

WICHITA STATE UNIVERSITY

Department of Mathematics and Statistics
& College of Engineering

Present a Jointly Sponsored Lecture by:

Prof. Graeme Milton

University of Utah

*" Using Analyticity to Check the Consistency of
Experimental Measurements "*

Abstract:

Experimental measurements often give the real and imaginary parts of the complex dielectric constant or magnetic permeability (or the bulk and shear moduli of viscoelastic materials) as a function of frequency. It is well known that the real and imaginary parts are Hilbert transforms of each other, with respect to frequency. These relations, known as the Kramers-Kronig dispersion relations, have a long history dating back to 1926 and have proved to be an invaluable tool for interpreting data. Such dispersion relations are prevalent throughout physics and derive from the causal nature of the response of materials, bodies or particles to electromagnetic, elastic or other fields. The dispersion relations require measurements over the entire frequency range from zero to infinite frequencies. Here we present dispersion inequalities that provide for a analysis of data known only over a finite range of frequencies. These inequalities generalize the Kramers-Kronig relations, providing bounds on the combinations of data values that are permissible over the measured frequency interval. They can provide highly accurate interpolation formulas for the real part, given its value at a few selected frequencies and given the imaginary part over a range of frequencies. We illustrate the practical utility of the bounds as applied to high frequency transmission line measurements of the complex relative magnetic permeability of a composite made with equal parts (by volume) of barium titanate and a magnesium-copper-zinc ferrite.

For viscoelasticity we obtain even tighter bounds by assuming the complex bulk and shear moduli derive from a relaxation model.

This is joint research with David Eyre, Joe Mantese and Roderic Lakes.

Friday, December 13, 2002

3:00 PM in 372 Jabara Hall

*Please come join us for refreshments before the lecture
at 2:30 p.m. in room 353 Jabara Hall.*