AEROSPACE & MECHANICAL ENGINEERING

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UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: **Dr. Victor Maldonado**
Postdoctoral Research Associate
The National Wind Resource Center
Lubbock, Texas

TOPIC: **SUSTAINABLE AERODYNAMIC SYSTEMS**

DATE: Tuesday, March 05, 2013

TIME: 3:30 p.m.

PLACE: Lower Level Auditorium, Geddes Hall

RECEPTION: 3:00 – 3:30 p.m. – Coffee House, Geddes Hall

ABSTRACT

The need for technical solutions to our environmental, social, and economic challenges is greater than ever. This seminar will focus on the currently unsustainable paradigms of *wind energy production* and *passenger air travel*. Presented are some novel developments in *flow control* to enhance the aerodynamic and aeroelastic performance of airfoil sections, which can increase the performance of wind turbines and aircraft and help reduce the environmental impact of these systems.

Wind turbine blade models based on the NACA 4415 and NREL S809 airfoils were fabricated and embedded with arrays of piezoelectric disk-based synthetic jet actuators and tested in a wind tunnel. Utilizing this technique, several crucial characteristics relevant to increasing the performance of airfoils during stall were displayed: (i) a delay in the stall angle of attack with a corresponding increasing in the maximum lift coefficient, and (ii) a significant reduction in the structural vibration of the blade. The latter is perhaps of most interest to the Wind Energy industry; the continued growth of wind turbine blades creates increasingly large unsteady loads and structural vibration which cause fatigue hub stress and may make premature blade breakdown a more common occurrence. More recent investigations at the *NWRC* into the emerging flow control sub-field of bio-inspired drag reduction has found its way into wind turbine blades (and potentially many aerodynamic systems) in a big way. High fidelity load cell measurements on an S809 airfoil section covered with a novel micro-structured surface have indicated up to a *40% baseline drag reduction* at low Reynolds numbers and angles of attack.

The last part of this talk will feature a novel flow control actuator, called the *Electromagnetic Synthetic Jet* (EMSJ) actuator aimed at bringing the performance enhancement of flow control from the laboratory to full-scale aerodynamic systems. Such an endeavor is proposed around the *TransAtlantic Green Aircraft Research Platform*; a unique sustainable 'green' aircraft design envisioned to make an impact in the important field of 'Green' Aviation. The Aviation industry currently accounts for about 3% of global CO_2 emissions, and is the fastest growing form of CO_2 pollution in the transportation sector.

NOTE: ***If you are interested in meeting individually with Dr. Maldonado, please contact Linda at 631-5431***