IUPUI | DEPARTMENT OF MECHANICAL ENGINEERING
SCHOOL OF ENGINEERING AND TECHNOLOGY
A Purdue University School
Indianapolis

DEPARTMENT OF MECHANICAL ENGINEERING
Purdue School of Engineering and Technology

THESIS SEMINAR

Date: Tuesday, November 25, 2008
Time: 11:00 am – 12:00 pm
Room: SL 220a

Everyone is invited

OPTIMAL CLUTCH PRESSURE CONTROL OF AN ON-DEMAND ALL WHEEL DRIVE SYSTEM FOR VEHICLE TRACTION ENHANCEMENT

Delon Reyhart, Graduate Student, Purdue School of Engineering and Technology, IUPUI, Indianapolis, IN

Abstract.
This Thesis presents an Optimal Algorithm to enhance the performance of an On-demand All Wheel Drive (ODAWD) vehicle by traction improvement through regulation of wheel slip. A “Minimum Fuel Problem” is developed with a cost function minimizing the slip error and the control action, being the ratio of the total torque transmitted to the non driven wheels (rear wheels). A simplified vehicle model (bicycle model) is used for the derivation and the system produces a Two Point Boundary Value Problem (TPBVP) once the Hamiltonian is formed and Pontryagin minimum Principle is used. An iterative algorithm based on the “Shooting Method” is then used to arrive at the optimal control action. The proposed controller optimally reduces the wheel slip error by engaging and dynamically controlling a hydraulic clutch which transmits the optimal torque to the rear wheels, thus reducing the vehicle longitudinal slip and enhancing vehicle traction. The controller was simulated in two phases where the first phase was an open loop simulation for a desired vehicle speed profile and the second phase, a closed loop system where the controller was integrated on a validated 14 degree-of-freedom detailed vehicle model in SIMULINK. Thereafter validating the performance of the algorithm on a real time HIL Bench which comprises of an electro-hydraulic clutch setup along with pressure sensors and an electro-hydraulic valve, which controls the clutch pressure. The verification and validation procedure on the controller on four different terrain profiles confirm the simulation results provide high promise for the controller performance on low friction coefficient surfaces with enhanced traction and reduced vehicle longitudinal slip in an acceleration event.

About the Speaker.
Delon Reyhart is a graduate student in Mechanical Engineering at Purdue School of Engineering and Technology and a Research Assistant at the Mechatronics Research Laboratory at IUPUI. He received his BS in Mechanical Engineering from the University of Moratuwa, Sri Lanka in 2005. He has been a Research Assistant at the MRL Lab of IUPUI since. His Academic Advisors are Dr. Sohel Anwar, Dr. Yaobin Chen and Dr. Hazim El-Mounayri.