



# BRÅKET



*Information om seminarier och högre undervisning  
i matematiska ämnen i Stockholmsområdet*

NR 25

FREDAGEN DEN 21 AUGUSTI 2009

## BRÅKET

Veckobladet från  
Institutionen för matematik  
vid Kungl Tekniska Högskolan  
och Matematiska institutionen  
vid Stockholms universitet

Redaktör: Gunnar Karlsson

Telefon: 08-790 84 79

Adress för e-post:  
gunnarkn@math.kth.se

Bråket på Internet: <http://www.math.kth.se/braaket.html> eller  
<http://www.math.kth.se/braket/>

Postadress:

Red. för Bråket  
Institutionen för matematik  
KTH  
100 44 Stockholm

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Sista manustid för nästa nummer:  
Torsdagen den 27 augusti kl. 13.00.

## Kurser

Rikard Bøgvad: Commutative Algebra. Se sidan 4.

Torsten Ekedahl: Algebraic Geometry. Se sidan 4.

## Matematikseminarium

Teknikdelegationen och Nationellt center för matematikutbildning anordnar detta fredagen den 21 augusti. Se sidan 2.

## SEMINARIER

Ti 08–25 kl. 14.00. Seminarium i teoretisk datalogi. Sonja Buchegger, Deutsche Telekom Laboratories: *PeerSoN: Privacy-Preserving P2P Online Social Networks*. Rum 1537, KTH CSC, Lindstedtsvägen 3, plan 5. Se sidan 3.

On 08–26 kl. 10.15–12.00. Kombinatorikseminarium. Jonathan Barmak, KTH: *Weak, simple and strong homotopy types*. Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 7.

On 08–26 kl. 11.00–12.00. KTH/Nordita/SU Seminar in Theoretical Physics. (*Observera lokalen!*) Cristiane Morais Smith, University of Utrecht: *The post-graphene era: strongly interacting Dirac fermions with cold atoms*. Sal FB52, Roslagstullsbacken 21, AlbaNova universitetscentrum. Se sidan 4.

Fortsättning på nästa sida.

## Disputation i optimeringslära och systemteori

Tove Gustavi skall disputeras vid KTH på avhandlingen *Control and Coordination of Mobile Multi-Agent Systems* fredagen den 4 september kl. 10.00. Se sidan 6.

## Plurikomplexa seminariet

Inga seminarier i denna serie kommer att ges under höstterminen 2009. Vi planerar att återuppta seminarierna under vårterminen 2010.

Mikael Passare

## Petter Brändén

har av Kungl. Vetenskapsakademien fått en femårig forskartjänst. Se sidan 3.

**Seminarier (fortsättning)**

**Må 08–31 kl. 15.15–16.00. Seminarium i finansiell matematik.** David Karlgren presenterar sitt examensarbete: *Random testing of a market place system. Simulation of a market place.* Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 5.

**On 09–02 kl. 14.30–15.30. KCSE (KTH Computational Science and Engineering Centre) Seminar.** Yana Di: *Simulations using a multi-mesh adaptive method.* PDC:s seminarierum, KTH, Teknikringen 14, plan 3. Se sidan 5.

**MATEMATIKSEMINARIUM**

Välkommen till ett intressant och utmanande eftermiddagsseminarium, arrangerat av Teknikdelegationen och Nationellt center för matematikutbildning (NCM). Seminariet är avgiftsfritt och öppet för allmänheten. Anmälan till seminariet kan göras via <http://www.teknikdelegationen.se>.

*Tid och plats:* Fredagen den 21 augusti kl. 13.00–16.30 i IVA's Conference Center, Grev Turegatan 16, Stockholm.

***Program***

13.00–14.00 **Anders Palm**, Director of Education, The Swedish National Agency for Education: *On-going and upcoming projects to increase young people's interest in mathematics.*

**Dr. Ola Helenius**, Deputy Director, The National Center for Mathematics Education, NCM: *NCM and mathematics education in Sweden.*

**M. Sc. Teresa Jonek**, First Secretary to the Technology Delegation: *The Technology Delegation — objectives and activities.*

14.00–14.30 Coffee.

14.30–16.00 **Dr. Keith Devlin:** *How much mathematics can be for all?*

Keith Devlin is Consulting Professor in the Department of Mathematics at Stanford and Senior Researcher at The Center for the Study of Language and Information.

In Keith Devlin's book *The Math Gene*, he argues that our capacity for mathematical thinking is part of our genetic inheritance. As a result, there may be a point beyond which most people will simply never "get it". This applies to at least one topic taught in the middle school. Thus, modern day education is faced with a major challenge: How do we ensure that everyone has sufficient mathematics education for today's highly mathematically-dependent society?

Keith Devlin's current research is focused on the use of different media to teach and communicate mathematics to diverse audiences. He also works on the design of information/reasoning systems for intelligence analysis. He has written 28 books and over 80 published research articles. He is recipient of the Pythagoras Prize, the Peano Prize, the Carl Sagan Award, and the Joint Policy Board for Mathematics Communications Award. He is "the Math Guy" on National Public Radio.

16.00–16.30 Questions.

## SEMINARIUM I TEORETISK DATALOGI

Sonja Buchegger:

### PeerSoN: Privacy-Preserving P2P Online Social Networks

*Abstract:* Online Social Networks like Facebook, MySpace, Xing, etc., have become extremely popular. Yet they have some limitations that we want to overcome for a next generation of social networks: privacy concerns and requirements of Internet connectivity, both of which are due to web-based applications on a central site whose owner has access to all data.

To overcome these limitations, we envision a paradigm shift from client-server to a peer-to-peer infrastructure coupled with encryption so that users keep control of their data and can use the social network also locally, without Internet access. This shift gives rise to many research questions intersecting networking, security, distributed systems and social network analysis, leading to a better understanding of how technology can support social interactions.

Our project consists of several parts. One part is to build a peer-to-peer infrastructure that supports the most important features of online social networks in a distributed way. We have written a first prototype to test our ideas. Another part is concerned with encryption, key management, and access control in such a distributed setting. Extending the distributed nature of the system, we investigate how to integrate such peer-to-peer social networking with ubiquitous computing and delay-tolerant networks, to enable direct exchange of information between devices and to take into account local information.

*Tid och plats:* Tisdagen den 25 augusti kl. 14.00 i rum 1537, KTH CSC, Lindstedtsvägen 3, plan 5.

## PETTER BRÄNDÉN FÅR FEMÅRIG FORSKARTJÄNST

Med stöd från Knut och Alice Wallenbergs Stiftelse har Kungl. Vetenskapsakademien erbjudit åtta av de främsta yngre forskarna i Sverige forskartjänster inom matematik/naturvetenskap under fem år. Tjänsterna ger dem möjlighet att ägna en större del av sin tid åt forskning. I år är sista gången som dessa tjänster tillsätts sedan starten år 2000.

Forskarna skall vara verksamma vid svenska universitet och högskolor men får forska utomlands under en del av tiden. Konkurrensen var mycket hård: De åtta som fick tjänsterna valdes ut bland 341 sökande. Bland de åtta utvalda finns en matematiker, *Petter Brändén*. Här är en kort presentation av honom:

Petter Brändén är 33 år och arbetar vid Stockholms universitet. Han forskar inom området algebraisk kombinatorik och har på kort tid uppnått ett antal spektakulära resultat. Dessa inkluderar ett motexempel mot en berömd förmodan av J. Neggers och R. P. Stanley, en karakterisering av vilka lineära operatorer som bevarar vissa klasser av polynom med inskränkningar på mängden av nollställen, och en teori om 'negativt beroende' inom sannolikhetsteori. Brändéns resultat har förutom sin betydelse inom kombinatoriken viktiga beröringspunkter med statistisk mekanik, där nollställen till polynomliknande funktioner som uppträder som partitionsfunktioner ger singulariteter relaterade till fasövergångar.

Låt oss gratulera Petter till denna fina framgång!

Mikael Passare

**KTH/NORDITA/SU SEMINAR IN THEORETICAL PHYSICS**

**Cristiane Morais Smith:**

**The post-graphene era: strongly interacting Dirac fermions  
with cold atoms**

*Abstract:* Uniform magnetic fields are ubiquitous in nature, but this is not the case for staggered magnetic fields. I will discuss an experimental set-up recently proposed by us, which may allow for the realization of a “staggered magnetic field” in a two-dimensional optical lattice loaded with cold atoms. If the lattice is loaded with bosons, the effective Hamiltonian of the system is a Bose-Hubbard one, with complex and anisotropic hopping coefficients. A very rich phase diagram emerges from the model: besides the usual Mott-insulator and zero-momentum condensate, a new phase with a finite momentum condensate becomes the ground-state at high-rotation. An extension for fermionic atoms leads to an anisotropic Dirac spectrum, which is relevant to graphene and high-T<sub>c</sub> superconductors. When the system is loaded with a mixture of fermions and bosons, an unconventional superconducting phase may be realized.

*Tid och plats:* Onsdagen den 26 augusti kl. 11.00–12.00 i sal FB52, Roslagstullsbacken 21, AlbaNova universitetscentrum.

**GRADUATE COURSES IN MATHEMATICS**

**Commutative Algebra and Algebraic Geometry**

*Teachers:* **Rikard Bøgvad** (Commutative Algebra) and **Torsten Ekedahl** (Algebraic Geometry).

During the fall 2009 two courses in commutative algebra and algebraic geometry, respectively, will be run in parallel. The two subjects are intimately related and the courses will be coordinated so that a participant in both of them will benefit particularly.

Commutative algebra is concerned with the theory of commutative rings with (at least originally) a view towards applications in algebraic geometry. The course will present the basic results of the subject. The coordination mentioned above will not mean that attendance at the course in algebraic geometry will be a requirement, but some understanding of the geometric picture will be an aid to understand the concepts presented.

Algebraic geometry, which generally can be said to deal with the geometry of zero sets of polynomials, can today be based either on the theory of complex analytic functions and differential geometry or on commutative algebra. The course will exclusively deal with the second type of foundation. The prospective attendant who does not know commutative algebra beforehand is strongly recommended to also attend the course in commutative algebra.

*Commutative Algebra:* The course will take place on Tuesdays at 13.15–15.00 in room 306, house 6, Department of Mathematics, SU, Kräftriket, starting on September 8. The book by RODNEY Y. SHARP, *Steps in Commutative Algebra*, London Mathematical Society Student Texts, will be followed.

*Algebraic Geometry:* The course will take place on Fridays at 13.15–15.00 in room 306, house 6, Department of Mathematics, SU, Kräftriket, starting on September 11. The book by ROBIN HARTSHORNE, *Algebraic Geometry*, Graduate Texts in Mathematics, Springer, will be followed.

## SEMINARIUM I FINANSIELL MATEMATIK

David Karlgren

presenterar sitt examensarbete:

### **Random testing of a market place system. Simulation of a market place**

*Abstract:* A market place system is a very complex software, which makes it very difficult to test. The functionalities of the system are at wide range, and theoretically the number of possible test cases is infinite.

Several methods are developed for the purpose of testing complex systems and make sure that they meet the requirements of the customers. The most commonly used test strategies are Static testing and Automated testing.

To be able to find low frequency failures and major critical failures, which cause the system to crash, Random testing is agreed to be a very useful tool of testing. For Random testing to be as efficient as possible in detecting errors, the input domain has to be accurate for the system and the output needs to be analysed carefully with an oracle that fits the purpose.

For the input domain to be accurate, an extensive statistical analysis of historical benchmark data is needed in order to validate under which circumstances the software is operating.

The stock exchange market has increased exponentially during the last few years regarding the number of orders on the market place. A large reason for this is the increasing number of markets in general and the increasing number of electronical trading platforms developed in particular. The ease at which a customer can trade and follow the market flow has evolved enormously. This forces the developers of the software to deliver a solid and robust trading software, that can handle a large variety of orders and market participants at the same time without major critical failures, such as a crash of the system. The consequences of a system crash can be a huge economic disaster as well as a loss in trust, which could lead to decreasing number of customers and in the end to a loss of income.

*Tid och plats:* Måndagen den 31 augusti kl. 15.15–16.00 i seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

## KCSE SEMINAR

Yana Di:

### **Simulations using a multi-mesh adaptive method**

*Abstract:* For some problems with multi variables, the solution functions might develop in very different styles. Here an efficient multi-mesh  $h$ -adaptive algorithm will be proposed to solve different variables on different meshes based on their own natures respectively. For example, for the interface problems, some interface functions can be used to provide implicitly the location of the interface, and their values are almost useless away from this interface. To fully resolve them, a fine grid is required only in a small region around the interface. Meanwhile, other physical quantities may extend well beyond the interface and have much milder variation in their gradients, permitting a much coarser grid to resolve it. Numerical simulations will be presented to demonstrate its capacity and efficiency.

*Tid och plats:* Onsdagen den 2 september kl. 14.30–15.30 i PDC:s seminarierum, KTH, Teknikringen 14, plan 3.

**DISPUTATION I OPTIMERINGSLÄRA OCH SYSTEMTEORI****Tove Gustavi**

skall disputeras på avhandlingen

**Control and Coordination of Mobile Multi-Agent Systems**

fredagen den 4 september 2009 kl. 10.00 i sal F3, KTH, Lindstedtsvägen 26, b.v. Till opponent har utsetts *professor Kostas J. Kyriakopoulos*, National Technical University of Athens, Grekland.

***Abstract of the thesis***

In this thesis, various control problems originating from the field of mobile robotics are considered. In particular, the thesis deals with problems that are related to the interaction and coordination of multiple mobile units. The scientific contributions are presented in five papers that together constitute the main part of the thesis. The papers are preceded by a longer introductory part, in which some important results from control theory, data processing and robotics are reviewed.

In the first of the appended papers, two stabilizing tracking controls are proposed for a non-holonomic robot platform of unicycle type. Tolerance to errors and other properties of the controllers are discussed and a reactive obstacle avoidance control, that can easily be incorporated with the proposed tracking controls, is suggested. In Paper B, the results from Paper A are extended to multi-agent systems. It is demonstrated how the tracking controls from Paper A can be used as building blocks when putting together formations of robots, in which each robot maintains a fixed position relative its neighbours during translation. In addition, switching between the different control functions is shown to be robust, implying that it is possible to change the shape of a formation on-line.

In the first two papers, the tracking problem is facilitated by the assumption that the approximate velocity of the target/leader is known to the tracking robot. Paper C treats the case where the target velocity is neither directly measurable with the available sensor setup, nor possible to obtain through communication with neighbouring agents. Straight-forward computation of the target velocity from available sensor data unfortunately tends to enhance measurement errors and give unreliable estimates. To overcome the difficulties, an alternative approach to velocity estimation is proposed, motivated by the local observability of the given control system.

Paper D deals with another problematic aspect of data acquisition. When using range sensors, one often obtains a mixed data set with measurements originating from many different sources. This problem would, for instance, be encountered by a robot moving in a formation, where it was surrounded by other agents. There exist established techniques for sorting mixed data sets off-line, but for time-depending systems where data need to be sorted on-line and only small time delays can be tolerated, established methods fail. The solution presented in the paper is a prediction-correction type algorithm, referred to as CCIA (Classification Correction and Identification Algorithm).

Finally, in Paper E, we consider the problem of maintaining connectivity in a multi-agent system. Often inter-agent communication abilities are associated with some proximity constraints, so when the robots move in relation to each other, communication links both break and form. In the paper we present a framework for analysis that makes it possible to compute a set of constraints which, if satisfied, are sufficient to guarantee maintained communication for a given multi-agent system. Constraints are computed for two sorts of consensus-based systems and the results are verified in simulations.

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**KOMBINATORIKSEMINARIUM****Jonathan Barmak:****Weak, simple and strong homotopy types**

*Abstract:* Homotopy types of finite topological spaces have a simple combinatorial description. On the other hand, homotopy types of simplicial complexes are much harder to understand. Whitehead's simple homotopy types provide an approach to attack this problem.

After recalling the relationship between finite topological spaces, posets and simplicial complexes, I will show how problems of collapsibility of complexes can be studied from the optic of finite spaces. Then I will introduce the notion of strong homotopy types of simplicial complexes, which can be defined by elementary moves (as in classical simple homotopy theory) or through contiguity classes of simplicial maps. This theory, which is directly connected to Stong's homotopy theory of finite spaces, is simpler to handle than Whitehead's and has applications to the study of fixed points of simplicial actions and to evasiveness.

These results are part of joint works with Gabriel Minian.

*Tid och plats:* Onsdagen den 26 augusti kl. 10.15 – 12.00 i seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

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