Performance Comparison of Order-Tracking Methods

Relevance to the Automotive Industry:	Weight- and efficiency-based gearbox designs lead in most cases to increased noise. Active measures can be used to significantly reduce this noise. For instance, order tracking can be used to identify the amplitudes of the different frequencies present, which can then be used for active vibration control. Furthermore, order tracking can be used to track system states, e.g. the motor torque, which then can be used for health monitoring purposes.
Research Location:	Technische Universität Darmstadt Institute for Mechatronic Systems (IMS)
Homepage (Engl.):	http://www.ims.tu-darmstadt.de
Faculty Mentor:	Prof. Dr.-Ing. S. Rinderknecht
Faculty Mentor Email:	rinderknecht@ims.tu-darmstadt.de
Graduate Mentor:	Jens Jungblut, M.Sc.
Graduate Mentor Email:	jungblut@ims.tu-darmstadt.de
Project Description: Jun 03 - Aug 09, 2019 (10 weeks, 40 h/week)	The automotive industry strives to steadily improve the performance of their cars, including by optimizing the gearbox. However, weight- and efficiency-optimized gearbox designs lead in most cases to structures that are sensitive to vibrations. These vibrations, which cause audible noise, are caused by gear meshing, and they often have frequencies that are multiples of the motor speed. Active control systems offer an efficient way to reduce these vibrations. To achieve this, one needs to determine the amplitudes of these frequencies, which can be done by order tracking. The goal of this NSF REU project is to compare different order-tracking algorithms with respect to (A) the convergence time, and (B) the accuracy of the determined amplitude and phase. **PHASE A** (2 weeks): During this introduction phase, the NSF REU student will review relevant research, and identify relevant algorithms for further investigation. **PHASE B** (4 weeks): Next, the student will develop and implement a simulation model in MATLAB/Simulink. The model will then be used to analyze and compare the performance of the different algorithms. The observations made may suggest a new approach for an order tracking algorithm. **PHASE C** (2 weeks): Then, the student will implement the algorithms on a test rig, and compare the physical results with the numerical simulation. **PHASE D** (2 weeks): Finally, the NSF REU student will prepare a written summary report and documentation of the research performed, and deliver an end-of-summer technical presentation on the research performed.
Target publications:	• VDI International Conference on Gears 2019
Necessary Skills/ Knowledge:	• Experience with MATLAB/Simulink
Desirable Skills/ Knowledge:	• Basic knowledge of Discrete Fourier Transformation and Fourier Series
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.