BRÅKET

Information om seminarier och högre undervisning i matematiska ämnen i Stockholmsområdet

NR 2 **FREDAGEN DEN 17 JANUARI 2003**

BRÅKET

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

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Sista manustid för nästa nummer:
Torsdagen den 23 januari
kl. 13.00.

Disputation i statistik

Michael Carlson disputerar på avhandlingen *Some Contributions to Statistical Disclosure Control* fredagen den 17 januari 2003 kl. 10.00 i Högbomsalen, Geovetenskapens hus, SU, Frescati. Se Bråket nr 1 sidorna 6 – 7.

SEMINARIER

Må 01–20 kl. 15.15 – 17.00. Seminarium i matematisk statistik. Lars Holst: *Om exkursionslängder i en Brownsk rörelse.* (Fortsättning från seminariet den 16 december 2002.) Seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Se Bråket 2002 nr 41 sidan 7.

Ti 01–21 kl. 10.15. Plurikomplexa seminariet. Nikolay Shcherbina: *Pluripolar graphs are holomorphic.* Sal 2145, Matematiska institutionen, Polacksbacken, Uppsala universitet. Se sidan 3.

Ti 01–21 kl. 13.30. Plurikomplexa seminariet. Christer Kiselman: *Implicit-function theorems and fixed-point theorems in digital geometry.* Sal 2145, Matematiska institutionen, Polacksbacken, Uppsala universitet. Se sidan 4.

Ti 01–21 kl. 14.00 – 15.00. Mittag-Leffler Seminar. Professor David Gilliam, Texas Tech University, Lubbock, USA: *Small-scale spatial mollifiers with application to output regulation for distributed parameter systems.* Institut Mittag-Leffler, Auravägen 17, Djursholm. Se sidan 5.

Ti 01–21 kl. 15.30 – 16.30. Mittag-Leffler Seminar. Professor Victor Shubov, Texas Tech University, Lubbock, USA: *Stability of fluid flows containing solid particles. Uniform regularity of control systems governed by parabolic equations.* Institut Mittag-Leffler, Auravägen 17, Djursholm. Se sidan 3.

Fortsättning på nästa sida.

Kurser

Dan Laksov: Algebraisk geometri. Se sidan 5.

Per Sjölin: Fourieranalys. Se sidan 4.

Andrzej Szulkin: Elementär differentialgeometri. Se sidan 5.

Seminarier (fortsättning)

On 01–22 kl. 10.15 – 11.00. Numerical Analysis Seminar. Mats Holmström, Institutet för Rymdfysik i Kiruna: *Computer simulations of the solar wind interaction with solar system objects: Applications for X-ray and ENA imaging.* Rum 4523, Nada, KTH, Lindstedtsvägen 5, plan 5. Se nedan.

On 01–22 kl. 15.15. Seminarium i matematisk statistik. Åke Svensson, SU: *Konkurrerande epidemier.* Rum 306 (Cramérrummet), hus 6, Matematiska institutionen, SU, Kräftriket. Se sidan 4.

To 01–23 kl. 14.00 – 15.00. Mittag-Leffler Seminar. Professor John A. Burns, Virginia Polytechnic Institute and State University, Blacksburg, USA: *Distributed parameter control, sensitivity analysis and transition to turbulence.* Institut Mittag-Leffler, Auravägen 17, Djursholm. Se sidan 6.

To 01–23 kl. 15.30 – 16.30. Mittag-Leffler Seminar. Professor Marianna A. Shubov, Texas Tech University, Lubbock, USA: *Asymptotic and spectral analysis of an aircraft wing model in subsonic airflow and the problem of flutter control.* Institut Mittag-Leffler, Auravägen 17, Djursholm. Se sidan 7.

Fr 01–31 kl. 11.00 – 12.00. Optimization and Systems Theory Seminar. Göran Sporre, Optimeringslära och systemteori, KTH: *On some properties of interior methods for optimization.* Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

I seminariet ger Göran Sporre en sammanfattning av sin doktorsavhandling, vilken han kommer att försvara vid en offentlig disputation måndagen den 17 februari 2003 kl. 10.00 i Kollegiesalen, Administrationsbyggnaden, KTH, Valhallavägen 79. Mer om disputationen kommer i nästa nummer av Bråket.

NUMERICAL ANALYSIS SEMINAR

Mats Holmström: Computer simulations of the solar wind interaction with solar system objects: Applications for X-ray and ENA imaging

Abstract: The solar wind is a stream of plasma flowing outward from the Sun, all the way through our solar system. Near planets, moons, comets and asteroids, an interaction region is created, where the object changes the flow of the solar wind. A review of different models and algorithms for the simulation of these interaction regions will be presented. Examples of models are: magnetohydrodynamic (MHD), kinetic, hybrid, and phase space fluid models. The merits and drawbacks of the different approaches are discussed, along with boundary conditions, sources and sinks of ions, and atmospheric models. Then we present some applications of these interaction models to X-ray and energetic neutral atom (ENA) imaging, such as generating simulated images and parameter estimation from observed images. The algorithms developed will be used to analyse ENA images from the Aspera-3 and -4 instruments, constructed at the Swedish Institute of Space Physics (IRF), that will arrive at Mars in 2003 on ESA's Mars Express mission and at Venus in 2006 on Venus Express, respectively.

Tid och plats: Onsdagen den 22 januari kl. 10.15 – 11.00 i rum 4523, Nada, KTH, Lindstedtsvägen 5, plan 5.

PLURIKOMPLEXA SEMINARIET

Nikolay Shcherbina:
Pluripolar graphs are holomorphic

Abstract: Let Ω be a domain in $\mathbf{C}^n$ and let $f\colon \Omega \to \mathbf{C}$ be a continuous function. We prove that the graph $\Gamma(f)$ of the function f is a pluripolar subset of $\mathbf{C}^{n+1}$ if and only if f is holomorphic.

Tid och plats: Tisdagen den 21 januari kl. 10.15 i sal 2145, Matematiska institutionen, Polacksbacken, Uppsala universitet.

MITTAG-LEFFLER SEMINAR

Victor Shubov:
Stability of fluid flows containing solid particles.
Uniform regularity of control systems governed by parabolic equations

Abstract: In this talk, two topics related to stability and control of systems governed by partial differential equations will be discussed.

The first topic deals with stability of fluid (or gas) flows containing suspended solid particles. Investigation of such particles is of a particular interest on the one hand in Atmospheric Sciences, and on the other hand, in electrical power generation industry in connection with the so-called fluidized-bed combustors. The fluid (and, under appropriate conditions, gas) flow is governed by incompressible Navier-Stokes equation. If the size of the solid particles is small and can be neglected, then the flow of particles can be modelled by the Euler equations for an ideal fluid. In the case of large particles, whose collisions must be taken into account, the flow of particles can be modelled by the Boltzmann equation. In both cases, the equations of particle flow and fluid flow are coupled through the Stokes drag law giving a very complicated coupled nonlinear system. The first result, which will be discussed, deals with the case of very small particles. The result is that the presence of such particles has a destabilizing action on the flow. More precisely, if the size of the particles tends to zero while their concentration in the fluid is constant, then the solution of the coupled system of Navier-Stokes and Euler equations converges to the solution of a single Navier-Stokes system with a smaller effective viscosity. This rigorous result provides a justification to known experimental facts. The statement of the problem and open questions in the case of large size particles will also be discussed.

The second part of the talk will be devoted to a particular property of linear control systems governed by parabolic equations. In the abstract theory of infinite-dimensional linear control systems, there is a well-known notion of regular systems. These systems form a general class, whose properties are rich enough to develop a parallel of the theory of systems with bounded control and observation operators. Construction of specific examples of distributed parameter systems, which belong to this class, is an important problem. While for systems governed by hyperbolic equations the problem of regularity is related to open unanswered questions, for parabolic equation this issue is basically clarified.

It will be pointed out in this talk that if input and output spaces are selected in an appropriate manner, then the systems governed by parabolic equations have an additional property of uniform regularity.

Tid och plats: Tisdagen den 21 januari kl. 15.30 – 16.30 vid Institut Mittag-Leffler, Auravägen 17, Djursholm.

PLURIKOMPLEXA SEMINARIET

Christer Kiselman: Implicit-function theorems and fixed-point theorems in digital geometry

Abstract: The integers $\mathbf{Z}$ equipped with the Khalimsky topology is a connected topological space. We shall prove that an equation $f(x, y) = 0$, where $f : \mathbf{Z}^2 \to \mathbf{Z}$ is a continuous function, sometimes admits a continuous solution $g : \mathbf{Z} \to \mathbf{Z}$ such that $f(x, g(x)) = 0$. This implicit function theorem will give rise to a new proof of the Brouwer fixed-point theorem.

Tid och plats: Tisdagen den 21 januari kl. 13.30 i sal 2145, Matematiska institutionen, Polacksbacken, Uppsala universitet.

SEMINARIUM I MATEMATISK STATISTIK

Åke Svensson: Konkurrerande epidemier

Sammanfattning: Vi undersöker vad som händer om två särskiljbara stammar av ett smittämne, som ger immunitet mot varandra, samtidigt sprids i en (sluten) population. Slutresultatet beror på hur snabbt de två stammarna etablerar sig i populationen. Det går att beräkna fördelningen för den relativa andelen av de infekterade som drabbas av vardera infektionen.

Tid och plats: Onsdagen den 22 januari kl. 15.15 i rum 306 (Cramérrummet), hus 6, Matematiska institutionen, SU, Kräftriket.

DOKTORANDKURS I MATEMATIK

Per Sjölin: Fourieranalys

Kursen kommer att behandla Fourieranalys i euklidiska rum. Bland annat kommer följande att diskuteras:

- Konvergens och summabilitet av Fourierserier och Fourierintegraler.
- Interpolation av operatorer.
- Hardy-Littlewoods maximalfunktion.
- Calderón-Zygmund-teori för singulära integraler.
- Fouriermultiplikatorer.
- Littlewood-Paley-teori.

Litteratur:

Stein: *Singular Integrals and Differentiability Properties of Functions.* Princeton University Press.

Katznelson: *An Introduction to Harmonic Analysis.*

Tid och plats: Fredagar kl. 10.15 – 12.00 i seminarierum 3733, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7. Den första föreläsningen äger rum den 24 januari.

Välkomna!

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MITTAG-LEFFLER SEMINAR

David Gilliam:
Small-scale spatial mollifiers with application to output regulation for distributed parameter systems

Abstract: In many important problems in applied mathematics and engineering, it is desirable to use approximate point evaluation sensors, which can also serve to damp high order frequencies of the system. Examples include problems in control of distributed parameter systems and computational fluid dynamics. In this talk we describe three one-parameter families of mollifiers with very special spectral filtering properties. We then describe in some detail an application of the use of these sensors in a problem of output regulation of a distributed parameter, in which the plant is governed by a parabolic partial differential equation and the signals to be tracked and disturbances to be rejected are generated by a distributed parameter system governed by a hyperbolic equation.

Tid och plats: Tisdagen den 21 januari kl. 14.00 – 15.00 vid Institut Mittag-Leffler, Auravägen 17, Djursholm.

FÖRDJUPNINGSKURS I MATEMATIK

Andrzej Szulkin: Elementär differentialgeometri

Föreläsningarna äger rum på onsdagar kl. 10.15 – 12.00 i rum 306, hus 6, Matematiska institutionen, SU, Kräftriket, med början den 22 januari.

Preliminärt kursinnehåll: Kurvor i $\mathbf{R}^3$: krökning, torsion, Frenets formler. Ytor i $\mathbf{R}^3$: första och andra fundamentalformen, tensorkalkyl, Gausskrökning, geodeter, Gauss-Bonnets formel och dess tillämpningar. I mån av tid kommer ytterligare material att gås igenom.

Kurslitteratur: E. Kreyszig: *Differential Geometry,* kap. I – V. Boken finns att köpa i Akademibokhandeln i Frescati.

Vid behov kommer kursen att ges på engelska.

Andrzej Szulkin

DOKTORANDKURS I MATEMATIK

Dan Laksov: Algebraisk geometri (5B5206)

Kurset består av den grunnleggende teorien for algebraiske varieteter. Mesteparten av *klassisk* algebraisk geometri handler om algebraiske varieteter, og de danner fundamentet for de fleste anvendelser av algebraisk geometri i naturvitenskap og i teknikk. Vår fremstilling vil betone videreutviklingen mot skjemaer.

Øvrig informasjon: http://www.math.kth.se/~laksov

Tid: Mandager kl. 15.15 – 17.00. Første gang: 27 januari.

Sal: Seminarierum 3721, Institutionen för matematik, KTH, Lindstedtsvägen 25, plan 7.

Dan Laksov

MITTAG-LEFFLER SEMINAR

John A. Burns:
Distributed parameter control, sensitivity analysis and transition to turbulence

Abstract: The problem of predicting the transition to turbulence in shear flows is a problem with considerable implications in modern fluid dynamics. Classical linear stability analysis fails to predict the correct transition even for simple Poiseuille flows. During the past ten years several new "theories" have emerged to explain this age old problem (see [2], [3], [4], [5], [6]). In addition, this theory has been successful in predicting the correct critical Reynolds number for certain flow problems where classical approaches fail. Unlike the classical approaches to hydrodynamic stability, these new theories are based on concepts with roots in modern robust control theory. The basic idea behind this body of work is that non-normal systems can be extremely sensitive to small perturbations in initial data, inputs and parameters, and these sensitivities can lead to large transient growth even for exponentially stable systems. It has been suggested that this sensitivity might be used to explain the onset of turbulence. This is a "mostly linear" (see [2]) theory. However, even if the linear part of the system is self-adjoint, certain nonlinear systems can be "infinitely sensitive" to parameters and boundary conditions as illustrated by Burgers' equation with Neumann boundary conditions (see [1]). Even though the basic idea behind all these theories is extreme sensitivity, it is not yet clear that any single theory will be able to capture the correct observed physics. In this presentation we discuss this approach to transition and the role that distributed parameter control theory has played in this development. In addition, we discuss some crucial approximation issues and present some open problems.

References

[1] E. Allen, J. Burns, D. Gilliam, J. Hill, and V. Shubov, "The Impact of Finite Precision Arithmetic and Sensitivity on the Numerical Solution of Partial Differential Equations", 2001, submitted.

[2] J. S. Baggett, T. A. Driscoll, and L. N. Trefethen, "A Mostly Linear Model of Transition to Turbulence", *Physics of Fluids* **7** (1995), 833 – 838.

[3] B. Bamieh, "Energy Amplification in Channel Flows with Stochastic Excitation", 1999, submitted.

[4] B. F. Farrell and P. J. Ioannou, "Generalized Stability Theory Part I: Autonomous Operators", *J. Atmos. Sci.* **53** (1996), 2025 – 2040.

[5] B. F. Farrell and P. J. Ioannou, "Generalized Stability Theory Part II: Non-autonomous Operators", *J. Atmos. Sci.* **53** (1996), 2041 – 2053.

[6] L. N. Trefethen, A. E. Trefethen, S. C. Reddy, and T. A. Driscoll, "Hydrodynamic Stability Without Eigenvalues", *Science* **261** (1993), 578 – 584.

Tid och plats: Torsdagen den 23 januari kl. 14.00 – 15.00 vid Institut Mittag-Leffler, Auravägen 17, Djursholm.

MITTAG-LEFFLER SEMINAR

Marianna A. Shubov:
Asymptotic and spectral analysis of an aircraft wing model in subsonic airflow and the problem of flutter control

Abstract: The aircraft wing model, which will be discussed in this talk, has been developed in the Flight Systems Research Center of UCLA in collaboration with NASA Dryden Flight Systems Center. The mathematical formulation of this model has been originally presented in the works by A. V. Balakrishnan. The model has been recently tested in a series of flight experiments at Edwards Airforce Base. The experimental results have shown very good agreement with the theoretical predictions of the model for at least several lowest aeroelastic modes. The objective of the entire wing modelling project is to treat the flutter phenomenon in aircraft wings and to give specific practical recommendations to aircraft industry engineers working on control and suppression of flutter vibrations.

In this talk, I will present the results of my six recent works and of a joint paper with A. V. Balakrishnan devoted to the mathematical analysis of the model. The model is governed by a system of two coupled linear integro-differential equations and a two parameter family of boundary conditions modelling the action of self-straining actuators. The differential parts of the equations of motion form a coupled linear hyperbolic system; the integral parts are of the convolution type. The aforementioned system is equivalent to a single operator evolution-convolution equation in the state space equipped with the energy metric. The Laplace transform of the solution of this equation can be represented in terms of the so-called generalized resolvent operator, which is an operator-valued function of the spectral parameter. This generalized resolvent operator is a finite-meromorphic function on the complex plane having a branch-cut along the negative real semi-axis. Its poles are precisely the aeroelastic modes and the residues at these poles are the generalized projectors on the corresponding eigenspaces.

I will describe the following results:

- Asymptotics of the eigenvalues (ground vibration modes) and eigenvectors (ground vibration mode shapes) of the nonselfadjoint operator, which is a dynamics generator of the differential part of the model. (This part of the model describes the vibrations of the wing when the aircraft is on the ground.)
- Riesz basis property of the generalized eigenvectors of the above operator in the state space.
- Asymptotics of aeroelastic modes and mode shapes for the entire model, describing the wing in a surrounding airflow, i.e., when the aircraft is in flight.
- Riesz basis property of the mode shapes.
- Application of the results of asymptotic and spectral analysis to the representation of the solution to the main initial-boundary value problem in the space-time domain.
- The problem of flutter control will be discussed.

Tid och plats: Torsdagen den 23 januari kl. 15.30 – 16.30 vid Institut Mittag-Leffler, Auravägen 17, Djursholm.