Location-Aware Adaptation of Vehicle Dynamics

Relevance to the Automotive Industry:	Location-aware adaption of vehicle dynamics aims to avoid situations in which the vehicle exceeds its handling capabilities when cornering. The objective is to improve driving safety by adding predictive responses to mitigate the need for subsequent reactive solutions.	
Research Location:	TUD Fahrzeugtechnik (FZD)	VT (Blacksburg, VA) Vehicle Terrain Performance Laboratory
Homepage (Engl.):	http://www.fzd.tu-darmstadt.de/fzd/aktuell/aktuelle_meldungen.en.jsp	http://www.me.vt.edu/VTPL
Faculty Mentor:	Prof. Dr. rer. nat. Hermann Winner	Prof. John B. Ferris, Ph.D.
Faculty Mentor Email:	winner@fzd.tu-darmstadt.de	jbferris@vt.edu
Graduate Mentor:	Yang Wang, M.Sc.	Rebecca Bandy, BS
Graduate Mentor Email:	wang@fzd.tu-darmstadt.de	bandy@vt.edu
Project Description: May 21 - Jul 12, 2013; (8 weeks, 40h/week)	The TUD Institute for Automotive Engineering (FZD) and the VT Vehicle Terrain Performance Laboratory (VTPL) are working together to improve vehicle safety by developing predictive capabilities to automatically mitigate unsafe situations before reactive solutions become necessary. The research is built on a "driver-in-the-loop" model where the driver provides control inputs to the vehicle as opposed to autonomous driving. The two NSF REU students will work with their graduate mentors at FZD and VTPL, respectively, to do the theoretical analysis by simulating with different tire- and suspension models, and do the experimental analysis by making the vehicle-driving test. The focus will be to analyze the influence of road surface bumps on the changes of tire longitudinal and vertical forces, considering the shape of the bump and the speed. PHASE 1: During the first two weeks, the two NSF REU students will become familiarized with the subject and scope out the specifics of the project. This includes performing a literature review on the selection of suitable tire- and suspension models for the study. PHASE 2a: During the next 4 weeks, the simulation model will be described and parameterized in MATLAB/SIMULINK, and the influence of vehicle driving over bumps will be investigated experimentally on TUD's testing ground using the measuring wheel and other measurement technologies. PHASE 2b: Simultaneously, the theoretical relationship between longitudinal and vertical force due to road excitations will be derived in Blacksburg. This derivation will help the team in Darmstadt model the relationship and compare to experimental data. If time permits, during the last 2 weeks (concurrent with paper writing in Phase 3), the NSF REU student in Blacksburg will expand the existing quarter-car model to a 7DOF full non-linear model based on the derived relationship. PHASE 3: During the final two weeks, the two NSF REU students will coordinate results and generate a presentation, report, and a conference paper under the supervision of their graduate advisors.	
Target publications:	• **Vehicle System Dynamics** • **International Conference Vehicle Dynamics** • **SAE World Congress 2014**	
Necessary Skills/ Knowledge:	• MATLAB/Simulink	
Desirable Skills/ Knowledge:	• Vehicle Dynamics software for Simulation (CarMaker, CarSim,…) • Basic knowledge of Vehicle Dynamics, Tire Model, Theory of Vibration • Driver's license for passenger cars	
Additional Online Resource(s):		

NSF REU Students must have completed at least two semesters of engineering studies prior to the proposed summer research, and they must have at least one semester remaining before they can earn their BS in Engineering.