UCF DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCEINCE

Spring 2015 Seminar Series

Presented by the ECE Division

MAGNETIC GEARBOXES AND ELECTRODYNAMIC WHEELS

FRIDAY MARCH 20, 2015

2:00 PM – HEC 450

In this presentation I will discuss two exciting research topics: (1) magnetically geared electrical machines for wind and ocean power generation applications and (2) maglev vehicle transportation using electrodynamic wheels.

A magnetic gearbox enables a contactless mechanism for speed amplification to be achieved. A magnetic gearbox does not require gear lubrication and has the potential for high conversion efficiency. A magnetic gearbox also has inherent overload protection since the magnetic poles will simply slip rather than mechanically break when overloaded. Although magnetic gearboxes have become an active research topic within academia they have so far not attracted that much commercial interest. This is most likely due to their cost and still untested capabilities. In order to greatly reduce their cost the volumetric and mass torque density capabilities of the magnetic gearbox needs to be significantly increased. In this presentation a summary of the experimental and theoretical analysis of magnetic gearboxes that I have conducted in my laboratory will be presented. Experimental results that demonstrate the capability to greatly improve on prior-art magnetic gearbox designs will be presented.

The second research topic that will be discussed involves looking at a new low-cost means of creating high-speed maglev (magnetic levitation) transportation. When magnets are electromechanically rotated above a conductive non-magnetic guideway, eddy-currents are induced that can simultaneously create lift and thrust force. This thrust force creation is analogous to how the wheels of an automobile use friction to create traction. The magnetic rotor that is used to create these non-contact magnetic forces has been termed an Electrodynamic Wheel (EDW). This presentation will outline the 3-D eddy-current modeling that has been conducted and the experimental test vehicles that have been built to investigate the performance potential of using EDWs for high-speed ground transportation.

DR. JONATHAN BIRD

University of North Carolina at Charlotte

Jonathan Bird obtained his B.E. (1st Class Hons.) from the University of Auckland, New Zealand, in 2000 and his M.S. and Ph.D. from the University of Wisconsin-Madison in 2004 and 2006 respectively. From 2006 to 2008 he was a senior design engineer at General Motor's Advanced Technology Center in Torrance, CA. Since 2009 he has been an Assistant Professor at the University of North Carolina at Charlotte (UNCC).

Professor Bird's research areas are at the intersection of applied electromagnetics, mechanics and controls. His graduate work involved investigating the performance capabilities of an electrodynamic wheel for high-speed ground transportation applications. While at General Motors, Dr. Bird designed high torque density induction and interior permanent magnet motors for hybrid and fuel-cell vehicle applications. Since joining UNCC Dr. Bird has been continuing his research into the use of electrodynamic wheels as well as investigating the capabilities of magnetically geared electrical machines. Dr. Bird has authored or coauthored over 40 peer reviewed papers in major journals and conferences. Dr Bird's research has been funded by the Department of Energy, the National Science Foundation, NASA and the North Carolina Coastal Studies Institute.