Feedforward Motion Cueing for HIL Simulation

Relevance to the Automotive Industry:	Human-In-the-Loop (or HIL) simulation is emerging in the auto industry as a highly cost effective tool for studying many aspects of vehicle design. New components can be evaluated like never before through "Virtual Prototyping" where a human driver can test drive a virtual vehicle using the prototype component. Traditional chassis and suspension design tradeoffs can be evaluated directly for both ride and handling performance using HIL simulation. The Virginia Institute for Performance Engineering and Research (VIPER) currently has two full-motion 6-DOF driving simulators that are actively being used for virtual prototyping of vehicle subsystems, as well as for a variety of HIL performance studies, and TUD is currently developing a novel motion platform for HIL driving simulation.	
Research Location:	TUD Fahrzeugtechnik (FZD)	VT (Danville, VA) VIPER Service Lab
Homepage (Engl.):	http://www.fzd.tu-darmstadt.de	http://www.viperservice.com
Faculty Mentor:	Prof. Dr. rer. nat. Hermann Winner	Prof. Steve C. Southward, Ph.D.
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Graduate Mentor Email:	betz@fzd.tu-darmstadt.de	wkirchne@vt.edu
Project Description: May 23 - Jul 15, 2011; (8 weeks, 40h/week)	The overall goal of this project is to establish the feasibility of using a novel feedforward control approach to improve the accuracy of the sensed motion in a driving simulator. The two NSF REU students, one at Virginia Tech and one at Technische Universität Darmstadt, will develop a simulation to model the pertinent features of lateral acceleration including a simple form of motion cueing. For the lateral acceleration case, motion cueing refers to the dynamic blending of acceleration caused by physical lateral motion and gravitational acceleration due to tilting of the human passenger platform. Motion cueing is required in all driving simulators where physical limitations in stroke or range do not permit sustained accelerations for long periods of time. Using this simulation, the students will then develop and evaluate a feedforward control approach to shaping the motion command in order to improve the accuracy of the sensed acceleration. The resulting feedforward control solution will be applicable to the driving simulator at the VIPER facility and the simulator being developed at TUD.	
Target publications:	• **SAE World Congress 2012**	
Necessary Skills/ Knowledge:	• MATLAB and Simulink • Fundamental concepts of Vehicle Dynamics	
Desirable Skills/ Knowledge:	• Adaptive signal processing • Feedforward compensation	
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.