Impact of Terrain Roughness on Automotive Reliability

Relevance to the Automotive Industry:	Throughout a chassis development program, terrain profiles that represent severe vehicle usage are necessary to simulate the vehicle for reliability predictions and to anticipate design requirements. However, maintaining hundreds or thousands of miles of terrain for simulation is not practical. If terrain characteristics can be understood and quantified, then synthetic terrain, having the same characteristics as the original terrain, can be used in simulations. Access to accurate terrain models for simulation purposes will allow for important design decisions to be made early in the design process. This will, in turn, shorten vehicle development time and reduce overall development costs.	
Research Location:	TUD Fahrzeugtechnik (FZD)	VT (Danville, VA) Vehicle Terrain Performance Laboratory
Homepage (Engl.):	http://www.tu-darmstadt.de/fzd/index_en.html	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:	Dipl.-Ing. Gunther Seipel	Heather Chemistruck
Graduate Mentor Email:	seipel@fzd.tu-darmstadt.de	chemisth@vt.edu
Project Description: Jun 1 - Jul 29, 2009; (8 weeks, 40h/week)	The Chair of Automotive Engineering (FZD) at TUD and the Vehicle Terrain Performance Laboratory at VT are working together to understand how the terrain affects the reliability of automobiles. Specifically, the two labs will work to understand how selecting a particular mathematical model by which terrain is characterized, along with the parameterization of those models, affects ground vehicle responses and resulting reliability. One NSF REU student will be assigned to each research location. The students will start with a two-week intense reading phase to become familiar with the terrain models to be used, the vehicle modeling software, and the current state of the research. They will also explore alternative software packages that may be used to perform the vehicle simulations. Following this introductory phase, the students and their mentors will decide which simulation tools will be pursued and how the work responsibilities will be distributed between the two NSF REU students. The students will be focused on the multi-body simulation of vehicles. The results of their project will be used as inputs into finite-element code to predict the effects on ground vehicle reliability. For the verification of the simulation models, the students will design and perform experiments with a tire-measurement trailer, which allows determining the influence of different parameters on the effective forces on the vehicle tires caused by the road pavement. The students are expected to work together transatlantic on this joint project, and to interact and communicate intensely with each other on a daily basis. The project deliverables will be a vehicle model and sets of terrain that were used for the simulations and a report that describes the results of the study, including the conclusions regarding the appropriateness of various terrain models for automotive reliability prediction.	
Necessary Skills/ Knowledge:	• MATLAB • Fundamental skills in vehicle dynamics	
Desirable Skills/ Knowledge:	• Multi-Body Dynamics software (ADAMS, DADS, CarSim,…)	
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.