Development of a fuel cell truck model in IPG TruckMaker and MATLAB Simulink

Relevance to the Automotive Industry:	The demand for CO_2-neutral powertrains requires new technologies in all applications. The wide diversity of mission profiles in the heavy-duty sector leads to the development of new strategies to find the optimum technology for each application. In this context the simulation of different powertrains in a virtual environment can save money and time.	
Research Location:	Technische Universität Darmstadt Institute for Internal Combustion Engines and Powertrain Systems (VKM)	
Homepage (Engl.):	http://www.vkm.tu-darmstadt.de	
Faculty Mentor:	Prof. Dr. techn. Christian Beidl	
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Graduate Mentors:	Nicolas Hummel, M.Sc.	
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Project Description: May 30 - Aug 06, 2022 (10 weeks, 40 h/week)	The Technische Universität Darmstadt Institute for Internal Combustion Engines and Powertrain Systems (VKM) investigates different kinds of truck powertrain systems. To evaluate the efficiency of these powertrain systems and to optimize the operation strategies, simulation tools are used. The objective of this NSF REU project will be to develop and compare two different approaches to simulate a fuel-cell heavy-duty truck. This will enable the Institute for Internal Combustion Engines and Powertrain Systems to choose the most appropriate heavy-duty truck technology for a given mission profile. **PHASE A** (2 weeks): First, the NSF REU student will learn to operate the IPG TruckMaker simulation software system and understand the models that will be used for this research project. **PHASE B** (3 weeks): Next, the NSF REU student will develop a fuel-cell truck simulation by adapting the range extender hybrid model from IPG TruckMaker. This includes adapting the engine maps according to the fuel cells specificity and verifying the validity of the model. This event-based model will serve as the benchmark for the next phase. **PHASE C** (3 weeks): Then, the NSF REU student will extend the IPG TruckMaker model to a MATLAB Simulink model that represents an optimization-based strategy for the vehicle model. These two models will then be compared on various logistic routes with regards to their energy balances. **PHASE D** (2 weeks): Finally, the NSF REU student will document the research performed, prepare a written report, and deliver an end-of-summer presentation on the research performed.	
Target publications:	• Antriebe und Energiesysteme von morgen 2023	
Necessary Skills/ Knowledge:	• Experience with MATLAB Simulink	
Desirable Skills/ Knowledge:	• Experience with IPG TruckMaker	
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.