Active Control of Gear Mesh Vibration in a Planetary Gearbox

Relevance to the Automotive Industry:	Vibrations caused by gear meshing can lead to audible noise. This is particularly prevalent in applications with high power-densities. In automotive, aerospace, and similar industries, lightweight structures provide high fuel-efficiency, but are susceptible to vibration. Passive damping introduces an undesirable amount of mass, which is unacceptable. The gear design is largely constraint by efficiency requirements and cannot prioritize quiet operation. Active vibration control using inertial mass actuators may provide a lightweight and efficient solution. The challenge will therefore be to identify an active vibration control strategy that is closely matched to the excitation mechanism.
Research Location:	TUD Institute for Mechatronic Systems (IMS)
Homepage (Engl.):	http://www.ims.tu-darmstadt.de
Faculty Mentor:	Prof. Dr.-Ing. S. Rinderknecht
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Graduate Mentor:	Daniel Fritz Plöger, M.Sc.
Graduate Mentor Email:	ploeger@ims.tu-darmstadt.de
Project Description: Jun 06 - Aug 11, 2017 (10 weeks, 40 h/week)	The Institute for Mechatronic Systems (IMS) has recently implemented a new gearbox test rig. It features a planetary gearbox running at speeds of up to 10,000 rpm at arbitrary loads. Different piezoelectric inertial mass actuators are operational, though active vibration control has not yet been implemented. The NSF REU student will investigate the gear mesh vibration under various operating conditions. Using these results, the student will develop a model of the vibrations. This model will then be used to derive an active vibration control strategy. This strategy will then be validated using the inertial mass actuators. **PHASE A** (2-3 weeks): During this introduction phase, the student will review relevant research and learn to operate the gearbox test rig. **PHASE B** (2-3 weeks): Next, the student will collect gear mesh data under various operating conditions. **PHASE C** (3-4 weeks): This data will then be used to create a model of the excitation mechanism. This model will then be used to derive an active vibration control strategy, which then will be validated using the inertial mass actuators. **PHASE D** (1-2 weeks): Finally, the NSF REU student will document the research performed, prepare a written report to support subsequent publications, and deliver an end-of-summer presentation on the research performed.
Target publications:	• **International Conference on Noise and Vibration Engineering 2018**
Necessary Skills/ Knowledge:	• Experience with Matlab
Desirable Skills/ Knowledge:	• Good understanding of mechanics and frequency domain representation of signals • Experience with Simulink
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.