Applied Analysis Fall 2008
Topic: Applied Harmonic Analysis

Course Number: 110411

Instructor: Götz Pfander

Course Description: This year's instalment of Applied Analysis will focus on application relevant topics in harmonic analysis. The topics discussed include a self contained discussion of Fourier Analysis on the line and on the torus. We shall then discuss wavelet theory and applications. The third pillar discussed in the course is time-frequency analysis of functions and of pseudo-differential operators. Throughout the course, we shall exhibit the role of representation theory in applied harmonic analysis.

The course is structured as follows.

1. Hilbert spaces, in particular orthonormal sequences and bases, Riesz bases, frames, Plancherel's Theorem
2. Fourier series, pointwise convergence, frames and nonharmonic Fourier series
3. Fourier transform on the line, bandlimited functions, Shannon Sampling Theorem, Poison Summation Formula, uncertainty principles,
4. Brief discussion of harmonic analysis on locally compact abelian groups, the Haar measure.
5. The continuous wavelet transform, ax+b group, orthogonality relation.
6. Orthonormal wavelet bases, multiresolution analysis, Daubechies wavelets, JPEG 2000,
7. Short time Fourier transform and Gabor frames, dual Gabor frames, Schrödinger representation of the Heisenberg Group
8. Pseudodifferential operators, symbolic calculus, Kohn-Nirenberg and Weyl symbols, applications.

Books: "*An Introduction to Frames and Riesz bases*", Ole Christensen
"*Ten lectures on wavelets*", Ingrid Daubechies.
"*A course in Functional Analysis*", John Conway.
"*Foundations of Time Frequency Analysis*", Karlheinz Grochenig
"*An Introduction to Harmonic Analysis"*, Yitzhak Katznelson

Prerequisites: Mathematical preparation as offered through the Analysis 1,2 and the Linear Algebra 1,2 courses offered at Jacobs University. An advanced Analysis course such as "Integration and Manifolds" is helpful but not necessary.

Homework: 5 Homework sets worth 15 points each.

Presentation: Topic presentation including extended abstract of the talk 25 points.

Grade: Depending on percentage of points received.

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