non-linearity of the problem. In this presentation, I discuss how we can combine the advantages of both the Lagrange and reduced approaches by adopting a penalty method. I also present some numerical experiments that illustrate the benefits of the penalty approach.

Nonlinear reconstruction for inverse problems in 4D imaging

Christoph Brune (UT)

∗ 16 april, A1, 14:10–14:40 Zaal Boole

Abstract: Nonlinear mathematical models for inverse problems play a fundamental role e.g. in biomedicine, nanotechnology or geophysics. In particular in the context of imaging in tomography and live microscopy, innovative spatio-temporal inversion methods are of strongly growing interest. The aim of this talk is to highlight novel variational methods using nonlinear sparsity and TV-type regularization and their combination with kinetic PDEs and optimal transport. Besides the analysis of the convex problem related to mean-feld games, an efficient primal-dual splitting method will be presented. Large-scale experimental 4D datasets from cell biology illustrate the usefulness of the proposed inversion models for mathematical imaging sciences.

Extreme value statistics for dynamical systems

Alef Sterk (RUG)

∗ 16 april, B1, 15:00–15:30 Zaal Boole

Abstract: Classical extreme value theory (EVT) is concerned with the probability distribution of unlikely large values in stochastic processes. In the last decade the applicability of EVT has been extended to deterministic dynamical systems; then the idea is study the statistics of a time series obtained by evaluating a scalar observable along evolutions of the system. In this talk I will discuss some recently obtained results and highlight promising directions for future research.

Stability of morphodynamical equilibria in tidal basins

Corine Meerman (UL)

∗ 16 april, B1, 15:30–15:45 Zaal Boole

Abstract: Interesting patterns are observed in the tidal basins in The Wadden Sea. To get a better understanding of these patterns, a morphodynamical model is constructed. This model describes the interaction between water motion, sediment transport and bed evolution. The goal is to find the morphodynamic equilibria, to investigate their sensitivity to parameter variations, and to understand the physical mechanisms resulting in these equilibria. In this talk, the mathematical method to obtain cross-sectionally averaged equilibria will be presented and the sensitivity of these equilibria to various parameters will be discussed.

Upscaling of particle systems

Patrick van Meurs (TU/e)

∗ 16 april, B1, 15:45–16:00 Zaal Boole

Abstract: I address a scientific challenge occurring in many complex systems: to predict the macroscale collective behaviour induced by interacting particles on the microscale. The particle system which I consider models plasticity of metals. The focus lies on describing this system by an energy in such a way that we can rigorously pass to the limit as the number of particles goes to infinity.

8.3 Leraren (A1/B1)

Incorporating digital technologies into school mathematics

Kenneth Ruthven (Cambridge)

∗ 16 april, A1, 13:40–14:40 Zaal Chip

Abstract: Over the last 40 years, a succession of computational tools have become the focus of advocacy for the incorporation of digital technologies into school mathematics. Through considering a series of key examples – including arithmetic calculators, programming languages, digital graphing and dynamic geometry – and drawing on relevant educational research, this talk will examine what we can learn about the benefits and challenges of integrating novel mathematical tools into the school subject.

De wiskunde achter rotaties

Roland van der Veen (UvA)

∗ 16 april, B1, 15:00–16:00 Zaal Chip

Abstract: Omdat we er de hele dag mee te maken hebben is onze practische kennis van rotaties en bewegingen heel sterk ontwikkeld. In deze hands-on workshop zetten we onze intuitieve kennis in om de prachtige wiskunde achter rotaties tot leven te brengen.

Met alleen de blote handen krijgen we een beeld van de fundamentele meetkundige eigenschappen achter rotaties. Zonder te verzanden in formules. Ook de vele toepassingen, van robotarmen en computer-graphics tot macromoleculen, passeren de revue.

8.4 Numerieke lineaire algebra (A1)

Large scale matrix functions with Krylov subspaces

Mike Botchev (UT)

∗ 16 april, A1, 13:40–14:00 Zaal D@ta

Abstract: Matrix functions, such as the matrix exponential or the matrix cosine, are an increasingly important tool in Applied Mathematics. Their applications vary from photonic crystals to oil industry to analysis of social networks. In models involving matrix functions, one often needs to compute actions of matrix functions on given vectors for large matrices. In this talk we focus on Krylov subspace methods which are an important class of numerical techniques to do this. Applications, mathematical background and some recent work will be discussed.

SDART: an algorithm for discrete tomography from noisy projections

Folkert Bleichrodt (CWI)

∗ 16 april, A1, 14:00–14:20 Zaal D@ta

Abstract: Computed tomography is a noninvasive technique for reconstructing an object from projection data. In many application areas, the object consists of only a few materials. This prior knowledge can be exploited by constraining the gray values corresponding to these materials in the reconstruction. These *discrete tomography* algorithms improve the accuracy of the reconstruction. In cases where only few projection images are available, exploiting this prior knowledge is essential.

The Discrete Algebraic Reconstruction Technique (DART) is a reconstruction algorithm for discrete tomography. DART can result in accurate reconstructions, computed by iteratively refining the boundary of the object. However, this boundary update is not robust against noise and DART does not work well when confronted with high noise levels.

In this talk I introduce a modified DART algorithm, called soft DART (SDART) which imposes a set of soft constraints on the pixel values. This alternative approach improves the robustness of the method with respect to noisy datasets. After a short introduction to discrete tomography and the original DART method, I will discuss the SDART algorithm. Results of numerical experiments are presented to demonstrate the accuracy of the SDART algorithm.

The eigenvectors corresponding to the second eigenvalue of the Google matrix and their relation to link spamming

Alex Sangers (TUD)

∗ 16 april, A1, 14:20–14:40 Zaal D@ta

Abstract: Google uses the PageRank algorithm to determine the relative importance of a website. Link spamming is the name for putting links between websites with no other purpose than to increase the PageRank value of a website. To give a fair result to a search query it is important to detect whether a website is link spammed so that it can be filtered out of the search result.

While the dominant eigenvector of the Google matrix determines the PageRank value, the second eigenvector can be used to detect a certain type of link spamming. We will describe an efficient algorithm for computing a complete set of independent eigenvectors for the

second eigenvalue, and explain how this algorithm can be used to detect link spamming. We will illustrate the performance of the algorithm on web crawls of millions of pages.

8.5 Finance (A1/B1)

Systemic financial risk measurement using new time varying parameter models
Andre Lucas (VU)
∗ 16 april, B1, 13:40–14:40 Zaal Pi

Abstract: We propose an empirical framework to assess the likelihood of joint credit events. The framework builds on a new class of time varying parameter models (Creal, Koopman, Lucas, Journal of Applied Econometrics 2013) that opens up a variety of interesting avenues for research, both mathematically and economically. We apply a version of the model to model joint and conditional sovereign defaults from observed CDS prices, as well as joint and conditional failure probabilities for a system of European banks. Our model is based on a dynamic skewed-t distribution that captures all salient features of the data, including skewed and heavy-tailed changes in the price of CDS protection against sovereign default, as well as dynamic volatilities and correlations that ensure that uncertainty and risk dependence can increase in times of stress. We apply the framework to euro area sovereign CDS spreads during the Euro area debt crisis. Our results reveal significant time-variation in distress dependence and spill-over effects for sovereign default risk. We investigate market perceptions of joint and conditional sovereign risk around announcements of Eurosystem asset purchases programs, and document a strong impact on joint risk.

Semiparametric Gaussian copula models: geometry and efficient rank-based estimation
Ramon van den Akker (UvT)
∗ 16 april, B1, 15:00–15:30 Zaal Pi

Abstract: We propose, for multivariate Gaussian copula models with unknown margins and structured correlation matrices, a rank-based, semiparametrically efficient estimator for the Euclidean copula parameter. This estimator is defined as a one-step update of a rank-based pilot estimator in the direction of the efficient influence function, which is calculated explicitly. Moreover, finite-dimensional algebraic conditions are given that completely characterize efficiency of the pseudo-likelihood estimator and adaptivity of the model with respect to the unknown marginal distributions. For correlation matrices structured according to a factor model, the pseudo-likelihood estimator turns out to be semiparametrically efficient. On the other hand, for Toeplitz correlation matrices, the asymptotic relative efficiency of the pseudo-likelihood estimator can be as low as 20%. These findings are confirmed by Monte Carlo simulations.

The talk is based on joint work with Johan Segers and Bas J.M. Werker.

Early-warning signals of topological collapse in interbank networks
Diego Garlaschelli (UL)
∗ 16 april, A1, 15:30–16:00 Zaal Pi

Abstract: The financial crisis clearly illustrated the importance of characterizing the level of systemic risk associated with an entire credit network, rather than with single institutions. However, the interplay between financial distress and topological changes is still poorly understood. Here we analyze the quarterly interbank exposures among Dutch banks over the period 1998-2008, ending with the crisis.

After controlling for the link density, many topological properties display an abrupt change in 2008, providing a clear – but unpredictable – signature of the crisis. By contrast, if the heterogeneity of banks' connectivity is controlled for, the same properties show a gradual transition to the crisis, starting in 2005 and preceded by an even earlier period during which anomalous debt loops could have led to the underestimation of counter-party risk.

These early-warning signals are undetectable if the network is reconstructed from partial bank-specific data, as routinely done. We discuss important implications for bank regulatory policies.

8.6 Modellering (B1)

Determination of the mechanism behind the formation of spatio-temporal hexagonal activity patterns in a model neuronal network
Daniel Koppenol (TUD)
∗ 16 april, B1, 15:00–15:20 Zaal D@ta

Abstract: The model under consideration can be seen as a simple model of a cortical sheet that describes the firing rate activity of interconnected excitatory and inhibitory neurons present in the sheet (Curtu-Ermentrout 2004) and (Hansel-Sompolinsky 1998). It is assumed that the excitatory neurons display spike frequency adaptation and this is also explicitly decribed by the model. Furthermore, it is assumed that the firing rate function is sigmoidal-shaped and that the synaptic coupling between the neurons is characterized by local excitation and long range inhibition. Taken together this results in a system of nonlocal nonlinear partial integro-differential equations for the description of the dynamics of the firing rate activity and the spike frequency adaptation of the neurons.

Running numerical simulations with this model has shown previously that a travelling regular hexagonal activity pattern is a stable solution of the model given certain sets of values for the parameters of the model. More recently the mechanism behind the formation of these patterns was investigated by using a combination of methods from pattern formation, nonlinear dynamical systems and bifurcation theory (see the PhD dissertation of Rodica Curtu and the work of Paul Bressloff and colleagues for most of the details of the methods used (Bressloff-Cowan-Golubitsky-Thomas 2001) and (Curtu1 2003). First a linear stability analysis around the uniform quiescent state of the model (which is stable before the bifurcation point) has been performed. This analysis allowed to determine the different types of bifurcation that can take place in the model. Given the type of pattern of interest, the focus was set on the analysis of the Hopf bifurcation. Next, a singular perturbation

analysis was carried out in order to obtain the general solution of the model corresponding to spatio-temporal hexagonal activity patterns. Finally, the equilibrium solution of this general solution that corresponds with a travelling regular hexagonal activity pattern was determined. During the talk I will present more details of the results of this investigation and I will give the mechanism behind the formation of these activity patterns.

Mathematical modeling of mechanical cell-extracellular matrix interactions during angiogenesis

Lisanne Rens (CWI)

∗ 16 april, B1, 15:20–15:40 Zaal D@ta

Abstract: Angiogenesis is the formation of blood vessels from pre-existing blood vessels. Cells are also able to form blood vessels de novo, which is called vasculogenesis. Vascular network formation plays a crucial role in various biological processes, such as organ development, tumor growth and retinal diseases. A good understanding of angiogenesis is vital for medicine and tissue engerineering. Computer models can be of assistance, because by simulation we can infer important parameters for the inhibition and promotion of angiogenesis and examine different mechanisms that are involved more thoroughly.

Cultures of endothelial cells have shown to collectively evolve into vascular like networks in vitro. Endothelial morphogenesis depends on various chemical and mechanical factors, such as chemotaxis towards growth factors within the extracellular matrix, adhesion of cell to the extracullular matrix and more. Recently, the compliance of the extracellular matrix has become of great interest in the study of blood vessel formation. It has been shown that cells sense and respond to the mechanical properties of the extracellular matrix. In addition, cells can remodel the substrate that they adhere to. This provides cells with the ability of cell-cell mechanical communication and collectively form a network.

In this work we use the Cellular Potts Model, a cell-based model with dynamics based on Hamiltonian minimization, to study this mechanical cell-substrate interaction during vascular network formation. We model cells that apply a force on the substrate which depends on the shape of the cell. With a finite element method we can calculate the deformations in the substrate. Subsequently, the cells respond to the strain in the matrix. We assume that cells preferentially adhere to the substrate in the direction of higher strain. This is a reasonable assumption, as it has been shown that cells align in the direction of strain.

With this model we are able to reproduce cell behavior as observed in vitro. Similar to experiments, cells in our model become small and round on compliant substrates, elongate on substrates of intermediate compliances and spread on stiff substrates. Remarkably, simulated cells elongate and round in a pulsating manner, which has recently been observed with melanoma cells as well. In the model, this oscillating behavior seems to depend on the random motility of the cells. The model is of help in elucidating the cell shape and migration properties on different substrate stiffnesses. Furthermore, with just this mechanical cell-substrate feedback in the Cellular Potts Model, simulations show that cells are able to generate vascular like patterns on substrates of intermediate stiffness. This model, compared to other Cellular Potts Models of angiogenesis based on chemotaxis produces networks that are just as regular, but with chords that are typically one cell thick. With this model, we will study this mechanical aspect of angiogenesis more thoroughly. Current

research focuses on the effect of changing the adhesiveness of the substrate. This is joint work with van Oers and Merks.

Uncovering the secrets of hormone transport in plants by combining modeling and experiments

Sander Hille (UL)

∗ 16 april, B1, 15:40–16:00 Zaal D@ta

Abstract: The hormone auxin plays an important role in plant growth and development. Accordingly, the mechanisms that underly its cell-to-cell and long-distance transport in cell tissue have been of intense research interest in plant physiology and molecular biology, proposing various hypothetical mechanisms, among which the so-called chemi-osmotic theory is the most prominent. Direct experimental support for these is hard to give, because the detailed location and local concentration of the rather small auxin molecules inside cellular tissue is impossible to measure (yet). However, radioactively labeled auxin can be used to measure macroscopic transport characteristics in detail. We show how intense interplay between mathematical modelling and experimental plant research has led to new insights into lower-level processes involved in polar auxin transport in the inflorescence stems of the model plant *Arabidopsis thaliana* by analysing the macroscopic transport data in view of appropriate dynamic models.

8.7 STAR (A2/B2)

Exceptional times in dynamical percolation, and the Incipient Infinite Cluster

Alan Hammond (Oxford)

∗ 17 april, A2, 13:40–14:40 Zaal Chip

Abstract: Critical percolation on planar lattices such as the hexagonal lattice is known to have no infinite open clusters at the critical point for percolation. The term "incipient infinite cluster" was introduced by physicists to describe the large open clusters that are present at the critical value. Kesten gave the term a precise mathematical meaning, as the weak limit of conditionings of critical percolation on larger and larger open clusters containing the origin.

Antal Jarai has shown that several natural means of conditioning into existence an infinite open cluster containing the origin in critical percolation all give the incipient infinite cluster, lending the concept a sense of being natural. One possible route leading to the incipient is via dynamical percolation, in which the status of each hexagon in percolation is independently updated at exponential rate one to become open or closed with probability one-half. In this way, dynamical percolation has critical percolation has its invariant measure. There are exceptional times at which the open cluster of the origin in dynamical percolation has an infinite cluster, and this set of times has been proved by Garban, Pete and Schramm to have Hausdorff dimension 31/36. In this talk, I will discuss joint work with Gabor Pete and Oded Schramm in which the question of how the incipient infinite cluster arises in dynamical percolation is examined. While the configuration at the first positive exceptional time does not have the law of the incipient, a certain selection procedure which in essence

picks a uniform exceptional time does locate a random configuration have this law.

Bayesian testability and consistency
Bas Kleijn (UvA)
∗ 17 april, B2, 15:00–15:30 Zaal Chip

Abstract: Bayesian consistency theorems come in (at least) three distinct types, e.g. Doob's prior-almost-sure consistency on Polish spaces (Doob, 1948), Schwartz's Hellinger consistency with KL-priors (Schwartz, 1965) and the 'tailfree' weak consistency of Dirichlet posteriors. We ask the question how these notions are related and argue that one characterises them most conveniently using tests. We show that the existence of Bayesian tests is equivalent with Doob-like consistency of the posterior and show that Bayesian tests exist in much greater abundance than uniform tests. As examples we consider hypothesis testing problems like Cover's rational mean problem (Cover, 1973) and tests for connectedness or cyclicality in networks. To achieve frequentist posterior consistency, we combine Bayesian tests with a prior condition that generalises Schwartz's KL-condition and is conjectured also to accommodate 'tailfree' behaviour like that of Dirichlet posteriors. Ultimately, we propose the use of so-called "net priors" to achieve consistency without tests or the KL property.

Sharp phase transition and desertification
Markus Heydenreich (UL)
∗ 17 april, B2, 15:00–15:30 Zaal Chip

Abstract: We consider a stochastic model for vegetation in arid landscape that obeys a phase transition between a vegetated phase and a desert phase. We investigate the possibility of robust critical behaviour as an early warning signal for desertification. In a greater picture, we address sharp phase transition for two-dimensional random spatial systems.

Based on joint work with J. van den Berg (CWI) and J. Björnberg (Uppsala).

8.8 Energie (A2)

Planning in smart grids
Johann Hurink (UT)
∗ 17 april, A2, 13:40–14:00 Zaal D@ta

Abstract: The change to distributed generation out of renewable sources poses major challenges within the planning and control of the electricity grid. To tackle these challenges the usual vision is to move to a smart grid; an energy grid that allows for more efficient use of smart device at all levels of the grid. The resulting energy planning problem has to treat significantly more appliances compared to the past. Furthermore, these appliances may be of total different scale and various objectives may occur at different levels of the grid.

In this talk a sketch of the planning problem occurring for Smart Grids is given. Based on the leveled structure of the problem we propose a decomposition approach using Column Generation. The general framework consists of creating patterns for single entities/appliances, combining patterns for such appliances on higher levels into so-called ag-

gregated patterns and using these aggregated patterns to solve a global planning problem at the top level.

Reactive power under non-sinusoidal conditions
Dimitri Jeltsema (TUD)
∗ 17 april, A2, 14:00–14:20 Zaal D@ta

Abstract: The power factor (PF) is used as a measure of the effectiveness of the transfer of power between an electrical source and a load. The mathematical mechanism behind the definition of the power factor is the Cauchy-Schwarz inequality. If this inequality holds with equality, it means that the voltages and currents drawn from the source are directly proportional (collinear) and results in the best possible power factor (PF= 1). If the power factor is less than one, the residual of the Cauchy-Schwarz inequality represents the so-called reactive (useless) power. For sinusoidal voltages and currents the definition of reactive power is generally accepted and considered standard practice. For non-sinusoidal voltages and currents, however, the situation is much more involved and many authors have aimed to improve the concept of reactive power to the most general case. In this talk, I will provide a short historical overview, discuss some simple examples illustrating the core of the problem, and present some recent developments and future directions.

Modeling and control of power networks
Arjan van der Schaft (RUG)
∗ 17 april, A2, 14:20–14:40 Zaal D@ta

Abstract: In this talk I will indicate a number of fascinating directions in the modeling, analysis and control of power networks which are waiting to be addressed by, among others, mathematicians. First of all, a full-order model of the synchronous generator will be given and its Hamiltonian structure will be discussed. Due to the presence of external inputs the stability problem will turn out to be non-trivial. Next I will consider a simplified model of networks of producers and consumers, known as the 'swing equations'. Using again a Hamiltonian modeling framework I will investigate a number of stability and control scenarios.

8.9 Geschiedenis van de wiskunde (A2/B2)

When every second counts
Jan Aarts (TUD)
∗ 17 april, A2, 13:40–14:10 Zaal Pi

Abstract: The special feature of the pendulum clock of Christiaan Huygens is the cycloidal suspension, which is the cause of its tautochronous property: the period of oscillation of the pendulum is independent of its amplitude.

The first clock with a cycloidal suspension was constructed in 1656 and in the following year Samuel Coster obtained a license for the serial production. It took some 16 years untill the book *Horologium Oscillatorium*, *The Pendulum Clock*, appeared in which the construction is explained. The main goal of the book is to present mathematical proofs of

the correctness of the construction.

In the talk I shall examine the proof of the tautochronous property.

Wiskunde voor Delft
Wijnand Rekers (VU)
∗ 17 april, A2, 14:10–14:40 Zaal Pi

Abstract: Vanaf 1864 bouwde Adriaan Huet een nieuw vak op aan de Polytechnische School: werktuigbouwkunde. Hij gaf daarvoor vorm aan de manier waarop aankomend ingenieurs vragen theoretisch konden benaderen. De bijdragen van Huet, en de controverses waar hij bij betrokken was, geven inzicht in de ontwikkeling van technische wiskunde.

Bepaling van de afstand tot en grootte van de zon en de maan door Aristarchos van Samos
Jeroen Spandaw (TUD)
∗ 17 april, A2, 15:00–15:30 Zaal Pi

Abstract: Meer dan 22 eeuwen geleden bepaalde Aristarchos van Samos de afstand tot en de grootte van de zon en de maan. Hoewel sommige resultaten nogal onnauwkeurig zijn, is zijn methode correct. Hoe deed hij dat en wat kan hiermee worden gedaan in het voortgezet onderwijs?

The Archimedes Palimpsest
Yvonne Ruckstuhl (TUD)
∗ 17 april, A2, 15:30–16:00 Zaal Pi

Abstract: The Ancient Greek mathematician Archimedes is known as one of the greatest scientists of all time. Throughout history, his brilliant work has been studied and used by many important scientists like Leonardo da Vinci, Galileo and Newton. Yet, one of the most important works of Archimedes has only been discovered halfway through the 19th century in the form of a palimpsest (a reused parchment). Modern technology enabled historians to recover a great part of the original text of the palimpsest, with a description of the socalled 'method of Archimedes'. This is a (for that time) revolutionary method to determine the volume or center of gravity of certain objects. In the talk I shall cover one example and explain why the method is considered to be revolutionary for that time.

8.10 Industrie (B2)

Mathematical formulation of a multi-year portfolio optimization problem for TenneT
Jok Tang (VORtech)
∗ 17 april, B2, 15:00–15:20 Zaal D@ta

Abstract: TenneT is the electricity transmission operator in the Netherlands and a large part of Germany. The company uses a risk-based investment strategy for their cost-related activities. They are based on balancing certain asset management business drivers: risk, performance and cost. To optimize the investment strategy, TenneT has been using a

mathematical formulation of a single-year linear optimization problem developed by UMS Group. This approach was not completely covering the needs of TenneT regarding advanced multi-year analysis. The generalization of the single-year formulation to a multi-year linear optimization problem is not straightforward. VORtech has assisted UMS Group and TenneT on constructing this advanced approach. In this talk, the resulting mathematical optimization model will be presented. We will show how several practical requirements are incorporated into this linear formulation and how TenneT can benefit from this advanced model.

Flow problems in geophysics

Bernard Meulenbroek (TUD)

∗ 17 april, A2, 15:20–15:40 Zaal D@ta

Abstract: Many geophysical problems lead to flow problems; examples are (enhanced) oil recovery (EOR) and CO2 sequestration. Those problems are often described by PDE's. Although it may be possible to find numerical approximations to the solutions of those PDE's using software packages, a number of fundamental questions remains.
Which physical processes have to be incorporated in the model? Is the system (un)stable and, if the system is unstable, what are the relevant length- and timescales?
In this talk I present some results on CO_2 sequestration, which is joint work with the Geophysics Department of the TUD. When CO_2 dissolves in water, both the volume and viscosity of the mixture depend on the CO_2 concentration. Those effects are often neglected, but how large/small is their influence?

Effective water storage as flood protection

Joep Evers (TU/e)

∗ 17 april, A2, 15:40–16:00 Zaal D@ta

Abstract: Climate change is expected to cause higher discharge levels in the river Rhine at the Dutch-German border, leading to flooding downstream. As a protective measure in case of emergency, deliberately flooding the Rijnstrangen area is currently considered. Rijkswaterstaat commissioned an investigation of this plan during the Study Group Mathematics with Industry 2013. Our study consists of three parts. We first analyze the data recorded by Rijkswaterstaat and estimate the likelihood and the duration of extremely large discharges at the German border into the river. Next, we investigate how a change in discharge levels affects the water height in the first 35 kilometer section in the Netherlands. Finally, we study the design of weirs and floodgates to allow diverting a sufficiently large amount of water flow from the river into the retention area.

9 Philips Wiskundeprijs voor promovendi (A2/B2)

Singularly perturbed reaction diffusion systems with a changing parameter
Eric Siero (UL; supervisor: Arjen Doelman, Jens Rademacher)
∗ 13:40–14:00 Zaal Boole

Abstract: We study reaction diffusion systems on $\mathbb{R}^+ \times \mathbb{R}^2$ of the type:

$$\begin{aligned} w_t &= \Delta w + C w_x + A(t) - w - w v^2 \\ v_t &= \epsilon^2 \Delta v - B v + w v^2 \end{aligned}$$

where $A(t)$ is a slowly changing parameter.

These equations model water w and vegetation v in (semi-)arid regions. The relevant question is whether vegetation will disappear due to a decrease of rainfall $A(t)$: desertification due to climate change.

We first restrict to one spatial dimension. One-dimensional vegetation patterns have been observed as vegetation stripes perpendicular to the slope of the terrain. In general the solution spends much of its time near quasi-steady periodic solutions. Numerically it can be shown that at some value of A the periodic solution destabilizes due to a sideband bifurcation, followed by transient behavior and restabilization near a new quasi-steady periodic solution. The transient behavior is influenced by the rate of change dA/dt and also changes qualitatively in case of exposure to noise.

In two spatial dimensions vegetation stripes align perpendicular to the advection Cw_x, so they become translation invariant in the y-direction. These patterns are prone to destabilization in the y-direction, depending on the value of the parameter C. Numerically it can be seen that increasing C tends to stabilize stripe patterns. Here C relates to the slope of the terrain.

Ghost fields: non-existing particles or existing geometric properties?
Roberta Anna Iseppi (RUN; supervisor: Walter van Suijlekom)
∗ 14:00–14:20 Zaal Boole

Abstract: With the discovery of quantum mechanics at the beginning of the XXth century, the classical notion of physical theory needed to be changed. The physicists were forced to definitely renounce the dream of constructing a deterministic theory for subatomic phenomena and to accept the idea that the behavior of nature at the level of particles would be known only in terms of probability. Thus it was introduced the notion of “quantization”: each physical theory, in order to describe nature to a subatomic level, needs to be quantized.

During the years, several methods were developed in order to quantize a classical theory. One of these is known under the name of “path integral quantization” and it is based on the computation of a particular kind of integral: the Feynman integral. Even though the results obtained with this procedure are extremely accurate, this method has a fundamental problem: in general, the Feynman integral is mathematically not well defined. There is only one particular situation in which this integral can be rigorously defined: this is the case of matrix models.

On the other hand, other problems arise when we want to quantize a gauge theory, namely

a theory endowed with a gauge symmetry group, as for example electrodynamics. Gauge theories play an extremely important role in physics and the problem of quantizing them through a path integral approach was solved by Faddeev and Popov in 1969 by introducing the notion of "ghost fields". My PhD-thesis is precisely based on the study of these ghost fields from a mathematical point of view.

During the presentation, I will first describe the mathematical setting, explaining the matrix models and the ghost fields and illustrating why we are forced to introduce these extra non-existing particles into the model. Then, I will present the main topic of my research: the understanding of the mathematical meaning of these ghost fields. In order to do it, I will restrict to the special case of $U(n)$ – matrix models, explaining how these extra non-existing particles, introduced for technical reasons, describe interesting geometric properties of the model. Finally, I will illustrate how the investigation of the cohomology theory defined on the space of ghost fields and known under the name of "BRST cohomology" allows to deduce important physics properties of the theory, such as its renormalizability.

Are almost all graphs determined by their spectrum?
Aida Abiad (UvT; supervisor: Willem H. Haemers)
∗ 14:20–14:40 Zaal Boole

Abstract: Characterizations of combinatorial structures is a main issue in discrete mathematics. In this work we look at the spectrum (eigenvalues) of the adjacency matrix of a graph, and ask whether the eigenvalues determine the graph. This is a difficult, but important problem which plays a special role in the famous graph isomorphism problem. In practice (Chemistry, Computer Science, Molecular Biology), complex structures are often modeled as graphs, and the spectra are used to distinguish them. The mentioned problem has been solved for several families of graph; sometimes by proving that the spectrum determines the graph, and sometimes by constructing nonisomorphic graphs with the same spectrum. In the present work we focus on a tool to construct graphs with the same spectrum (cospectral graphs).

If A and A' are the adjacency matrices of the cospectral graphs G and G', then there exists an orthogonal matrix Q such that $Q^TAQ = A'$. We investigate when Q^TAQ is a $(0,1)$-matrix again in the special situation when Q has constant row sum and $2Q$ is integral. If Q is integral, G and G' are isomorphic. But if Q is not integral, then the graphs may be nonisomorphic; in this case we call G and G' semi-isomorphic graphs. This concept is interesting since in 2010 Wang and Xu conjectured that almost all pairs of nonisomorphic cospectral graphs are semi-isomorphic.

Treewidth in phylogenetics
Nela Lekić (UM; supervisor: Steven Kelk)
∗ 15:00–15:20 Zaal Boole

Abstract: One of the central challenges within computational evolutionary biology is to infer the evolutionary history of a set of contemporary species using only the genotype of the contemporary species. This evolutionary history is often modeled as a tree and increasingly as a directed acyclic graph, which gives rise to a number of intriguing and challenging combinatorial optimization problems. However, it is well-known that most of these problems are NP-hard, and this intractability is a serious problem when constructing

phylogenetic trees for large numbers of species.

Here we approach the problem of constructing a phylogenetic tree from a graph-theoretical angle. This is an exciting new direction to pursue because it promises two things: an efficient combinatorial algorithm for a highly relevant biological problem and, more fundamentally, a bridge between graph theoretic machinery and phylogenetics.

There is a recent trend in this direction, which to a large extent can be traced back to a seminal paper of Bryant and Lagergren from 2006. They observed a surprising relationship between a problem of constructing an unrooted phylogenetic tree (known as the compatibility problem) on one hand and treewidth of an auxiliary graph (known as the display graph) on the other.

The upper bound on the treewidth that this condition generates makes it possible to formulate and answer the problem in a computationally efficient way. However, this efficiency is purely theoretical in nature, obtained via an indirect route, and it remains a challenge to succinctly characterize phylogenetic compatibility. Since Bryant and Largergren various other authors have picked up this thread although the question remains: what exactly is the role of treewidth in compatibility?

Here we take a step forward in understanding that role. We prove that if the display graph has treewidth at most 2, then it is not necessary to look deeper into the structure of the instance; compatibility is immediately guaranteed. The proof of this, based on graph separators and graph minors, leads to a simple polynomial-time algorithm for constructing a phylogenetic tree, when this condition holds. We also show that in some sense this result is best possible: we show how to construct both compatible and incompatible instances that have display graphs of treewidth 3. This confirms that the treewidth of the display graph cannot, on its own, fully capture phylogenetic compatibility, and that auxiliary parameters will be required if we are to obtain a complete characterization.

The main contribution of this result is that it opens the door to the possibility that existing "descriptive" characterizations of compatibility can be specialized into simple and efficient combinatorial algorithms when the display graph has sufficiently low treewidth. We aim to lay the necessary theoretical foundations to be able to better tackle such questions in practice.

Deforming group representations

Krzysztof Dorobisz (UL; supervisor: Bart de Smit)

∗ 15:20–15:40 Zaal Boole

Abstract: My ongoing PhD project is devoted to deformations of linear group representations and its main focus is the inverse problem for universal deformation rings. This may say little to a non-specialist, so I will first explain what hides behind these notions and only then proceed to presenting my own results. The following short and rather vague exposition only aims at giving an intuitive idea and will be made more precise during the presentation.

The topic is highly abstract, but I hope I will be able to make the audience appreciate its beauty, hidden in an interesting interplay of several mathematical structures.

Linear group representations. Recall that a group is a set endowed with an operation satisfying certain properties. Many groups have some "geometric flavour" and occur as sets of transformations of vector spaces over some fields. The dihedral, orthogonal and general linear groups serve here as examples. Representation theory deals with the problem of presenting groups in such a geometric way. It is a well-developed branch of mathematics, studied for over hundred years.

Rings and deformations. One can think of a field as a set in which addition, subtraction, multiplication and division are allowed. Requiring that only the first three operations can be performed we arrive at a more general definition of a ring. By analogy to vector spaces over fields, one can study "vector spaces" over rings, the so called modules.

Deformation theory attempts to study group representations in such more general spaces. Its name can be explained by the fact that given a group representation over a field, there exists a procedure of "deforming" it to representations over certain rings. This procedure will be explained during the presentation.

Universal deformation rings and the inverse problem. There are several natural restrictions which we usually make on the objects we "deform". It is a basic fact of the deformation theory that such assumptions guarantee that the (very complicated) outcome of the process of "deforming" is reflected in a structure of a just one single ring, the so called universal deformation ring. It is worth adding here that this fact was used by Andrew Wiles in his famous paper proving the Fermat's Last Theorem.

The above described phenomenon will be explained better during the presentation, but for a moment it is sufficient to imagine that we have a black box which, given a field, a group and a representation $\overline{\rho}$, outputs a ring (the universal deformation ring of $\overline{\rho}$). Reversing the process, we may consider a ring R and wonder whether there exists an input for which the black box will output R. This is what we call the inverse problem and what is mine main interest.

My results. In the course of my PhD project I have proved that every ring R (satisfying the above mentioned natural restrictions) can be obtained as a universal deformation ring. More specifically, I have studied the deformation behaviour of some natural representation of the special linear group $\mathrm{SL}_n(R)$. Interestingly, in order to obtain R as a universal deformation ring it is important that $n \geq 4$, because the lower dimensional cases admit some puzzling exceptions, requiring a careful analysis. I would like to present all my conclusions, together with further results refering to analogous representations of other linear group. There are also some interesting modifications of the inverse problem for which I have obtained partial results and about which I would like to tell a few words as well.

Flight path of a moth

Moritz Schauer (TUD; supervisor: Frank van der Meulen, Harry van Zanten)

∗ 15:40–16:00 Zaal Boole

Abstract: The author investigates the topic of Bayesian inference for discretely observed diffusion processes. One motivation of the techniques developed is nicely illustrated by the following example liberally taken from behavioral biology.

According to the "light compass theory" moths use the moon as navigational beacon and manage to fly a straight line by keeping the moon at constant angle in their field of view. A textbook model for the flight path of an object moving at constant angle relative to a fixed point is a linear differential equation whose solution is a logarithmic spiral, which could

describe the idealized flight path of the moth around an artificial light source mistaken for the moon. Of course moths show erratic flight patterns so a slightly more honest description of the flight path would involve an additional stochastic component (resulting in a linear stochastic differential equation).

Experiments performed in the seventies by biologist Henry Hsiao with moths tethered to miniature styrofoam boats on an artificial pond cast doubt on the "light compass theory". According to Hsiao a moth flies directly towards the light source while at distance and only when close to the light source turns away from it and then starts to circle the light source.

Based on his observations Hsiao provided an alternative explanation and suggested that when close to the light source moths suffer an optical illusion[1] letting them believe that the darkest spot (and thus a good spot to hide) is located directly behind the light source. This nonlinear flight behavior gives rise to stochastic differential equation of a more general type.

The author shows how in a playful manner his work could be applied to observed flight paths to compare both theories statistically. Observations of a single moth at discrete times are taken as a starting point for the investigation. On a small time scale the path of a moth is a smooth curve unlike the solution of a stochastic differential equation and working with discrete observations can have advantages in this situation.

References:

[1] Cecil Adams, *Why are moths attracted to bright lights?* The Straight Dope (1989).
[2] Henry Hsiao, *Flight paths of night-flying moths to light*, Journal of Insect Physiology (19) 10, pp. 1971–1976 (1973).
[3] M.S., Frank van der Meulen, Harry van Zanten, *Guided proposals for simulating multi dimensional diffusion bridges*, arXiv:1311.3606 (2013).
[4] Frank van der Meulen, M.S. Harry van Zanten *Reversible jump MCMC for nonparametric drift estimation for diffusion processes*, Comput. Statist. Data Anal. 71, 615-632 (2014).

[1] A "Mach band", an optical illusion which makes a uniformly black background appear darker close to a bright foreground.