Department of Mathematics
Analysis Seminar
Spring 2006

Wednesday, February 15, 2006
10 - 11 AM
Alavi Commons Room

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The coneigenvalues of a matrix as the second set of its eigenvalues

According to 'Matrix Analysis' by R. Horn and C. Johnson, λ is a coneigenvalue of a matrix $A \in \mathbb{C}^{n\times n}$ if there exists a nonzero vector $x \in \mathbb{C}^n$ such that $A\overline{x} = \lambda x$. Coneigenvalues defined in this way may exist if and only if $\overline{A}A$ has real nonnegative (ordinary) eigenvalues. If A does have coneigenvalues, there are always infinitely many of them. Here we adopt a different definition that provides any matrix $A \in \mathbb{C}^{n\times n}$ with a set of exactly n coneigenvalues (counting multiplicities). Based on this definition and on the concept of a coninvariant subspace, we attempt to derive a coherent theory that incorporates the most important facts related to unitary congruence transformations, such as the Youla theorem, normal forms for symmetric and conjugate-normal matrices, and so on. A number of new facts on conjugate-normal matrices are obtained in the course of this construction. For example, we characterize conjugate-normal matrices as unitary congruence images of real normal matrices; in particular, this implies that the singular values of a conjugate-normal matrix are the moduli of its coneigenvalues.

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