Princeton University
Department of Electrical Engineering

Information Sciences and Systems (ISS) Seminar

Speaker: Rene Vidal
Johns Hopkins University

Date: Wednesday, November 8, 2006

Time & Location: 4:30 pm ~ Room B205 ~ EQuad

Title: Binet-Cauchy Kernels on Dynamical Systems

Abstract:
The past few years have witnessed an increasing interest in the application of system-theoretic techniques to modeling visual dynamical processes. However, in practical applications we may not only be interested in obtaining a model for the process (identification problem), but also in determining whether two video sequences correspond to the same process (classification problem) or identifying which process is being observed in a given video sequence (recognition problem).

In this talk, we propose a family of kernels explicitly designed for dynamical systems. More specifically, we propose to compare two dynamical systems by computing traces of compound matrices from system trajectories. The Binet-Cauchy theorem is then invoked to show that such traces satisfy the properties of a kernel. In the case of linear time-invariant systems, we derive explicit formulae for computing the proposed Binet-Cauchy kernels by solving Sylvester equations, and relate the proposed kernels to existing kernels based on cepstrum coefficients and subspace angles.

Finally, we show how the proposed kernels can be used to classify dynamic textures and segment dynamic scenes by modeling them as ARMA models and computing kernels on the ARMA models. Experimental evidence shows the superiority of our kernels in capturing differences in the dynamics of video sequences.

Brief Biography:
Professor Vidal received his B.S. degree in Electrical Engineering (highest honors) from the Pontificia Universidad Catolica de Chile in 1997 and his M.S. and Ph.D. degrees in Electrical Engineering and Computer Sciences from the University of California at Berkeley in 2000 and 2003, respectively. He was a research fellow at the National ICT Australia since September 2003 and joined The Johns Hopkins University in January 2004 as an Assistant Professor in the Department of Biomedical Engineering and the Center for Imaging Science. His areas of research are biomedical imaging (DTI registration and clustering, heart motion analysis), computer vision (segmentation of static and dynamic scenes, multiple view geometry, omnidirectional vision), machine learning (generalized principal component analysis GPCA, kernel GPCA, dynamic GPCA), vision-based coordination and control of unmanned vehicles, and hybrid systems identification and control.

Dr. Vidal is recipient of the 2005 NFS CAREER Award and the 2004 Best Paper Award Honorable Mention (with Prof. Yi Ma) for his work on "A Unified Algebraic Approach to 2-D and 3-D Motion Segmentation" presented at the European Conference on Computer Vision. He also received the 2004 Sakrison Memorial Prize for "completing an exceptionally documented piece of research", the 2003 Eli Jury award for "outstanding achievement in the area of Systems, Communications, Control, or Signal Processing", the 2002 Student Continuation Award from NASA Ames, the 1998 Marcos Orrego Puelma Award from the Institute of Engineers of Chile, and the 1997 Award of the School of Engineering of the Pontificia Universidad Catolica de Chile to the best graduating student of the school.