AEROSPACE & MECHANICAL ENGINEERING

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UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: **Ralph J. Volino**
Mechanical Engineering Department
United States Naval Academy
Annapolis, Maryland

TOPIC: **UNSTEADY FLOW AND FLOW CONTROL IN TURBOMACHINERY APPLICATIONS**

DATE: Thursday, March 25, 2010

TIME: 3:30 p.m.

PLACE: 126 DeBartolo Hall

ABSTRACT

The flow through gas turbine engines is inherently unsteady due to the rotation of airfoil stages with respect to each other. A stationary vane, for example, sheds wakes which impinge on the rotor blades passing downstream. The blades in turn create varying amounts of flow blockage as they move across the passages between the vanes. The periodic pressure, velocity and turbulence fluctuations which result can have a strong effect on both aerodynamic performance and heat transfer. In this seminar, two unsteady flows will be considered. In the first, a surface is film cooled with pulsed jets and subject to periodic wakes from upstream rods. In typical experimental studies the film cooling jets are steady, but in engines periodic pressure fluctuations cause the jets to pulse. Pulsing might also be induced deliberately in an attempt to reduce cooling flow requirements and control jet liftoff. Detailed, time-resolved flow temperature measurements show the unsteady behavior of the jets and their response to wakes. Time averaged surface temperature measurements show the effect of pulsing and wakes on the film cooling effectiveness and heat transfer coefficient. In the second study, the flow through a cascade of very high lift low-pressure turbine airfoils is considered. Unsteady wakes are produced with moving upstream rods. Without flow control the high loading results in massive boundary layer separation at low Reynolds numbers. Separation control is accomplished with a row of pulsed vortex generator jets on the suction surface of each blade. If the pulsing frequency is sufficiently high, separation can be suppressed using very low jet mass flow, even at the lowest Reynolds numbers considered. Total pressure measurements show the effect of the jets on profile loss, and instantaneous velocity measurements show the response of the suction surface boundary layer to wakes and flow control during the pulsing cycle.

NOTE: ***If you are interested in meeting individually with Prof. Volino, please contact Evelyn at 631-5431***