4:00 PM, MONDAY, APRIL 9, 2007, BOYD 304

Speaker: **Prof. Sergei Avdonin**, Department of Mathematics, University of Alaska, Fairbanks, Alaska

Title: **Families of Exponentials in Control Theory and Signal Processing**

Families of 'nonharmonic' exponentials $\left\{e^{i\lambda_n t}\right\}$ appear in various fields of mathematics and signal processing. One of the central problems arising in all of these applications is the question of the Riesz basis property of an exponential family. For $L^2(0,T)$, this problem was considered for the first time in the classical work of R. Paley and N. Wiener (1934), and since then has motivated a great deal of work by many mathematicians. The problem was ultimately given a complete solution on the basis of an approach suggested by B. Pavlov (1979).

The theory of nonharmonic Fourier series was successfully applied to control problems for distributed parameter systems and formed the base of the powerful method of moments. This method is based on properties of exponential families (usually in $L^2(0,T)$), the most important of which for control theory are minimality, the Riesz basis property, and also the $\mathcal{L}$-*basis* property. The latter is defined to mean a Riesz basis in the closure of its linear span.

Recent investigations into new classes of distributed systems such as hybrid systems and structurally damped systems have raised a number of new difficult problems in the theory of exponential families. One of them is connected with the properties of the family $\mathcal{E} = \left\{e^{i\lambda_n t}\right\}$ in the case when the set $\{\lambda_n\}$ does not satisfy the separation condition, and therefore $\mathcal{E}$ does not form a Riesz basis in its span in $L^2(0,T)$ for any $T > 0$. In this case we meet the problem of obtaining a description of Riesz bases of elements which are 'simple and natural' linear combinations of exponentials.

We describe Riesz bases of exponential divided differences and their applications to problems of simultaneous control of elastic strings and beams. Connections between Control Theory and Sampling Theory of band-limited and multi-band signals will be also discussed.

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