Attitude Control and Estimation using the Rotation Matrix Directly

Thursday, September 24, 2015
4:00 p.m. | 202 Reed McDonald Building

Abstract
Spacecraft are critically reliant on a reliable control system and an accurate attitude estimate for operation. For instance, in order to slew and point an imager or antenna onboard a spacecraft, noisy sensor data must be fused together into an attitude estimate that is in turn used within an attitude control strategy. This talk will focus on recent developments in attitude estimation and control. First, attitude control will be considered. In particular, vector and rate measurements will be used directly within a rotation-matrix-based control law realizing a simple yet effective control law suitable for micro- or nano-satellites. Second, deterministic SO(3)-based attitude estimation will be discussed. An estimator with a structure similar to Poisson’s Equation and superior convergence properties compared to similar SO(3)-based estimators found in the literature will be presented. Estimating the rotation matrix (an element of SO(3)) directly is the motivation by the deficiencies of all attitude parameterization (e.g., non-uniqueness and kinematic singularities).

James Richard Forbes was born in southern Ontario, Canada. James received his B.A.Sc. in Mechanical Engineering (Honours, Co-op) from the University of Waterloo in 2006. While attending the University of Waterloo James participated in the co-op program; James had the opportunity to work in the manufacturing, automotive, rail, and industrial automation (robotics) industries. James was awarded his M.A.Sc. and Ph.D. degrees in Aerospace Science and Engineering from the University of Toronto Institute for Aerospace Studies (UTIAS) in 2008 and 2011, respectively. He was awarded the G. N. Patterson Award for the most outstanding Ph.D. thesis in 2011. From May 2011 to August 2013 James was an Assistant Professor of Mechanical Engineering at McGill University located in Montreal, Quebec, Canada. From September 2013 to July 2015 James was an Assistant Professor of Aerospace Engineering at the University of Michigan. In August 2015 James returned to McGill as an Assistant Professor of Mechanical Engineering. The focus of James’ research is linear and nonlinear control theory with applications to mechanical, aerospace, and robotic systems.

Refreshments will be served at 3:45 p.m. | Hosted by Suman Chakravorty