Department of Electrical and Computer Engineering
University of California, San Diego

SPECIAL SEMINAR FR

Dr. Amit Roy Chowdhury
University of Maryland

Wednesday, March 6, 2002
1:30-2:30 P.M.
EBU1, Room 4307

ESTIMATING THE 3D WORLD FROM VIDEO - AN INTERPLAY OF STATISTICS AND GEOMETRY

ABSTRACT
Reconstructing a 3D scene from a video sequence is an important problem with numerous applications in multimedia, video communications, medical imaging, automatic navigation, surveillance, and many others. One of the most powerful techniques for solving this problem is to estimate the motion between successive frames of the video sequence and then reconstruct the 3D structure of the scene that was imaged. Successful solution of this problem requires a detailed understanding of the geometry of the 3D world and its 2D projections on the image planes. However, practical algorithms, that consider only the geometry of the problem, often give unsatisfactory solutions due to errors in the motion estimates between frames. Hence, in order to obtain a satisfactory solution, it is important to understand the statistics of the errors and their interaction with the geometry of the problem. In this talk, we will pose the 3D reconstruction problem in an estimation-theoretic framework. We will show how the statistics of the errors in the input motion estimates are propagated through the 3D reconstruction algorithm and affect the quality of the output. We present a new result that we have derived: the 3D estimate is always statistically biased, and the magnitude of this bias is significant. We have considered the question of how to automatically evaluate the quality of a 3D reconstruction from a video sequence, and we will present one of our ideas which uses concepts from information theory. In order to demonstrate the effect of this analysis in a practical application, we will consider the problem of reconstructing a 3D model of a human face from a video, and propose an algorithm that obtains a robust 3D estimate using stochastic approximation theory and a Markov chain Monte Carlo optimization procedure. The overall aim of the presentation will be to show that in order to obtain accurate 3D estimates from a video sequence, it is important not only to understand the geometry of the problem but also its statistical aspects.

About the Speaker
 Amit K. Roy Chowdhury is completing his Ph.D. in the Department of Electrical and Computer Engineering, at the University of Maryland, College Park, where he has been since 1998. He is also affiliated with the Center for Automation Research, University of Maryland Institute for Advanced Computer Studies. He received his BE and ME degrees in 1995 and 1997 respectively, both in Electrical Engineering. He has worked in the signal processing and multimedia group in Motorola, India and at their Corporate Research Labs, Chicago. He has also worked at NEC Research Institute, Princeton and Hughes Research Labs, Malibu as a summer intern. His research interests are in stochastic modeling in signal, image and video processing, statistical pattern recognition and computer vision, and multimedia communications.