Measurement of pump-controlled hydraulic excavator

Site: Purdue University, Maha Fluid Power Research Center
Professor: Monika Ivantysynova
Graduate Mentor: Chris Williamson
Preferred major(s): ME, ABE
Desired experience: LabView
Students desired: 1
Comments: Funded by CCEFP REU program

This project complements CCEFP Testbed 1, which is a 5-ton mini excavator with a new energy-saving pump-controlled hydraulic system. The undergraduate researcher will support continuing efforts to develop advanced optimal controls for this machine. Tasks include measuring dynamic performance of components and systems on the excavator and on a stationary test rig for parameter identification and control validation. Measurements will be taken in both laboratory and field conditions. The undergraduate will work with various sensors and data acquisition systems, design and run experiments, and analyze the results. Completed coursework in instrumentation and measurement is desired. Familiarity with LabView software would also be useful, but could be learned without much difficulty.
Simulation study of pump-controlled excavator with reduced maximum power

Site: Purdue University, Maha Fluid Power Research Center

Professor: Monika Ivantysynova

Graduate Mentors: Josh Zimmerman

Preferred major(s): ME, ABE

Desired experience: Matlab/Simulink

Students desired: 1

Comments: Funded by CCEFP REU Program

This project complements CCEFP Project 1A2, which focuses on the development of energy efficient pump-controlled hydraulic systems and controls for mobile hydraulic machines. A new energy-saving hydraulic system for a 5-ton excavator has already been designed and modeled, and construction of a prototype is in progress. A detailed dynamic and hydraulic co-simulation model of the machine has previously been created and the undergraduate researcher will use this model to study and analyze the performance of different hydraulic system architectures. The goal of the study will be to find the optimal system configuration which will consume the least amount of fuel without sacrificing the overall system performance. This project is well suited to an undergraduate student interested in system design and simulation and/or fluid power control systems. Previous experience with Matlab/Simulink and completed coursework in dynamic systems and fluid power is desired, but not required.
Simulation Study on the Behavior of Piston/Cylinder Interface in Axial Piston Machines Considering ThermoElastoHydrodynamic Lubrication

Site: Purdue University, Maha Fluid Power Research Center

Professor: Monika Ivantysynova

Graduate Mentors: Matteo Pelosi

Preferred major(s): ME

Desired experience:

Students desired: 1

Comments: Funded by CCEFP REU Program

The aim of this project is to study the fluid film conditions and the energy dissipation in the lubricating gap between piston and cylinder in axial piston machines. A fully coupled thermal and fluid-structure simulation model capturing the complex thermoelasto-hydrodynamic lubrication conditions has been developed recently. The undergraduate researcher will use this new model to study and analyze the fluid film behavior in a wide range of operating condition for a given pump. The simulation results will be compared with available measurement data. The results of this study will need to be documented in a project report. This project is part of CCEFP project 1B1, where new concepts for surface design for piston pumps and motors are under investigation to drastically improve efficiency of current pumps and motors. This project is well suited to an undergraduate student interested in design and simulation and/or fluid power systems.
Simulation and measurement of quiet hydrostatic transmissions

Site: Purdue University, Maha Fluid Power Research Center

Professor: Monika Ivantysynova

Graduate Mentors: Richard Klop

Preferred major(s): ME

Desired experience:

Students desired: 1

Keywords Noise control engineering, Room acoustics, hydrostatic transmission, CAD

The objective of the project is to measure sound intensity to estimate total sound power radiation of a hydraulic pump/motor inside a semi-anechoic chamber and to perform a simulation investigation to discover quiet hydrostatic transmission designs. The project is estimated to last 11 weeks. The student will be responsible for applying noise control engineering and room acoustics analysis; this involves setting up sound intensity sensors, measuring acoustical material performance of the chamber, and deriving sound power based on measurements. Furthermore, the student would perform a systematic study using a pre-developed simulation tool to investigate unique designs for minimal noise emissions. This work is a part of a larger research effort to develop novel noise source reduction techniques for hydrostatic pumps and motors.