BRÅKET

Information om seminarier och högre undervisning i matematiska ämnen i Stockholmsområdet

NR 8 **FREDAGEN DEN 28 FEBRUARI 2003**

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://www2.math.kth.se/~gunnarkn/

Postadress:
Red. för Bråket
Institutionen för matematik
KTH
100 44 Stockholm

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Sista manustid för nästa nummer: Torsdagen den 6 mars kl. 13.00.

Disputation i optimeringslära och systemteori

Mathias Stolpe disputerar på avhandlingen *On models and methods for global optimization of structural topology* den 7 mars kl. 10.00 i Kollegiesalen, Administrationsbyggnaden, KTH, Valhallavägen 79. Se Bråket nr 6 sidan 8.

Kurs

Christer Kiselman: Ill-Posed Problems. Se sidan 8.

SEMINARIER

Fr 02–28 kl. 11.00–12.00. Optimization and Systems Theory Seminar. Mathias Stolpe, Optimeringslära och systemteori, KTH: *Topology optimization of continuum structures.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se Bråket nr 7 sidan 6.

I seminariet ger Mathias Stolpe en sammanfattning av den senare delen av sin doktorsavhandling, vilken han kommer att försvara vid en offentlig disputation fredagen den 7 mars 2003 kl. 10.00. Se Bråket nr 6 sidan 8.

Fr 02–28 kl. 15.15. Seminarium i ekonomisk statistik. Katarina Juselius, Københavns Universitet: *European wage, price and unemployment dynamics and the consequence towards purchasing power parity.* Rum 750, Institutionen för ekonomisk statistik, Handelshögskolan, Stockholm.

Må 03–03 kl. 15.15–16.00. Seminarium i finansiell matematik. Fredrik Davéus presenterar sitt examensarbete: *Nonparametric local modeling of financial time series.* Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 6.

Må 03–03 kl. 16.15–17.00. Seminarium i finansiell matematik. George Englund presenterar sitt examensarbete: *Valuing Credit Default Swaps.* Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se Bråket nr 7 sidan 7.

Ti 03–04 kl. 10.00–11.00. Plurikomplexa seminariet. *(Observera tiden och lokalen!)* **Mikael Passare,** SU: *The Lee-Yang circle theorem and geometry of amoebas.* Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 3.

Fortsättning på nästa sida.

Seminarier (fortsättning)

Ti 03–04 kl. 11.30 – 12.30. Plurikomplexa seminariet. *(Observera tiden och lokalen!)* **August Tsikh,** Krasnojarsk: *On residue theory without Hironaka's theorem.* Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se sidan 4.

Ti 03–04 kl. 14.00 – 15.00. Mittag-Leffler Seminar. Laurent Baratchart, INRIA, Sophia Antipolis, France: *Identification and design of linear systems in the frequency domain and function theory.* Institut Mittag-Leffler, Auravägen 17, Djursholm. Se sidan 4.

Ti 03–04 kl. 15.30 – 16.30. Mittag-Leffler Seminar. Michele Pavon, Dipartimento di Matematica Pura e Applicata, Padova, Italy: *Quantum Schrödinger bridges and quantum control.* Institut Mittag-Leffler, Auravägen 17, Djursholm. Se sidan 5.

On 03–05 kl. 13.15. Logikseminariet Stockholm-Uppsala. *(Observera tiden och lokalen!)* **Benno van den Berg,** Utrecht: *Inductive types, ex/reg-completions, and realizability.* Rum 3513, Matematiska institutionen, Polacksbacken, Uppsala universitet.

On 03–05 kl. 13.15 – 15.00. Algebra and Geometry Seminar. Leif Melkersson, Linköping: *When is the category of cofinite modules abelian?* Rum 306, hus 6, Matematiska institutionen, SU, Kräftriket. Se sidan 6.

On 03–05 kl. 13.15 – 15.00. Seminarium i analys och dynamiska system. Jan-Erik Björk, SU: *Rigid bodies and the Kovalevsky gyroscope.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se Bråket nr 7 sidan 5.

To 03–06 kl. 13.00 – 14.00. Presentation av examensarbete i matematik. Andreas Bexelius: *abc-förmodan.* Rum 306 (Cramérrummet), hus 6, Matematiska institutionen, SU, Kräftriket. Se sidan 9.

To 03–06 kl. 14.00 – 15.00. Mittag-Leffler Seminar. Tryphon Georgiou, University of Minnesota, Minneapolis, USA: *High resolution spectral analysis via analytic interpolation.* Institut Mittag-Leffler, Auravägen 17, Djursholm. Se sidan 3.

To 03–06 kl. 15.30 – 16.30. Mittag-Leffler Seminar. Anders Lindquist, KTH, Stockholm: *A convex optimization approach to generalized moment problems with complexity constraint.* Institut Mittag-Leffler, Auravägen 17, Djursholm. Se sidan 4.

Fr 03–07 kl. 10.15 – 12.00. Valda problem i geometri. Torsten Ekedahl: *Non-archimedean amoebas.* Rum 306, hus 6, Matematiska institutionen, SU, Kräftriket. Se sidan 5.

Må 03–10 kl. 13.00. Seminarium i teoretisk datalogi. Jonas Holmerin, Nada, KTH: *(Icke-)approximerbarhet hos ekvationer över ändliga grupper.* Rum 4523, Nada, KTH, Lindstedtsvägen 3, plan 5. Se sidan 5.

To 03–13 kl. 14.15 – 15.00. Seminarium i numerisk analys. Anders Lansner, Nada, KTH: *Some current examples of computational modelling in biology.* Rum 4523, Nada, KTH, Lindstedtsvägen 3, plan 5. Se sidan 6.

To 03–13 kl. 16.15 – 18.00. Seminarium i matematik och fysik vid Mälardalens högskola (Eskilstuna). Andreas Andersson, Mälardalens högskola: *Matematik och didaktik — Finns det någon motsättning?* Lektionssal H122, Mälardalens högskola, Eskilstuna.

Fortsättning på nästa sida.

Seminarier (fortsättning)

Fr 03–14 kl. 11.00 – 12.00. Optimization and Systems Theory Seminar. Chung-Yao Kao, Institut Mittag-Leffler: *Title to be announced.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

Fr 03–14 kl. 15.15 – 17.00. Licentiatseminarium i matematik. Tanja Bergkvist: *On Polynomial Eigenfunctions of Differential Operators.* Rum 306, hus 6, Matematiska institutionen, SU, Kräftriket. Se sidan 7.

PLURIKOMPLEXA SEMINARIET

Mikael Passare:
The Lee-Yang circle theorem and geometry of amoebas

Abstract: Let (a_{jk}) be a symmetric $(n \times n)$-matrix with real entries of absolute value ≤ 1, and consider the polynomial

$$P(z_1, \ldots, z_n) = \sum_I \prod_{j \in I} \Big(z_j \prod_{k \notin I} a_{jk} \Big),$$

where I runs over all subsets of $\{1, 2, \ldots, n\}$. It is a famous result due to Tsung Dao Lee and Chen Ning Yang that the one variable polynomial $z \mapsto P(z, \ldots, z)$ has all its complex roots located on the unit circle. We shall study the structure of the amoeba of P, that is, the image of its zero set under the mapping $(z_1, \ldots, z_n) \mapsto (\log|z_1|, \ldots, \log|z_n|)$, and in particular we obtain a new quick proof of the Lee-Yang theorem.

Tid och plats: Tisdagen den 4 mars kl. 10.00 – 11.00 i seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

MITTAG-LEFFLER SEMINAR

Tryphon Georgiou:
High resolution spectral analysis via analytic interpolation

Abstract: Imaging technology from ultrasound and magnetic resonance (MRI) to antenna arrays and synthetic aperture radar (SAR), relies on the mathematical tools of spectral analysis.

We will overview an approach to spectral analysis which uses analytic interpolation for obtaining information about the power spectrum of an underlying stochastic process from covariance statistics. Early work during the 1980's and 1990's was based on the theory of the classical trigonometric moment problem and of Szegö orthogonal polynomials, and led to the so-called "modern nonlinear methods" (Burg's maximum entropy method, Capon's method, MUSIC, ESPRIT, etc.). More recent developments take advantage of generalized statistics and, accordingly, generalized analytic interpolation, and give rise to methods with substantially better resolution.

Finally, we will discuss an approach to approximation of power spectra and its relevance in reconciling inconsistent measurements with prior estimates.

Tid och plats: Torsdagen den 6 mars kl. 14.00 – 15.00 vid Institut Mittag-Leffler, Auravägen 17, Djursholm.

PLURIKOMPLEXA SEMINARIET

August Tsikh:
On residue theory without Hironaka's theorem

Abstract: For the general residue current (associated with the holomorphic mapping $f : \mathbb{C}^n \to \mathbb{C}^p$) there are a lot of problems in the proof of its existence, even using Hironaka's (nonconstructive) desingularization theorem. Moreover, it remains unknown whether there exists some simple proof of such a fact without using the desingularization theorem. It turns out that in the special case when the mapping $f : \mathbb{C}^n \to \mathbb{C}^n$ defines a complete intersection, there exists a relatively simple proof based on the trace formula for integrals and on the notion of amoeba for the discriminant of f.

Tid och plats: Tisdagen den 4 mars kl. 11.30 – 12.30 i seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

MITTAG-LEFFLER SEMINAR

Laurent Baratchart:
Identification and design of linear systems in the frequency domain and function theory

Abstract: We consider in this talk the approximation problem raised by the identification of a fractional filter with two branched singularities, using the so-called output error scheme in fixed rational degree. This is an example of a situation where "the true model" does not belong to the model class. This leads us to study non-Hermitian orthogonal polynomials with varying weights, and to analyse the location of their zeros. Further generalization gives us an opportunity to consider the asymptotic behaviour of these zeros in connection with some extremal capacity issues in potential theory.

Tid och plats: Tisdagen den 4 mars kl. 14.00 – 15.00 vid Institut Mittag-Leffler, Auravägen 17, Djursholm.

MITTAG-LEFFLER SEMINAR

Anders Lindquist:
A convex optimization approach to generalized moment problems with complexity constraint

Abstract: Many important problems in circuit theory, robust stabilization and control, statistical signal processing, speech synthesis, and stochastic systems theory can be formulated as generalized moment problems. However, such applications often impose complexity constraints that significantly alter the mathematical problem. In this talk we give a complete parameterization of all solutions to the generalized moment problem satisfying such a non-classical complexity constraint. We then show that each solution in this class can be obtained by minimizing a strictly convex nonlinear functional. Finally, we apply these results to interpolation problems of the Carathéodory and of the Nevanlinna-Pick type, arising in control and systems theory.

Tid och plats: Torsdagen den 6 mars kl. 15.30 – 16.30 vid Institut Mittag-Leffler, Auravägen 17, Djursholm.

MITTAG-LEFFLER SEMINAR

Michele Pavon:
Quantum Schrödinger bridges and quantum control

Abstract: We present a variational principle within Nelson stochastic mechanics that produces the wave packet reduction after a position measurement. This stochastic control problem parallels, with a different kinematics, the probabilistic problem of the Schrödinger bridge. We then discuss how a suitable extension of this variational technique may represent a general way to attack the steering problem for quantum mechanical systems.

Tid och plats: Tisdagen den 4 mars kl. 15.30 – 16.30 vid Institut Mittag-Leffler, Auravägen 17, Djursholm.

VALDA PROBLEM I GEOMETRI

Torsten Ekedahl: Non-archimedean amoebas

Abstract: Amoebas, the image under the logarithm of the absolute value of complex hypersurfaces has been discussed in previous lectures as well as the related "tropical geometry". I will discuss amoebas over non-archimedean fields, in particular the field of Puiseux series. These will turn out to be even more closely related to tropical geometry. Knowledge of previous lectures will not be necessary.

Tid och plats: Fredagen den 7 mars kl. 10.15 – 12.00 i rum 306, hus 6, Matematiska institutionen, SU, Kräftriket.

SEMINARIUM I TEORETISK DATALOGI

Jonas Holmerin:
(Icke-)approximerbarhet hos ekvationer över ändliga grupper

Sammanfattning: En ekvation över en ändlig grupp G är ett uttryck på formen $w_1 w_2 \cdots w_k = 1_G$, där varje w_i är en variabel, en inverterad variabel eller konstant från G. En sådan ekvation är satisfierbar om det går att tilldela variablerna värden från G på ett sådant sätt att likheten realiseras.

I detta seminarium behandlas problemet att samtidigt satisfiera så många som möjligt av en familj av ekvationer över en ändlig grupp G. Vi presenterar ett bevis för att det är NP-svårt att satisfiera mer än en andel $1/|G|$ av det optimala antalet ekvationer, eller med andra ord att problemet är NP-svårt att approximera inom $|G|$-epsilon för varje epsilon > 0. Motsvarande resultat var tidigare känt enbart för abelska grupper (Håstad 2001).

I seminariet skissar vi på en koppling mellan problemet att satisfiera maximalt antal ekvationer och så kallade PCP:er ("Probabilistically Checkable Proofs"), som kan ses som ett slags spel mellan två personer, en verifierare och en bevisare, där bevisaren vill övertyga verifieraren om något påstående. Vi konstruerar ett sådant spel som motsvarar optimeringsproblemet ovan, och för att analysera detta spel använder vi sedan representationsteori för ändliga grupper.

Arbetet har utförts tillsammans med Lars Engebretsen och Alexander Russell.

Tid och plats: Måndagen den 10 mars kl. 13.00 i rum 4523, Nada, KTH, Lindstedtsvägen 3, plan 5.

SEMINARIUM I FINANSIELL MATEMATIK

Fredrik Davéus

presenterar sitt examensarbete:

Nonparametric local modeling of financial time series

Sammanfattning: Examensarbetet har gått ut på att skapa en modell för prediktering av finansiella tidsserier på kort sikt, d.v.s. ungefär 1 – 10 dagar. Idén bakom modellen är att hitta historiska kursrörelsemönster som liknar det nuvarande och dra viktade slutsatser baserade på historiska utfall om framtiden. En praktisk studie på aktier noterade på Stockholmsbörsen har utförts. Resultatet visar på signifikant förmåga hos modellen att korrekt prediktera framtida riktning för prisutvecklingen hos enskilda aktier.

Tid och plats: Måndagen den 3 mars kl. 15.15 – 16.00 i seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

ALGEBRA AND GEOMETRY SEMINAR

Leif Melkersson:
When is the category of cofinite modules abelian?

Abstract: Let A be a commutative noetherian ring and M an A-module (not supposed to be finitely generated!). In order to study finiteness of local cohomology modules Hartshorne [Inventiones Mathematicae, vol. 9, 1970] defined the module M to be cofinite with respect to an ideal a in A if $\mathrm{Supp}(M) \subset V(a)$ and $\mathrm{Ext}^i_A(A/a, M)$ is finitely generated for all $i \geq 0$. He showed that the category of a-cofinite modules is abelian when a is a prime in a complete regular noetherian local ring A such that $\dim(A/a) = 1$. Delfino and Marley dropped the requirement that A be regular. I will prove that the category of A-cofinite modules is abelian for an arbitrary ideal a in an arbitrary local noetherian ring A such that $\dim(A/a) = 1$. Results from the theory of asymptotic prime divisors are used in the proof.

Tid och plats: Onsdagen den 5 mars kl. 13.15 – 15.00 i rum 306, hus 6, Matematiska institutionen, SU, Kräftriket.

SEMINARIUM I NUMERISK ANALYS

Anders Lansner:
Some current examples of computational modelling in biology

Abstract: Biology is now developing along the same path as earlier physics and chemistry towards becoming more of a quantitative and hypothesis driven science. Computational modelling of biological processes has a key role in this development. The Sans (Studies of Artificial Neural Systems) group has been active in computational neuroscience and neurocomputing for a long time. We develop and investigate computational models at levels from molecules to multi-cellular networks, e.g. biochemical networks underlying synaptic plasticity and learning, insulin secretion in pancreatic β-cells, signal processing in single neurons as well as dynamics of large-scale neuronal network models.

The seminar will go through a couple of illustrative examples of the type of formalism, models and methodology used together with some results from such modelling.

Tid och plats: Torsdagen den 13 mars kl. 14.15 – 15.00 i rum 4523, Nada, KTH, Lindstedtsvägen 3, plan 5.

LICENTIATSEMINARIUM I MATEMATIK

Tanja Bergkvist:
On Polynomial Eigenfunctions of Differential Operators

Abstract: The main topic of the present licentiate thesis is the study of the asymptotic properties of zeros in polynomial families satisfying certain linear differential equations. This study was inspired by a number of striking conjectures, based on extensive computer experiments made by B. Shapiro and G. Másson in the summer of 2000. In all three papers we study polynomial systems appearing as eigenfunctions for the differential operator given by

$$T_Q = \sum_{j=0}^{k} Q_j \frac{d^j}{dz^j} \tag{1}$$

with varying conditions on the Q_j.

The first paper, *On Polynomial Eigenfunctions for a Class of Differential Operators,* deals with the case when $\deg Q_j \leq j \ \forall j$ with equality for $j = k$ in (1). We will call this situation the *nondegenerate case,* and the corresponding operator T_Q the *nondegenerate operator.* In this case the eigenvalue problem $T_Q(p_n) = \lambda_n p_n$ can be considered as a generalization to higher orders of the (nonconfluent) hypergeometric equation

$$(z^2 - 1)f''(z) + (az + b)f'(z) + cf(z) = 0. \tag{2}$$

If n is a nonnegative integer and a, b, c are constants satisfying $a > b$, $a + b > 0$, and $c = n(1 - a - n)$, then the Jacobi polynomials, which constitute an orthogonal system, will appear as solutions to (2). However, when $k > 2$ in (1), the sequence $\{p_n\}$ is in general not an orthogonal system of polynomials, and it can therefore not be studied by means of the theory known for such systems. The goal of this paper is to prove some of the conjectures proposed by Shapiro and Másson about the zeros of the polynomial eigenfunctions. Most important, we prove that asymptotically as $n \to \infty$, the zeros of p_n are distributed according to a certain probability measure which depends only on the leading polynomial Q_k.

In the second paper, *On Bochner-Krall Orthogonal Polynomial Systems,* we address the classical question going back to S. Bochner and H. L. Krall to describe all systems $\{p_n(x)\}_{n=0}^{\infty}$ of orthogonal polynomials which are the eigenfunctions of some finite order differential operator. Such systems are called *Bochner-Krall orthogonal polynomial systems* and the corresponding differential operators are called *Bochner-Krall operators.* We show that the leading coefficient of a Nevai type Bochner-Krall operator is of the form $((x - a)(x - b))^{N/2}$, which settles the special case of a general conjecture describing the leading terms of all Bochner-Krall operators.

In the last paper, *On Generalized Laguerre Polynomials with Real and Complex Parameter,* we consider the eigenvalue problem $T_Q(p_n) = \lambda_n p_n$ where $\deg Q_j \leq j \ \forall j$ and $\deg Q_k < k$ in (1). We call T_Q the *degenerate operator.* Computer experiments indicate the existence of a limiting measure for the distribution of zeros of p_n, but that it no longer has compact support as in the nondegenerate case. We pay particular attention to the simplest degenerate operator, in which case our eigenvalue problem becomes a confluent hypergeometric equation. The object is to study the location of the zeros of the polynomial eigenfunctions of this operator, and to say something about the asymptotic zero distribution. The classical (orthogonal) Laguerre polynomials will appear as a special case, and some well-known results about these will therefore be recovered and generalized.

Tid och plats: Fredagen den 14 mars kl. 15.15 – 17.00 i rum 306, hus 6, Matematiska institutionen, SU, Kräftriket.

GRADUATE COURSE IN MATHEMATICS

Christer Kiselman: Ill-Posed Problems

This is a course for beginning graduate students in mathematics and related subjects. It will start on March 3 and go on until the beginning of June. Lectures are generally on Mondays and Tuesdays at 15.15.

The notion of a well-posed problem, "un problème bien posé", goes back to a famous paper by Jacques Hadamard published in 1902. In an earlier paper in 1901 he mentioned "questions mal posées". He argued that the problems that are physically important are both "possible" and "déterminé", i.e., solvable and uniquely solvable. He gave examples of problems that are not well-posed; they are also "dépourvu de signification physique". However, I shall show that important problems in technology, medicine, and the natural sciences that are ill-posed abound. In fact, any measurement, except for the most trivial ones, gives rise to an inverse problem that is ill-posed.

Today one defines a well-posed problem as a problem that is uniquely solvable and is such that the solution depends in a continuous way on the data. If the solution depends in a discontinuous way on the data, then small errors, whether rounding off errors, measurement errors, or perturbations caused by noise, can create large deviations. Therefore the numerical treatment of ill-posed problems is a challenge.

In this course I will present examples of well-posed and ill-posed problems. I shall discuss mathematical methods to treat them. I will take the material mainly from the book

> M. M. Lavrent'ev and L. Ja. Savel'ev (1999), *Teorija operatorov i nekorrektnye zadaˆci.* Novosibirsk, Izdatel'stvo Rossijskoj Akademii Nauk, Sibirskoe Otdelenie, Institut Matematiki im. S. L. Soboleva. 702 pp. ISBN 5-86134-077-3.

I shall start with its third part, that on ill-posed problems, and explain results from functional analysis and partial differential equations as needed when we go along.

Prerequisites: A general acquaintance with analysis. A basic course on Fourier analysis and differential equations will suffice to follow the course successfully.

Start: Monday, March 3, at 15.15 – 17.00 in room MIC 2145, Department of Mathematics, Polacksbacken, Uppsala University: Definitions of well-posed and ill-posed problems. Hadamard's 1902 paper. Examples of ill-posed problems: example from medicine and the geosciences; Hadamard's examples; other mathematical examples.

Next: March 10, 11, 24, 25.

See also my web page, http://www.math.uu.se/~kiselman.

Welcome!
Christer Kiselman

PRESENTATION AV EXAMENSARBETE I MATEMATIK

Andreas Bexelius: *abc*-förmodan

Sammanfattning: Arbetet tar upp den s.k. *abc*-förmodan som säger att om a och b är två relativt prima positiva heltal (d.v.s. $\text{sgd}(a,b)=1$) och om $a+b=c$ och $\text{rad}(n)$ är produkten av primtalsdelarna till det positiva heltalet n så finns det för varje $\epsilon>0$ ett $K(\epsilon)>0$ sådant att

$$\max(a,b,c)\leq K(\epsilon)\text{rad}(abc)^{1+\epsilon}.$$

abc-förmodan kan på ett ekvivalent sätt formuleras på logaritmisk form enligt följande: För varje $\epsilon>0$ finns endast ett ändligt antal kvoter sådana att

$$L(a,b,c):=\frac{\log(c)}{\log(\text{rad}(abc))}>1+\epsilon.$$

abc-förmodan kan således formuleras som att den största gränspunkten till mängden är 1. Ingen har ännu lyckats visa detta, eller ens att 1 är en gränspunkt vilket det mesta dock tyder på.

Tid och plats: Torsdagen den 6 mars kl. 13.00 – 14.00 i rum 306 (Cramérrummet), hus 6, Matematiska institutionen, SU, Kräftriket.