



OIST SEMINAR

Date: March 27th, 2017 (Mon)
Time: 3:00 pm – 4:00 pm
Venue: D015 (Lab1, Level D)
Speaker: Professor Fernando Ponta
(Michigan Technological University)

Analyzing the Aeroelastic Dynamics of Wind Turbine Rotors in Rapid Pitch-Control Actions

Abstract

Pitch control comprises a significant proportion of current wind turbine load-control approaches. Collective pitching is used in restricting the overall power generation at high winds, whereas individual pitching has the added advantage of mitigating cyclic loads that are detrimental in fatigue damage of the turbines. Currently, there are many studies on conventional pitching control that account for long-term variations in wind speeds and associated high loads, but a smaller number of studies in short-term pitch action.

The present study focuses on the use of rapid pitch control for handling short-term variations in wind conditions and load fluctuations within the cycle of rotation, with special attention to the prognosis of the aeroelastic response of the rotor. We use a numerical model capable of handling the complexities of the multiphysics dynamics of the wind rotor behavior. Based on a nonlinear adaptive ODE algorithm, it provides a natural way to integrate the various multi-physics aspects of wind turbine dynamics, including the control system and the coupled response of the aerodynamics and the structural deformation of the rotor. Results are presented for the case study of the NREL-5M Reference Wind Turbine, and their significance for wind-turbine rotors in general is discussed.

BIO-SKETCH:

Fernando Ponta, the Richard and Elizabeth Henes Endowed Professor in Wind Energy at the Department of Mechanical Engineering - Engineering Mechanics, Michigan Technological University, earned his engineering degree and PhD at the University of Buenos Aires. Before coming to Michigan Tech in 2007, he was for three years a Postdoctoral Fellow in Theoretical and

Applied Mechanics at the University of Illinois at Urbana-Champaign. Dr. Ponta's area of expertise is in theoretical and computational continuum mechanics, vortex dynamics, and advanced numerical methods for fluid-structure interaction analysis; especially as they apply to the study of wind-turbine aeroelastic dynamics, and other energy systems utilizing renewable sources. His research has resulted in more than 70 peer-reviewed articles and book chapters. Dr. Ponta has been awarded a 2010 Faculty Early Career Development Award from the National Science Foundation to help reduce the uncertainties related to wind turbine blade dynamics. He was also awarded the Gold Medal for Best Scientific Paper, at the Fifth World Renewable Energy Congress (Florence, Italy, September 1998), for a work in innovative wind-power concepts.



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