NSF-REU Proposal
"Active Drag Control in Turbulent Pipe Flows"

Relevance to the Automotive Industry:	Understanding flow friction in turbulent flows plays an important role in increasing the performance of cars - for example by reducing the aerodynamic vehicle drag or actively controlling the exhaust gas back pressure. This pressure is determined by friction of the turbulent exhaust gas flow in the muffler, piping and catalytic converter. A complete and fundamental understanding of turbulent drag in wall bounded flows can therefore help to face challenges arising from environmental concerns and limits of global fossil resources by increasing the overall car efficiency.	
Research Location:	TUD	VT
	Numerische Berechnungsverfahren im Maschinenbau	*Fluids, Turbulence and Fundamental Transport Lab*
Faculty Mentor:	Prof. Dr. rer. nat. Michael Schaefer	Prof. Ken Ball
Faculty Mentor Email:	schaefer@fnb.tu-darmstadt.de	ball@vt.edu
Graduate Mentor:	Dipl.-Ing. Markus Schwaenen	William Pollard, MS candidate
Graduate Mentor Email:	markus.schwaenen@gmx.net	pollardw@vt.edu
Project Description:	Current research at the Fluids, Turbulence, and Fundamental Transport Lab includes experimental and computational investigations of drag reduction in turbulent pipe flow (see for example Duggleby et al. 2007). Continuing this research, the proposed REU summer students would be divided into two groups: - At VT: experiments with rotating pipe wall parts using an existing rig; Design and test active devices inside the pipe. - At TUD: Perform numerical simulations, explore new active drag devices inside the pipe, validating CFD results with experiments. One student will be assigned to each research location. They will work closely together, staying in regular contact via email and video conferencing with each other and the project supervisors. Interaction is necessary to validate numerical results and to test out drag reduction approaches discovered by computations. During the first two weeks, both students will go through an intense training phase consisting of an introduction to the principles of scientific work, individual literature review, brief overview on fluid dynamics and turbulence, and training for their respective research tools (experimental operations, data acquisition, CFD software, etc.). The last week of the summer research is reserved for making a presentation and writing a report in journal paper format.	
Necessary Skills/ Knowledge:	• MS Office	
Desirable Skills/ Knowledge:	• Linux, C, Fluid dynamics, CFD, Data acquisition	
Additional Online Resource(s):	A. Duggleby, K. S. Ball, and M. R. Paul, 2007. "The effect of spanwise wall oscillation on turbulent pipe flow structures resulting in drag reduction," Physics of Fluids, vol. 19, no. 12. *Available from http://link.aip.org/link/?PHFLE6/19/125107/1*	

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.