



# INFOMAT

September 2015

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## 25 ÅR MED THE EUROPEAN MATHEMATICAL SOCIETY

EMS (European Mathematical Society) ble grunnlagt i 1990 i Mandralin, utenfor Warszawa. Organisasjonen fyller dermed 25 år i år. Jubileet blir markert med et 1-dags-seminar med tittelen “*Challenges for the next 25 years*” ved Institut Henri Poincaré i Paris den 22. oktober. I tillegg til faglige foredrag vil det også være en paneldebatt som vil belyse de utfordringene faget står overfor.

INFOMAT gratulerer jubelanten med jubileet!

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INFOMAT kommer ut med 11 nummer i året og gis ut av Norsk Matematisk Forening. Deadline for neste utgave er alltid den 15. i neste måned. Stoff til INFOMAT sendes til

**infomat at math.ntnu.no**

Foreningen har hjemmeside <http://www.matematikkforeningen.no/INFOMAT>

Ansvarlig redaktør er Arne B. Sletsjøe, Universitetet i Oslo.

## Matematisk kalender

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**2015:**

**Oktober:**

*14.-16. MatRIC Videokollokvium, Tromsø*

**November:**

*5.-6. Nasjonalt algebramøte, Oslo*

*26.-28. MatRIC årskonferanse, Trondheim*

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## Nye doktorgrader

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M. Sc. **Jonathan Feinberg**, UiO, forsvarte 28. august 2015 sin avhandling *Some Improvements and Applications of Non-intrusive Polynomial Chaos Expansions* for graden ph.d. Veiledere har vært Professor Hans Petter Langtangen, UiO, Professor Arne Huseby, UiO og Dr. Stuart R. Clark, Simula Research Laboratory.

**Sammendrag:**

Banebrytende forskningsmodeller innenfor viktige tema/fagområder som blant annet klima, menneskekroppen og jordskorpen tar alle utgangspunkt i kompliserte dataprogrammer, og krever ofte flere dager for en super-datamaskin å beregne. Uavhengig av hvor imponerende disse modellene er, kan vi ikke stole på forskningsresultatene uten at vi samtidig kartlegger hvor stor usikkerheten assosiert med modellene er. Usikkerheten forteller hvor stor feilmargin vi kan forvente at forskningsmodellene har. Kartlegging av usikkerhet er imidlertid ressurskrevende, og byr ofte på større utfordringer enn selve beregningen av modellene. Kaos-polynomer er et nytt verktøy som er spesielt godt egnet for å kartlegge usikkerhet i slike større modeller. Metoden kan ofte være flere hundre ganger mer effektiv enn dagens standardmetoder. Med andre ord kan man med kaos-polynomer redusere tiden det vil ta å kartlegge usikkerhet i en større modell med flere måneder, av og til år. Kaos-polynomer muliggjør dermed usikkerhetsanalyse på områder der det tidligere ikke var praktisk mulig fordi det tok for lang tid.

En av de største utfordringene med fersk forskning er som regel mangel på anvendelig programvare. Uten tilgjengelig programvare som gjør det mulig å anvende kaos-polynomer på forskningsmodellene,

blir hver forsker overlatt til seg selv i utviklingen av programvaren for å analysere usikkerhet i sine egne modeller. Dette er problematisk fordi det tar unødvendig mye tid, og fordi ikke de færreste forskere er spesialisert i å utvikle slik programvare. Derfor introduserer denne avhandlingen Chaospy: En programvare skreddersydd for å assistere forskere med å bruke kaos-polynomer i sine forskningsmodeller. Siden forskningen på kaos-polynomer er så ny av dato, er Chaospy blant de første programvarene av sitt slag.

I samarbeid med NTNU har vi testet denne nye programvaren på en modell som tar for seg hjertet og blodårene i menneskekroppen. Modellen simulerer blodets oppførsel i bevegelse gjennom årene, og er utviklet for å kunne finne direkte sammenhenger mellom høyt blodtrykk og hjerte- og karsykdommer. Ved hjelp av Chaospy-programvaren kan vi vise at bruken av kaos-polynomer for å kartlegge usikkerhet i modellen fungerer godt. Metoden bidrar til en enorm besparelse av tid og ressurser i arbeidet med usikkerhetsanalysen, og Chaospy er en egnet programvare i dette arbeidet.

Enhver ny metode kommer imidlertid med begrensninger, og kaos-polynomer er intet unntak. I visse tilfeller går kaos-polynomer veldig tregt. For å bøte på dette, introduseres en helt ny matematisk metode i avhandlingen. I denne metoden utvides bruksområdet av kaos-polynomer til langt flere modeller enn det som er mulig i dag. Dette åpner en vei for å gjøre kaos-polynomer til et enda mer allmenntilgjengelig verktøy.

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Siv.ing. **Geir Bogfjellmo**, NTNU, forsvarte 4. september 2015 sin avhandling *Algebraic and Topological Properties of Numerical Integrators* for graden PhD. Veileder har vært Professor Brynjulf Owren.

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M. Sc. **David Ruiz Baños**, UiO, forsvarte 4. september 2015 sin avhandling *Regularity of Stochastic Flows of Stochastic Differential Equations with Singular Coefficients and Applications to Finance* for graden ph.d. Veiledere har vært Professor Frank Norbert Proske, Professor Giulia Di Nunno og Professor Bernt Øksendal, alle UiO.

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# NYHETER

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## **Sammendrag:**

The study of nature and our environment is a large part of science. Life science, social or physical sciences constitute important branches of science. The scientific method can be regarded as a collection of techniques for investigating phenomena in the aforementioned areas of research, acquiring knowledge, correcting or updating with new knowledge and drawing conclusions or predictions. Mathematics establishes the grounds of logic reasoning to develop theoretical models and rules of calculus that serve as framework and utensils to explain such phenomena. An example of this is mathematical models such as differential equations, which, in short, can be viewed as theoretical laws describing some phenomenon of interest. For the reason that nature is complex, sometimes, one needs to consider random inputs in the model that may interfere in, say measurements or possible outcomes or results. In the recent decades the branch stochastic analysis has been a broadly investigated topic as a possible answer for this, especially within economical sciences. In this thesis we focus in this particular branch of mathematics: stochastic calculus and stochastic differential equations, which in a summary, comprise the rules of calculus one needs to deal with theoretical models involving “randomness” (stochastic differential equations). Because real life problems are extremely complex and difficult to model, in this thesis, we study all these objects in what we call an “irregular setting”, that is to say, when the parts of the model behave in a “rough way” with sudden changes and jumps. Then the natural question whether one can solve such equations in this irregular setting arises and what properties of the solutions of these equations we can expect. In this thesis we answer these questions. We also find an application to mathematical finance in the so-called sensitivity analysis of financial options. In this thesis we use a new method to construct solutions of stochastic differential equations when the coefficients involved are singular. We study their regularity in several aspects and at several levels. We study the regularity of flows of the solution and thus extend some existing results on this topic. We also provide with a numerical method to compute sensitivity with respect to ini-

tial conditions based on the so-called Malliavin calculus and local-time integration under presence or singular coefficients. Finally, we study the problem of changing the source of noise in the stochastic equation by fractional Brownian motion which is neither a Markov process nor a weak semimartingale and construct for the first time solutions of such equations when the coefficient is singular and dimensions are high.

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**Jan Nyquist Roksvold**, UiT-Norges arktiske universitet, forsvarte 8. september 2015 sin avhandling *Some combinatorial invariants determined by Betti numbers of Stanley-Reisner ideals* for Ph.D.-graden ved UiT. Hovedveileder: Hugues Verdure.

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**Petter Arnesen**, NTNU, forsvarte 22. september 2015 sin avhandling *Prior construction for discrete Markov models* for Ph.D.-graden. Hovedveileder har vært Professor Håkon Tjelmeland.

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**Markus Eslitzbichler**, NTNU, forsvarte 28. september 2015 sin avhandling *Geometric Shape Analysis in Computer Animation* for Ph.D.-graden. Hovedveileder har vært Professor Elena Celledoni.

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## Nyheter

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### **NYTT FRA NMF**

Norsk matematisk forening er opptatt som institusjonsmedlem av ICIAM (International Council for Industrial and Applied Mathematics). Elena Celledoni blir NMFs representant/kontaktperson.

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### **NYTT FRA EMS: THE EMS ANNIVERSARY**

Preparations proceed for the one day meeting on October 22, 2015, at the Institut Henri Poincaré in Paris, where the EMS will celebrate its 25th birthday. The programme will include lectures

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# NYHETER

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by Hendrik Lenstra, Laure Saint-Raymond, László Lovász and Andrew Stuart, as well as a panel discussion with Peter Bühlmann, Maria Esteban, Ari Laptev and Roberto Natalini, moderated by Jean-Pierre Bourguignon.

## BIDS FOR THE 8TH ECM

The Executive Committee has received full bids from the two organisations hoping to organize the eighth ECM in 2020: the Universities of Sevilla in Spain and Primorska in Slovenia. These will be considered carefully and the ultimate decision will be taken at the council meeting in Berlin, before the opening of the seventh ECM.

## 7TH EUROPEAN CONGRESS OF MATHEMATICS IN BERLIN!

Dear Fellow Mathematicians,

In less than one year, we will warmly welcome you to the 7Th European Congress Of Mathematics In Berlin! We have developed a broad scientific program consisting of ten Plenary Lectures, 31 Invited Lectures, several Prize Lectures, the Hirzebruch Lecture, the Abel Lecture and much more! We are looking forward to welcoming you, Furthermore, the calls for the Otto Neugebauer Prize, the Felix Klein Prize and ten EMS prizes are under way. We cordially invite all of you to contribute to the program in terms of Mini-Symposia, Contributed Talks and Posters.

To ensure broad participation in the 7ECM and reduce economic barriers, 100 grants will be offered to mathematicians from less developed countries. The grants will cover a tuition fee waiver and a financial support of a maximum amount of 400 Euro. Women are particularly encouraged to apply. All abstracts and proposals must be submitted via the 7Ecm Registration Platform.

We also invite mathematicians to organize (conferences etc.) around the congress. 7ECM participants will enjoy some privileges in registering for the satellite events. Pre-conditions for granting the satellite status to an event are scientific quality, geographical proximity and temporal connection with the 7ECM.

We are looking forward to meeting you in Berlin in 2016.

## PRIZES

Any European mathematician who has not reached his/her 35th birthday on July 15, 2016, and who has not previously received the prize, is eligible for an EMS Prize at 7ecm. Up to ten prizes will be awarded. The maximum age may be increased by up to three years in the case of an individual with a broken career pattern. Mathematicians are defined to be European if they are of European nationality or their normal place of work is within Europe. Europe is defined to be the union of any country or part of a country which is geographically within Europe or that has a corporate member of the EMS based in that country. Prizes are to be awarded for work accepted for publication before October 31, 2015.

The Prize Committee is responsible for the evaluation of nominations. Nominations can be made by anyone, including members of the Prize Committee and candidates themselves. It is the responsibility of the nominator to provide all relevant information to the Prize Committee, including a résumé and documentation. The nomination for each award must be accompanied by a written justification and a citation of about 100 words that can be read at the award ceremony. The prizes cannot be shared.

The award comprises a certificate including the citation and a cash prize of 5000 €.

The prizes will be presented at the Seventh European Congress of Mathematics in Berlin, July 18-22, 2016, by the President of the European Mathematical Society. The recipients will be invited to present their work at the congress. The Foundation Compositio Mathematica has kindly offered to sponsor a substantial part of the prize money.

Nominations for the prize must reach the chairman of the Prize Committee at the address given below, not later than **November 1, 2015**: Professor Björn Engquist, The Institute for Computational Engineering and Sciences The University of Texas at Austin, engquist@ices.utexas.edu. See: <http://www.euro-math-soc.eu/ems-prizes> for more information.

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