# MMAE SEMINAR

**MONDAY, FEBRUARY 15, 2010**
**E-1 BUILDING – CRAWFORD AUDITORIUM**
**3:30 – 4:30 PM**

## Recent Developments in Flow Control of Separation and Circulation and their Impact on Improved Aerodynamic Performance

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### Abstract

After a couple of decades of intensive basic research in Active Flow Control (AFC), the aerospace industry is now receptive to conducting demonstrations to explore the potential (feasibility, affordability and performance) of these techniques for a wide range of aircraft such as the ATT, V-22, QTR, XV-15, as well as various Advanced Rotorcraft and Unmanned Air Vehicles (UAV). Zero-net mass flux oscillatory jets introduced from span wise slots at various locations on the upper surface of steady and oscillating airfoil models are shown to be effective in controlling lift, moment and drag coefficients over the range of Mach numbers over 0.4. This control is demonstrated over a wide range of mean angles of attack from light to deep stall conditions on several airfoil cross sections with and without flaps. With non-dimensional frequency and amplitude of the forcing unchanged, we find comparable modifications of the aerodynamic coefficients throughout this Mach number range. Near the higher end of this Mach number range, local supercritical conditions are experienced near the leading edge and shocks are present. Even in these cases the flow control was found to be effective with slot positions near the location of the shock. Therefore, it appears that this active flow control technique is only limited by the ability to generate the adequate forcing conditions at the higher Mach numbers required for applications such as rotorcraft, and aircraft requiring high lift for short takeoff and landing or controllable drag for rapid maneuverability. The presentation will focus on the flow physics in the regions where the control is introduced and on the scaling of the control parameters, and explain why we have emphasized open loop control so far.

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Professor Nagib is the John T Rettaliata Distinguished Professor of Mechanical and Aerospace Engineering at the Illinois Institute of Technology, Chicago, Illinois, and the Founding Director of the Institute's Fluid Dynamics Research Center. His field of specialty is in fluid mechanics, turbulent flow and flow management and control. Professor Nagib is the recipient of a number of prestigious honors including being a Fellow of the American Physical Society, the American Association of Advancement of Science, the American Institute of Aeronautics and Astronautics, and the American Society of Mechanical Engineers.