

Simulative Analysis of the Excitation of a Test Rig with Terrain Constraints

Relevance to the Automotive Industry:	Mechatronic Systems are one of the biggest drivers of innovation in automotive engineering. During the last several years dual clutch transmissions, active steering and suspensions entered the market. The interaction of those systems on vehicle level is essential to obtain optimal results in the fields of safety, efficiency, dynamics, and comfort. In this context the so-called Car-in-the-Loop test rig enables function development and optimization of the interaction of mechatronic systems on vehicle level through repeatable reproduction of driving maneuvers, which include longitudinal, steering, and vertical dynamics.	
Research Location:	TUD Institute for Mechatronic Systems (IMS)	VT Vehicle Terrain Performance Laboratory
Homepage (Engl.):	http://www.ims.tu-darmstadt.de	http://www.me.vt.edu/VTPL
Faculty Mentor:	Prof. Dr.-Ing. Stephan Rinderknecht	Prof. John B. Ferris, Ph.D.
Faculty Mentor Email:	rinderknecht@ims.tu-darmstadt.de	jbferris@vt.edu
Graduate Mentor:	Dipl.-Wirtsch.-Ing. Rafael Fietzek	Philip Chin, MSEE
Graduate Mentor Email:	fietzek@ims.tu-darmstadt.de	pachin@vt.edu
Project Description: May 21 - Jul 13, 2012; (8 weeks, 40h/week)	<p>The Institute for Mechatronic Systems (IMS) at TUD and the Vehicle Terrain Performance Laboratory (VTPL) at VT are working together to understand how different types of terrain can be realistically reproduced on the Car-in-the-Loop test rig. To complete this task, two NSF REU students, one at TUD and one at VT, will work together and with their graduate mentors to develop a simulation model of the test rig and a simulation model of vehicle behavior due to terrain excitations using Matlab/Simulink. The main goals of the project are to modify the existing vehicle suspension model so that it can more accurately simulate the behavior of a compact vehicle excited by terrain input, and to model test rig actuators to more accurately reproduce terrain excitations. This joint effort will be organized into three phases:</p> <p><u>Phase 1 (2 weeks):</u> Joint effort between IMS and VTPL to conduct literature review, research current full car and Car-in-the-Loop test rig models, and identify problems associated with previous models and parameterization methods.</p> <p><u>Phase 2 (4 weeks):</u> The project will be divided into two parts: IMS will measure physical parameters for a specific vehicle and further develop models and characterize the frequency response of simulated vertical wheel displacement test rig actuators. Simultaneously, VTPL will incorporate IMS's measured physical parameters into the vehicle model and simulate the wheel displacement response due to various types of terrain. The output of vehicle model will be used as the input to the Car-in-the-Loop test rig model and a control will be developed for the actuator.</p> <p><u>Phase 3 (2 weeks):</u> Assess the improvement of both the vehicle and test rig models created. IMS and VTPL will coordinate results and generate a presentation, report, and a conference paper.</p>	
Target publications:	<ul style="list-style-type: none"> • SAE World Congress 2013 	
Necessary Skills/ Knowledge:	<ul style="list-style-type: none"> • Matlab/Simulink 	
Desirable Skills/ Knowledge:	<ul style="list-style-type: none"> • Multi-Body Dynamics software (SimMechanics) 	
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.