APPLIED MATHEMATICS COLLOQUIUM

SUPER-RESOLUTION METHODS OF SPECTRAL ANALYSIS OF MULTIDIMENSIONAL TIME SIGNALS

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ABSTRACT:

The Discrete Fourier Transform (DFT) is a commonly used numerical method for spectral analysis of time signals. It is also a common belief that the "uncertainty principle", albeit only a property of the finite DFT, is a general principle defining the spectral resolution in terms of the length of the time signal. Apparently, the spectral information can be extracted much more efficiently from the time domain data using so called "Super-resolution Methods." A particular example of such a method is the Filter Diagonalization Method (FDM), a linear algebraic technique for high resolution spectral analysis of time signals. That is, it can provide a higher spectral resolution than the conventional DFT if the data satisfies well the "Lorentzian" (or auto regression) assumption. The extensions of the method to the analysis of multidimensional data and to problems involving the inverse Laplace transform are especially interesting. In the cases of spectral analysis of multidimensional signals, the conventional strategy is to reduce the spectral estimation problem to a series of 1D problems. Apparently, this "simplification" leads to a substantial loss of information as it ignores the correlations possibly present in the multidimensional data. FDM avoids the 1D factorizations and as such is a truly multidimensional approach.

FDM found many applications in conceptually diverse areas of Physics and Chemistry, in particular, in the area of Nuclear Magnetic Resonance (NMR) experiments.

MONDAY, NOVEMBER 6, 2006
4:30 PM
Building 2, Room 105

Refreshments at 4:00 PM in Building 4, Room 174
(Math Majors Lounge)

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