

# DEPARTMENT OF MECHANICAL ENGINEERING

## COLLOQUIUM SEMINAR SERIES



### **High-Fidelity Numerical Experiments in Low-Re Airfoil Unsteady Aerodynamics, Acoustics and Flow Control**

**Dr. Vladimir Golubev**

**Professor of Aerospace Engineering**

**Director, Propulsion and Aerodynamics Computational Laboratory**

**Embry-Riddle Aeronautical University**

**Daytona Beach, Florida, USA**

We report on a series of benchmark high-fidelity numerical studies investigating various forms of low-speed airfoil unsteady responses in non-uniform flow, and means for their control.

The first part of the talk discusses selected results of long-term collaborative work with the Air Force Research Laboratory on micro air vehicles (MAV) behavior in gusty environments. The flight path of an aircraft in an urban canyon is often characterized by sudden crosswinds and turbulent drafts that may have a particularly strong effect on small vehicle aerodynamics and overall flight stability. Development of efficient flight control strategies should benefit from high-fidelity studies elucidating airfoil responses to various types of flow disturbances characteristic of such unsteady environments. To this end, we propose several deterministic and non-deterministic canonical forms of impinging flow disturbances and examine their effect of unsteady aerodynamic, aeroelastic and aeroacoustic responses. For a transitional airfoil, we particularly focus on complex nonlinear resonant phenomena such as flow-acoustic feedback-loop interactions and their effect on the airfoil response.

The second part of the presentation is devoted to studies of the airfoil flow control using distributed arrays of synthetic-jet micro-actuators. We show that micro-jets may produce significant impact on boundary-layer vorticity dynamics and thus on aerodynamic and even acoustic responses. Furthermore, these studies are now expanded to include analysis of heated actuation effect on airfoil icing control, and we present preliminary results of these studies conducted in collaboration with McGill University's CFD Lab.

**DATE:** Wednesday, February 20, 2013  
**TIME:** 2:00 - 3:00pm  
**LOCATION:** Macdonald Engineering Bldg, RM 267



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#### **BIOSKETCH**

**Dr. Golubev** is a tenured Professor at the Department of Aerospace Engineering of Embry-Riddle Aeronautical University. He joined the school in 2001 following a 3-year industrial engineering research experience at the Trane Co. His primary research interests include high-fidelity numerical analyses of unsteady flow-structure interactions with focus on applications in aerodynamics, aeroacoustics, propulsion and flow control. He developed computational high-fidelity prediction analyses also applied to other disciplines such as financial engineering. At Embry-Riddle, Dr. Golubev is the founding Director of ERAU Propulsion and Aerodynamics Computational Laboratory. He now leads an interdisciplinary Computational Aero Propulsion Group of multi-university Florida Center for Advanced Aero Propulsion combining faculty and students from different academic programs and collaborating in multi-disciplinary areas of Flow, Flight and Propulsion Control of Micro-Air Vehicles, with focus both on fundamental and applied science of MAV operation in gusty urban environments. Dr. Golubev authored over 60 refereed journal and conference publications and was a Keynote speaker at several engineering meetings. His research efforts are currently supported by NSF, Air Force Research Laboratory, Air Force Office of Scientific Research, Florida Center for Advanced Aero Propulsion, and United Launch Alliance. He has been a member of AIAA Aeroacoustics Technical Committee since 2005, and served as organizer and co-organizer of two AIAA Aeroacoustics meetings and numerous conference sessions. Dr. Golubev is an AIAA Associate Fellow, and has served for several years as the Air Force/ASEE and NASA Summer Faculty Fellow. Dr. Golubev is the 2011 recipient of ERAU Outstanding Researcher Award.

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**McGill**