
Date: October 16, 2007
Time: 2:00 pm – 3:30 pm
Room: SL 165

Everyone is invited

Sliding Mode Observer and Long Range Prediction Based Fault Tolerant Control of a Steer-By-Wire (SBW) System

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Abstract. This thesis presents a nonlinear observer and long range prediction based analytical redundancy for a Steer-By-Wire (SBW) system. A nonlinear full state Sliding Mode Observer (SMO) was designed to estimate the vehicle body side slip angle and the steering angle by using the combined linearized vehicle model, SBW system and the yaw rate as model input. The estimated steering angle along with the road wheel motor current input was used to predict the steering angle at various prediction horizons by a long range prediction methodology. An analytical redundancy methodology was utilized to reduce the total number of redundant Road-Wheel Angle (RWA) sensors in a triply redundant RWA-based SBW system, while maintaining a high level of reliability. The Fault Detection, Isolation and Accommodation (FDIA) algorithms were developed using the majority voting scheme, which was then used to detect faulty sensor(s) in order to maintain safe drivability. The proposed observer-prediction based FDIA algorithms as well as the linearized vehicle model were modeled in MATLAB SIMULINK. This FDIA approach was introduced with the estimated steering angle as well as with the predicted steering angles. Three different fault types were used to evaluate the effectiveness of the proposed algorithms: transient, persistent, and incipient faults. Simulation results show that the faulty sensor identification time decreases with the increase of prediction horizon illustrating advantages of the predictive analytical redundancy based algorithms against single point failures for all fault types.

About the Speaker. Mohammad Sharif-ul Hasan is a Masters' candidate at the Department of Mechanical Engineering of IUPUI. He received his B.S.M.E. degree from Bangladesh University of Engineering and Technology (BUET) in 2004. He then worked as a Lecturer at the Department of Mechanical Engineering in the same university from April 2004 to July 2005. As of fall 2005, he is pursuing a M.S.M.E. degree at IUPUI and has been working as a graduate assistant. Since July 2007, he is employed at Cummins Inc. as a Systems Engineer in the Light Duty Diesel (LDD) Controls group. His academic advisor is Dr. Sohel Anwar, and the members of the research committee are Dr. Yaobin Chen and Dr. Hazim El-Mounayri.