

# MATHEMATICS COLLOQUIUM

## *Application of Spherical Harmonics and Complex Variables to Determine Bounds on Antenna Performance*

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In modern communication systems there is a need for antennas that exhibit good performance over a wide bandwidth (range of usable frequencies). There is not currently any synthesis procedure that one can use to design an optimum antenna (maximum bandwidth for a given size, or minimum size for a given bandwidth). However, it is possible to determine upper bounds on the maximum bandwidth for a given size, which are useful for evaluating potential designs.

For cases where the antenna size is constrained to fit within a given spherical region, the the electromagnetic fields external to the region can be expressed in terms of wave functions, each of which is a product of a spherical Hankel function of the second kind, Legendre polynomial, and harmonic function. The complex wave impedance for each function can be expressed as continued fraction, which leads to an exact analogy to a finite electrical circuit.

Bounds on bandwidth can then be determined by applying results from circuit theory, in particular Fanos formulation. Fanos method uses Cauchys integral relations to give a series of constraints the bandwidth must obey. Until recently, this approach has not been brought to a useful numerical result except in unrealistically simple cases, however, with the help of Dr. Villalobos in the UTPA math department, useful results are now available.

Date: Monday, November 13, 2006  
Time: 3:00pm-4:00pm  
Place: J. Wiener Lecture Hall, MAGC 1.302

Refreshments will be served at 2:50pm.

For further information or for special accommodations, contact Dr. Karen Yagdjian at 381-2145, via email at [yagdjian@utpa.edu](mailto:yagdjian@utpa.edu), or visit [www.math.panam.edu/colloquia.html](http://www.math.panam.edu/colloquia.html)