BRÅKET

Information om seminarier och högre undervisning i matematiska ämnen i Stockholmsområdet

NR 27 **FREDAGEN DEN 7 SEPTEMBER 2007**

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

- - - - - - -

Sista manustid för nästa nummer: Torsdagen den 13 september kl. 13.00.

SEMINARIER

Fr 09–07 kl. 13.15 – 14.15. Graduate Student Seminar. Alan Sola, Matematik, KTH: *Univalent functions III.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 7.

Må 09–10 kl. 10.15. Seminar on Digital Convexity. Christer Kiselman: *Three problems in digital convexity: local minima, marginal functions, and separating hyperplanes.* Sal 2002, Ångströmlaboratoriet, Uppsala universitet. Se sidan 4.

Må 09–10 kl. 13.15. Seminarium i teoretisk datalogi. Christian Schulte, Institutionen för elektronik-, dator- och programvarusystem, KTH-Kista: *Generating propagators for finite set constraints.* Rum 1537, KTH CSC, Lindstedtsvägen 3, plan 5. Se Bråket nr 26 sidan 6.

Fortsättning på nästa sida.

Disputation i numerisk analys

Erik von Schwerin disputerar vid KTH på avhandlingen *Adaptivity for Stochastic and Partial Differential Equations with Applications to Phase Transformations* måndagen den 17 september kl. 13.00. Se sidorna 6 – 7.

Disputation i teoretisk fysik

Åsa Ericsson disputerar på avhandlingen *Exploring the Set of Quantum States* måndagen den 17 september kl. 13.00 i sal FB42, Roslagstullsbacken 21, AlbaNova universitetscentrum. Se Bråket nr 26 sidan 6.

Disputation i matematik

Patrik Hellgren disputerar vid SU på avhandlingen *G-structures and Families of Isotropic Submanifolds in Complex Contact Manifolds* tisdagen den 18 september kl. 13.00. Se sidan 8.

Workshops vid Institut Mittag-Leffler

Den första av två workshops äger rum den 10 – 14 september. Se Bråket nr 24 sidan 6.

Presentation av Wallenbergprojektet

Denna äger rum vid KTH den 19 september. Se Bråket nr 24 sidan 6.

Seminarier (fortsättning)

Ti 09–11 kl. 10.15. Plurikomplexa seminariet. Petter Brändén, KTH: *Hyperbolic polynomials in exotic environments.* Rum 306, hus 6, Matematiska institutionen, SU, Kräftriket. Se sidan 4.

On 09–12 kl. 10.15 – 12.00. Kombinatorikseminarium. Alexander Engström, KTH: *Discrete Morse functions from Fourier transforms.* Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 9.

On 09–12 kl. 11.00 – 12.00. Common SU KoF/KTH Theoretical Physics Seminar. Z. Tesanovich, Johns Hopkins University: *d-wave duality, gauge theories and the physics of high temperature superconductors.* Sal FA31, Roslagstullsbacken 21, AlbaNova universitetscentrum.

On 09–12 kl. 13.15 – 14.15. Seminarium i analys och dynamiska system. Bertrand Duplantier, Institut de Physique Théorique de Saclay, France: *SLE and quantum gravity.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 5.

Observera att Bertrand Duplantier skall tala vid seminariet i analys och dynamiska system den 12 september. I Bråket nr 26 angavs fel talare vid detta seminarium.

On 09–12 kl. 13.15 – 15.00. Algebra and Geometry Seminar. Jan-Erik Roos: *New results about hyperplane arrangements.* Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 3.

On 09–12 kl. 15.00 – 15.45. Seminarium i matematisk statistik. Frank Ball, University of Nottingham: *Network epidemic models with casual contacts.* Rum 306 (Cramérrummet), hus 6, Matematiska institutionen, SU, Kräftriket. Se sidan 8.

To 09–13 kl. 10.00. Informellt doktorandseminarium i teoretisk datalogi. *(Observera dagen, tiden och lokalen!)* **Jakob Nordström,** Teorigruppen, KTH CSC: *On length, width and space in resolution.* Rum 1635, KTH CSC, Lindstedtsvägen 3, plan 6. Se sidan 5.

To 09–13 kl. 15.00 – 16.00. AlbaNova and Nordita Colloquium in Physics. Bertrand Duplantier, Institut de Physique Théorique de Saclay, France: *Einstein and Brownian Motion.* Oskar Kleins auditorium, Roslagstullsbacken 21, AlbaNova universitetscentrum.

Fr 09–14 kl. 11.00 – 12.00. Optimization and Systems Theory Seminar. Luca Schenato, University of Padova, Italy: *Some results on optimal estimation and control for lossy networked control.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se Bråket nr 26 sidan 5.

Fr 09–14 kl. 13.15 – 14.15. Graduate Student Seminar. Teitur Arnarson, Matematik, KTH: *Free boundary regularity close to initial state and applications to finance.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 4.

On 09–19 kl. 13.00. Algebra- och geometriseminarium. Torsten Ekedahl, SU: *Title to be announced.* Rum 306, hus 6, Matematiska institutionen, SU, Kräftriket.

On 09–19 kl. 13.15 – 14.15. Seminarium i analys och dynamiska system. Richard Miles, KTH: *Algebraic dynamical systems.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 9.

Fortsättning på nästa sida.

Seminarier (fortsättning)

Fr 09–21 kl. 11.00–12.00. Optimization and Systems Theory Seminar. Hisaya Fujioka, Department of Applied Analysis and Complex Dynamical Systems, Kyoto University, Japan: *Stability analysis for a class of networked/embedded control systems: continuous- and discrete-time approaches.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 6.

Fr 09–21 kl. 13.15–14.15. Graduate Student Seminar. Björn Winckler, Matematik, KTH: *Title to be announced.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

ALGEBRA AND GEOMETRY SEMINAR

Jan-Erik Roos:
New results about hyperplane arrangements

Abstract: A (complex) hyperplane arrangement is a family $\mathcal{A}$ of hyperplanes $H \subset \mathbf{C}^n$. (We will assume here that they all pass through the origin.) The complement of the union of these hyperplanes:

$$X = \mathbf{C}^n \setminus \bigcup_{H \in \mathcal{A}} H$$

has an interesting algebraic and topological structure. In particular the fundamental group G of X has been much studied since the time of Zariski. In general if G is any group and $\gamma_2 = [G, G]$ is the subgroup of G generated by the set of commutators of G and in a similar way $\gamma_t = [G, \gamma_{t-1}]$, then we have a decreasing set of subgroups of G

$$(*) \qquad G = \gamma_1 \supset \gamma_2 \supset \gamma_3 \supset \ldots \supset \gamma_t \ldots$$

(the lower central series of G) and the direct sum of the successive quotients in $(*)$ tensored with $\mathbf{Q}$ can be given the structure of a graded Lie algebra (which in the case of an arrangement is called the holonomy Lie algebra of the arrangement). For arrangements the structure of this Lie algebra can be read off from the cohomology ring of X (the Orlik-Solomon algebra of $\mathcal{A}$) and I have recently used this fact to show that it can happen that the Hilbert series of the enveloping algebra of this Lie algebra is a transcendental function, which solves an open problem about hyperplane arrangements from the literature. All this leads also in particular to the first example of a reducible algebraic curve of degree 8 in $\mathbf{P}^2(\mathbf{C})$, where the fundamental group of the complement has a graded Lie algebra with this strange transcendental structure. This indicates that there might also exist irreducible curves with this property. Using results by Garber, Teicher and Vishne I have recently been able to determine the holonomy Lie algebra for all cases of complexified real arrangements with ≤ 8 hyperplanes in $\mathbf{C}^n$ except for the so-called non-Fano arrangement, where I have at least found more precise results than those given in the literature. Computer programs by Jörgen Backelin (`Bergman`), Clas Löfwall (`liedim.m`) and others have been important in revealing phenomena, which are then in favourable cases proved by hand calculations.

In the lecture I will start with a short basic survey of the subject for beginners.

Tid och plats: Onsdagen den 12 september kl. 13.15–15.00 i seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

SEMINAR ON DIGITAL CONVEXITY

Christer Kiselman:
Three problems in digital convexity:
local minima, marginal functions, and separating hyperplanes

Abstract: My goal is to prove results in optimization theory of two integer variables which correspond to fundamental results in convex analysis of real variables, viz. that a local minimum of a convex function is global; that the marginal function of a convex function is convex; and that two disjoint convex sets can be separated by a hyperplane. To this end I introduce a new class of functions of two discrete variables which I call strongly convex functions.

Tid och plats: Måndagen den 10 september kl. 10.15 i sal 2002, Ångströmlaboratoriet, Uppsala universitet.

PLURIKOMPLEXA SEMINARIET

Petter Brändén:
Hyperbolic polynomials in exotic environments

Abstract: Hyperbolic polynomials have their origin in the theory of partial differential equations, where they were studied by Gårding and Hörmander. Recently hyperbolic polynomials have proved to be useful in other areas of mathematics such as combinatorics, convex programming and optimization.

We will show how they and their cousins appear in the solutions to problems in probability theory, classical analysis and matrix theory.

This is based on joint work with several people.

Tid och plats: Tisdagen den 11 september kl. 10.15 i rum 306, hus 6, Matematiska institutionen, SU, Kräftriket.

GRADUATE STUDENT SEMINAR

Teitur Arnarson:
Free boundary regularity close to initial state
and applications to finance

Abstract: The choice whether to hold or exercise an American option in finance is determined by a free boundary occurring in the obstacle problem solved by the option pricing function. It is, however, hard to calculate this free boundary close to the option expiry (or initial state for the time reversed problem). The problem is well studied and good results are known in the basic one-dimensional Black-Scholes setting. We present a method for determining the free boundary regularity with less precision but in a very general, higher-dimensional, non-linear setting.

Tid och plats: Fredagen den 14 september kl. 13.15 – 14.15 i seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

INFORMELLT DOKTORANDSEMINARIUM I TEORETISK DATALOGI

Jakob Nordström:
On length, width and space in resolution

Abstract: Determining whether a propositional logic formula is a tautology, i.e., whether it is satified by all truth value assignments, is a fundamental problem both from a theoretical and a practical point of view. On the one hand, it is closely related to central questions in computational complexity and mathematics (e.g. the $P \neq NP$ millennium problem of the Clay Mathematics Institute). On the other hand, designing efficient algorithms for proving tautologies, or equivalently refuting unsatisfiable formulas, is a very important problem in applied research and in industry, e.g. in the context of formal methods.

In this talk, we will focus on *resolution,* which proves tautologies by showing that their negations, expressed as CNF formulas, are unsatisfiable. It is arguably the single most studied propositional proof system, and many real-world automated theorem provers are based on it.

For resolution, two important complexity measures are the minimum *length* of a proof for a formula and the minimum *space* of a proof. The length, or number of lines, gives a lower bound on the time needed for any algorithm producing a resolution proof, and the space measure tells us the minimum amount of memory needed while searching for a proof. A third interesting measure turns out to be the *width,* which is the maximal number of variables in any line in the proof. Studying the measures of length, width and space, and relating them to one another, can help us devise good heuristics and/or understand the limitations of different approaches for proving tautologies.

In the first half of the talk, we will review some of the significant (and surprising!) results relating length, space and width, and also try to briefly sketch our own contribution to the area.

In the second half, we will present some interesting open problems, which should be readily accessible to a general computer science and mathematics audience.

This talk is a tutorial that will be given at The Fall School of Logic and Complexity '07 in the Czech Republic, and it will therefore be held in English. It is intended to last for 2×45 minutes. No prerequisites are needed, apart from a basic knowledge of (propositional) logic. Feedback will be most welcome.

Tid och plats: Torsdagen den 13 september kl. 10.00 i rum 1635, KTH CSC, Lindstedtsvägen 3, plan 6.

SEMINARIUM I ANALYS OCH DYNAMISKA SYSTEM

Bertrand Duplantier:
SLE and quantum gravity

Abstract: We shall describe some geometrical properties of conformally invariant scaling curves in the plane, i.e., SLE curves, and the multifractal properties of their harmonic measure. These properties have natural "quantum gravity" aspects, corresponding to the embedding of the curves in a random lattice, i.e., in a random Riemannian metric.

The quantum gravity perspective on conformal random geometry will be exemplified in the cases of Brownian and self-avoiding paths (SLE8/3) and percolation (SLE6).

Tid och plats: Onsdagen den 12 september kl. 13.15 – 14.15 i seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

OPTIMIZATION AND SYSTEMS THEORY SEMINAR

Hisaya Fujioka:
Stability analysis for a class of networked/embedded control systems: continuous- and discrete-time approaches

Abstract: Motivated by the widespread use of networked and/or embedded control systems, the stability analysis problem is considered for sampled-data feedback control systems with uncertainly time-varying sampling intervals. In the first part the problem is cast into a robustness analysis problem, where the nominal part is a continuous-time FDLTI system and then the perturbation is a time-varying delay. It is shown that the IQC technique improves small-gain type results in the literature. In the second part of the talk, the problem is again cast to a robustness problem, but the related periodic sampled-data system is taken as the nominal part.

A stability analysis algorithm is developed based on the robustness against the variation of sampling intervals derived by the small-gain condition.

Tid och plats: Fredagen den 21 september kl. 11.00 – 12.00 i seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

DISPUTATION I NUMERISK ANALYS

Erik von Schwerin

disputerar på avhandlingen

Adaptivity for Stochastic and Partial Differential Equations with Applications to Phase Transformations

måndagen den 17 september 2007 kl. 13.00 i sal F3, KTH, Lindstedtsvägen 26, b.v. Till opponent har utsetts *professor Desmond Higham,* University of Strathclyde, Scotland.

Abstract of the thesis

This work is concentrated on efforts to efficiently compute properties of systems, modelled by differential equations, involving multiple scales. Goal oriented adaptivity is the common approach to all the treated problems. Here the goal of a numerical computation is to approximate a functional of the solution to the differential equation, and the numerical method is adapted to this task.

The thesis consists of four papers. The first three papers concern the convergence of adaptive algorithms for numerical solution of differential equations; based on a posteriori expansions of global errors in the sought functional, the discretizations used in a numerical solution of the differential equation are adaptively refined. The fourth paper uses expansion of the adaptive modelling error to compute a stochastic differential equation for a phase-field by coarse-graining molecular dynamics.

An adaptive algorithm aims to minimize the number of degrees of freedom to make the error in the functional less than a given tolerance. The number of degrees of freedom provides the convergence rate of the adaptive algorithm as the tolerance tends to zero. Provided that the computational work is proportional to the degrees of freedom, this gives an estimate of the efficiency of the algorithm.

(Continued on the next page.)

The first paper treats approximation of functionals of solutions to second order elliptic partial differential equations in bounded domains of $\mathbb{R}^d$, using isoparametric d-linear quadrilateral finite elements. For an adaptive algorithm, an error expansion with computable leading order term is derived and used in a computable error density, which is proved to converge uniformly as the mesh size tends to zero. For each element an error indicator is defined by the computed error density multiplying the local mesh size to the power of $2 + d$. The adaptive algorithm is based on successive subdivisions of elements, where it uses the error indicators. It is proved, using the uniform convergence of the error density, that the algorithm either reduces the maximal error indicator with a factor or stops; if it stops, then the error is asymptotically bounded by the tolerance using the optimal number of elements for an adaptive isotropic mesh, up to a problem independent factor. Here the optimal number of elements is proportional to the $d/2$ power of the $L^{d/(d+2)}$ quasi-norm of the error density, whereas a uniform mesh requires a number of elements proportional to the $d/2$ power of the larger L^1 norm of the same error density to obtain the same accuracy. For problems with multiple scales, in particular, these convergence rates may differ much, even though the convergence order may be the same.

The second paper presents an adaptive algorithm for Monte Carlo Euler approximation of the expected value $E[g(X(\tau), \tau)]$ of a given function g depending on the solution X of an Itô stochastic differential equation and on the first exit time τ from a given domain. An error expansion with computable leading order term for the approximation of $E[g(X(T))]$ with a fixed final time $T > 0$ was given in [Szepessy, Tempone, and Zouraris, Comm. Pure and Appl. Math., **54,** 1169 – 1214, 2001. This error expansion is now extended to the case with stopped diffusion. In the extension conditional probabilities are used to estimate the first exit time error, and difference quotients are used to approximate the initial data of the dual solutions. For the stopped diffusion problem the time discretization error is of order $N^{-1/2}$ for a method with N uniform time steps. Numerical results show that the adaptive algorithm improves the time discretization error to the order N^{-1}, with N adaptive time steps.

The third paper gives an overview of the application of the adaptive algorithm in the first two papers to ordinary, stochastic, and partial differential equations.

The fourth paper investigates the possibility of computing some of the model functions in an Allen-Cahn type phase-field equation from a microscale model, where the material is described by stochastic, Smoluchowski, molecular dynamics. A local average of contributions to the potential energy in the micro model is used to determine the local phase, and a stochastic phase-field model is computed by coarse-graining the molecular dynamics. Molecular dynamics simulations on a two phase system at the melting point are used to compute a double-well reaction term in the Allen-Cahn equation and a diffusion matrix describing the noise in the coarse-grained phase-field.

GRADUATE STUDENT SEMINAR

Alan Sola:
Univalent functions III

Abstract: In this talk, I will discuss coefficient problems for the class Σ of functions univalent in the exterior disk $\Delta = \{z \in \mathbb{C} : |z| > 1\}$. We shall see that while $|b_2| \leq 2/3$ holds for functions in Σ, matters are more complicated for the subsequent coefficients.

Tid och plats: Fredagen den 7 september kl. 13.15 – 14.15 i seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

SEMINARIUM I MATEMATISK STATISTIK

Frank Ball:
Network epidemic models with casual contacts

Abstract: The study of epidemics on social networks has attracted considerable attention recently. In this talk, we consider a stochastic SIR (susceptible → infective → removed) model for the spread of an epidemic on a finite network, having an arbitrary but specified degree distribution, in which individuals also make casual contacts, i.e. with people chosen uniformly from the population. The behaviour of the model as the network size tends to infinity is investigated. In particular, its threshold behaviour is determined, as is the proportion of the population who are ultimately infected by an epidemic that becomes established. For the case when the infectious period is constant and all individuals in the network have the same degree, the asymptotic variance and a central limit theorem for the size of an epidemic that becomes established are obtained. Corresponding results for the epidemic without casual contacts, i.e. for the standard SIR network epidemic model, are discussed. The theory is illustrated by numerical studies, which demonstrate that the asymptotic approximations work well, even for only moderately sized networks, and that the degree distribution and the inclusion of casual contacts can each have a major impact on the outcome of an epidemic.

Tid och plats: Onsdagen den 12 september kl. 15.00 – 15.45 i rum 306 (Cramérrummet), hus 6, Matematiska institutionen, SU, Kräftriket.

DISPUTATION I MATEMATIK

Patrik Hellgren

disputerar på avhandlingen

G-structures and Families of Isotropic Submanifolds in Complex Contact Manifolds

tisdagen den 18 september 2007 kl. 13.00 i sal 14, hus 5, Matematiska institutionen, SU, Kräftriket. Till opponent har utsetts *professor Henrik Pedersen,* Department of Mathematics, University of Southern Denmark.

Abstract of the thesis

We study a generalized twistor correspondence between irreducible G-structures (with torsion in general) on complex manifolds Z and moduli spaces M of deformations of isotropic homogeneous submanifolds X in complex contact manifolds Y.

For any irreducible G-structure on a complex manifold M we present an explicit construction of a contact manifold (a generalized twistor space) Y with contact line bundle L and a family F of isotropic submanifolds X in Y having M as its moduli space. We study those special properties of this family which encode geometric invariants of the original G-structure.

Conversely, given a contact manifold (Y, L) and a homogeneous isotropic submanifold X in Y satisfying certain properties, we show that the associated moduli space M of isotropic deformations of X inside Y has an induced G-structure, G_{ind}, and then show how the invariant torsion of G_{ind} can be read off from certain cohomology groups canonically associated with the holomorphic embedding data of X in Y.

KOMBINATORIKSEMINARIUM

Alexander Engström:
Discrete Morse functions from Fourier transforms

Abstract: A discrete Morse function for a simplicial complex describes how to construct a homotopy equivalent CW-complex with hopefully fewer cells. We associate a boolean function with the simplicial complex and construct a discrete Morse function using its Fourier transform.

Methods from theoretical computer science by O'Donnell, Saks, Schramm, and Servedio, together with experimental data on complexes from Hachimoro's library, provide some evidence that the constructed discrete Morse functions are efficient.

Tid och plats: Onsdagen den 12 september kl. 10.15 – 12.00 i seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

SEMINARIUM I ANALYS OCH DYNAMISKA SYSTEM

Richard Miles:
Algebraic dynamical systems

Abstract: Dynamical systems arising from automorphisms of compact abelian groups are a familiar testing ground for ideas in ergodic theory, as well as being of interest in their own right. In 1989, B. Kitchens and K. Schmidt introduced commutative algebra as a tool for studying such systems, leading to substantial developments in this area. We review some results from the subsequent 'algebraic dictionary' of dynamical properties together with some newer concepts for algebraic actions of Z^d, $d > 1$.

Tid och plats: Onsdagen den 19 september kl. 13.15 – 14.15 i seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.
