Summer school, August 17-21

Complex analysis and passivity with applications

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KTH Royal Institute of Technology in Stockholm

August 17-21

Complex analysis and passivity with applications

- The summer school on “complex analysis and passivity with applications” is organized by Lund University, KTH, Linnæus University, Stockholm University, and University of Iceland, and will take place at KTH in August 17-21.
- Part of the Swedish Foundation for Strategic Research (SSF), Applied Mathematics project "Complex analysis and convex optimization for EM design". Additional information at `http://www.eit.lth.se/index.php?puid=175&projectpage=projektfakta&L=1`
- The summer school is aimed for PhD students in mathematics, applied mathematics, physics or engineering, as well as for senior researchers with an interest in complex analysis and its engineering/physics applications.
- The objective of the course is to give a multi-disciplinary overview over the field, at the same time as individual students will get an in-depth study of related topics that are central for his/her research.

Learning outcomes

After the course the student shall be able to:

- use analytic function theory to analyze causal and passive systems
- use integral representations for Herglotz functions
- construct Herglotz functions to derive sum rules and physical bounds
- formulate and solve convex optimization problems related to passive systems
- explore and investigate representation theorems of analytic functions for the disc and half planes
- discuss challenges and possibilities with multidimensional complex functions and passive systems

Examination

The examination will be tailored for each participating student by his/her respective examiner/supervisor.
The course is divided into three parts

- Preparation before August 17, see litterature slide at the end.
- One week of lectures at KTH from August 17-21
- Solutions to suggested problems.

Lecturers

LU	Mats Gustafsson and Daniel Sjöberg
KTH	Lars Jonsson
LnU	Sven Nordebo
SU	Annemarie Luger
UI	Ragnar Sigurðsson






The lectures will take place in the seminar room 3428 at KTH on Teknikringen 33, second floor. map

Summer school schedule, August 17-21 2015 at KTH

	Monday	Tuesday	Wednesday	Thursday	Friday
9	Review of complex analysis in one variable and introduction in several variables. Power series expansions, analytic continuation of Fourier and Laplace transforms, and inversion formulas. (RS)	Introduction to the theory of measure and integration. Lebesgue measure and integral on the real line. Complex measures and the Riesz representation formula. Weak convergence of measures. (RS+AL)	Application of measure theory in complex analysis. The Riesz representation formulas for subharmonic functions in the disc and in the upper half plane. Herglotz functions. (RS+AL)	A few concepts from distribution theory. Fourier and Laplace transforms of distributions and analytic continuation. The Paley-Wiener-Schwartz theorem. Inversion formulas. (RS)	Integral representation formulas and Herglotz functions in several variables. (RS+AL)
11					
12					
13	Linear system, causality, passivity, analytic signals, Hilbert transform, Herglotz and positive real functions. Applications. (MG)	Integral identities for Herglotz functions, sum rules, stored energy for passive systems, convex optimization. (MG)	Sum rules and physical bounds for passive systems. Applications in scattering, antennas, absorbers, high-impedance surfaces. (MG)	Convex optimization and approximation of Herglotz functions and passive systems. Disciplined convex programming using CVX. (SN)	Passivity in multidimensional problems. Cones, in $\mathbb{R}^n_+$ and light-cones, implications on sum-rules. Applications. (LJ)
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Literature

Recommended literature to prepare for the course. For participants with a physics and engineering background:

- Arfken, Mathematical Methods for Physicists, sixth edition. Chapter 6 and 7 for an overview of complex analysis.
- King, Hilbert Transforms: Volume 1. Chapter 2 and 3 for an overview of the Hilbert transform and representation theorems.
- Zemanian, Distribution Theory and Transform Analysis: An Introduction to Generalized Functions, with Applications. Chapter 10 for an introduction to passive systems.

For participants with a background in mathematics:

- King, Hilbert Transforms: Volume 2. Chapter 17 to 19.
- Zemanian, Distribution Theory and Transform Analysis: An Introduction to Generalized Functions, with Applications. Chapter 10 for an introduction to passive systems.
- Nussenzveig, Causality and Dispersion Relations.

Literature con't.

Literature **during** the summer course: We will mainly use hand-outs from lecture notes. They contain references to current results and literature. See also:

- Greene and Krantz, Function Theory of One Complex Variable
- Krantz, Function Theory of Several Complex Variables
- Vladimirov, Methods of the Theory of Generalized Functions
- Boyd and Vandenberghe, Convex optimization

Teknikringen 33, room 3428, KTH