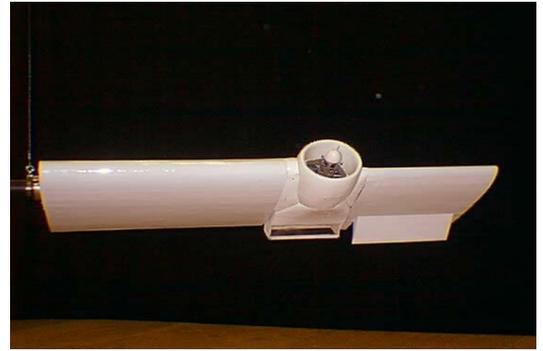# The Department of Innovation Engineering
Università del Salento, 2007 Seminar Series

presents

High Performance Maneuvering
for Thrust Vectoring Aircraft
Professor John Hauser
University of Colorado
Thursday, June 28th 2007, 3.30pm - 4.30pm, Aula O2

On 12 Jun 99, ``both crew members of the prototype vectored-thrust Sukhoi Su-30MKI multi-role fighter survived a spectacular minimum-altitude ejection without injury when it crashed on the Le Bourget airfield ... the pilot was seen to attempt a maximum rotation recovery ... using full 2D TVC. Most eye-witnesses agree that he was almost successful in his attempted recovery ...'' [AVweek] The Sukhoi that crashed at the June 99 Paris Air Show had impressive levels maneuverability and agility. Even still, one of the most highly skilled (thrust vector) pilots was unable to fully recover the aircraft. Either the aircraft was not recoverable or the pilot was unable to extract the needed level of available maneuvering performance.

A century of piloted flight has taught us many lessons in the design and control of high performance flight vehicles. However, little of this experience is useful when we radically modify the design of an aircraft system. It appears that we still have much to learn in obtaining maximum maneuvering performance. Further difficulties are to be expected as we move toward more autonomy. We are working to develop high performance maneuvering capabilities for new aircraft configurations as may be employed in both piloted and uninhabited flight (UAV). Through the use of optimization, both online and offline, we seek to understand and exploit aircraft capabilities, providing guaranteed regions of operation. These techniques have been developed and tested on the Caltech Ducted Fan experiment configured effectively as a flying wing with thrust vectoring. Videos of the maneuvering capabilities of such vectored thrust flying wings will be presented. Also, in June 2004, we demonstrated the in-flight use of online optimal control on a (full scale) T-33 Shooting Star flying (as an autonomous wingman) in formation with an F-15 Eagle over the California desert.

John Hauser received the BS degree from the United States Air Force Academy in 1980 and the MS and PhD degrees from the University of California at Berkeley in 1986 and 1989. From 1980 to 1984, he flew Air Force jets throughout the US and Canada participating in active Air Defense exercises. In 1989, he joined the Department of EE-Systems at the University of Southern California as the Fred O'Green Assistant Professor of Engineering. Since 1992, he has been at the University of Colorado at Boulder in the Electrical and Computer Engineering and Aerospace Engineering Sciences. He has held visiting positions at Lund Institute of Technology and Ecole Superieure d'Electricite (LSS), Caltech, and the University of Padova. His research interests include nonlinear dynamics and control, optimization and optimal control, aerospace applications, high performance motorcycle maneuvering.

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