IZTECH ME401 Project Proposal

Advisor(s): Can Dede / Erdal Çetkin

Project title: Electro-hydraulic cylinder design

Number of groups: 1

Number of students in each group: (ideally 3 to 5 people)

Is the project within the scope of Co-Op Extended?:

Project Background:

Please describe the background and motivation of the project with several sentences.

Electrification is highly increasing in construction equipment industry and efficiency is becoming the most challenging topic. New technologies also should be developed around machine components to support development of zero emission machines. Hydraulic cylinder is a key element on construction machines and hydraulic still succeeds to remain best power transmitting element. Electro-hydraulic cylinders can be the main solution to transfer energy through electric harness by eliminating many inefficient hydraulic hoses, fittings and other elements. An electric excavator using electro-hydraulic actuators will be step forward to be a real electric excavator.

Project Objective:

Please list main project goals.

- Reducing the overall size and weight of the actuator for easier integration into various systems.
- Increasing the energy efficiency and operational reliability.
- Designing a more adaptable system capable of operating under a wider range of environmental conditions.
- Enhancing the sustainability of the actuator by utilizing eco-friendly materials and manufacturing processes.

Project Design Criteria:

Please list measureable and non-measurable criteria that would be useful in evaluating the success of the project.

- Reducing the overall size and weight of the actuator for easier integration into various systems.
- Increasing the energy efficiency and operational reliability.
- Designing a more adaptable system capable of operating under a wider range of environmental conditions.
- Enhancing the sustainability of the actuator by utilizing eco-friendly materials and manufacturing processes.

Expected Outcomes:

Please describe the expected outcomes or deliverables (physical or theoretical) of the project.

- Prototype Development: Creation of a functional prototype demonstrating the advanced features and improvements over current designs.
- Performance Metrics: Detailed performance metrics comparing the new designs to conventional hydraulic cylinder solutions, highlighting efficiency gains and operational reliability.
- Scalability and Integration Models: A framework for adapting the technology across digging mechanisms of 6tons to 10tons excavators.
- Sustainability Report: An assessment of the environmental impact of the new actuator, including lifecycle analysis and potential reductions in carbon footprint.

Sustainable Development Goals:

Please describe any potential impact on the field or society. You may want to reference the UN SDGs. (https://sdgs.un.org/goals)

Goal 9: Industry, Innovation, and Infrastructure: By fostering innovation in actuator technology, the project contributes to resilient infrastructure and sustainable industrialization.
Goal 12: Responsible Consumption and Production: The project emphasizes sustainable manufacturing processes and efficient use of resources.
Goal 13: Climate Action: By improving energy efficiency and reducing dependency on non-renewable power sources, the actuator design contributes to mitigating climate change.
Goal 14: Life Below Water: Reducing environmental contamination through eco-friendly materials and processes helps protect aquatic ecosystems.

Literature Survey Subjects:

Please list fundamental research topics to guide students. There should be as many different subjects as the number of people in a group.

- Current Electro-Hydraulic Actuator Designs
    - Overview of existing technologies.
    - Design variations and their specific applications across different industries.
- Advancements in Hydraulic and Electric Motor Technologies
    - Recent developments in hydraulic pumps and motors.

    - Innovations in electric motor designs, focusing on improving efficiency and reducing size.
- Material Science
    - Review of materials currently used in actuator construction.
    - Exploration of new materials and composites to enhance actuator performance.
- Energy Efficiency and Sustainability
    - Techniques for reducing energy consumption in hydraulic systems.
    - Eco-friendly practices in the design and manufacturing of hydraulic systems.
- System Integration and Modularity
    - Challenges in integrating actuators into various systems.
    - Research on modular designs for scalability and adaptability.

Please write your notes below, which you find useful for students to know about the project.

You can set criteria such as min. GPA of each student or min average GPA of the group.

Each student should have a basic level of sense of humor and a grade not lower than CC regarding below courses:

- CALCULUS
- THERMODYNAMIC
- MANUFACTURING PROCESSES
- FLUID MECHANICS
- MACHINE ELEMENTS
- SYSTEM ANALYSIS AND CONTROL