



BIG energy seminar series

Addressing the scale and complexity of the global energy challenge.



MODELING, MONITORING AND CONTROL OF WIND TURBINE DRIVE-TRAINS

Jaspreet Singh Dhupia

Assistant Professor at the School of Mechanical and Aerospace Engineering
Nanyang Technological University - Singapore

Tuesday, October 23rd, 2012

3:30 p.m. at Engineering Center - ECEE 1B32

Summary:

The wind turbine drive-train is an integral part of the turbine that converts rotational kinetic energy from the wind to electrical energy. Ensuring reliable and robust operation of the drive-train necessitates developing an accurate dynamic response model that includes its aero-dynamic interaction with the wind, torsional and translational responses of its mechanical components, as well as electro-mechanical interaction at the generator. This presentation will describe a high-fidelity lumped mass model of the wind turbine drive-train, which is integrated with FAST, an openly available aero-elastic code developed by the National Renewable Energy Laboratory (NREL). This wind turbine drive-train model will be investigated for its dynamic response, and implications of the obtained results on controller design and safe operation of the turbine will be discussed. The drivetrain model will be extended to investigate the effects of drive-train faults, such as broken gear teeth, on the dynamic response of the drive-train. Currently, the vibration based monitoring of gearboxes is most well-studied because of the ease of measurement from the stationary sensor attached to the gearbox housing. However, the vibration spectrum obtained from a planetary gearbox, which is widely employed in wind turbine drive-trains, can be fairly complex due to the relative motion of the planet gears with respect to the stationary sensor attached to the gearbox housing. A geometry-based analytical model will be presented that allows for an understanding of the complex vibration spectrum measured by fixed sensors attached to the stationary ring gear. This analytical model allows prediction of the frequency locations where dominant response is located for healthy gearbox operation, as well as, for operation of gearbox with local faults such as broken, pitted, or worn teeth. In the case of wind turbines, the voltage/ current measurements from generators are readily available and thus can be used for monitoring applications. Finally, we will investigate the effect of gearbox faults on the voltage/ current measurements from the generator.

Short Bio:

Jaspreet Singh Dhupia is an Assistant Professor at Nanyang Technological University, Singapore since July 2008. Prior to that, Prof. Dhupia graduated with a PhD and MS in Mechanical Engineering from the University of Michigan, Ann Arbor, and a B.Tech. from Indian Institute of Technology, Delhi. His doctoral research was carried out at the Center for Reconfigurable Manufacturing Systems funded by National Science Foundation. Currently, his research activities are funded by several government and industrial organizations in Singapore, which include the Ministry of Education, Maritime Port Authority, Rolls-Royce Singapore Pte. Ltd., and ABB Singapore Pte. Ltd. His research focuses on drive-train controls, monitoring, and modeling for different applications, such as ships, aircraft, and wind turbines.

Campus Map: <http://www.colorado.edu/campusmap/map.html?bldg=EC&x=8&y=13>