



Company Information

Company Name	<i>Schaeffler</i>	Date Submitted	<i>05/20/2022</i>
Project Title	<i>Active suspension driver seat – Phase 3 (SG_SEAT3)</i>	Planned Starting Semester	<i>Fall 2022</i>

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical	2	Electrical	2
Computer	2	Systems	

Company and Project Overview:

Schaeffler (www.schaeffler.us) is a German based technology company, manufacturing advanced mechatronic systems for industrial and automotive applications. The North American headquarters for industrial mechatronics R&D is in Fort Mill, SC. Our teams design and develop complex actuation and control systems to solve customer problems related to motion and position.

Active and semi-active suspension systems are employed in some vehicle seats to alleviate the harmful and damaging effects due to the transmitted vibration to the human body. To improve riding comfort, the operator's body displacement and acceleration must be reduced. According to the research, active suspension control systems are the best choice to reduce the transmitted vibration to the drivers' body and provide the best ride comfort in comparison with passive and semi-active systems.

Schaeffler has previously sponsored a senior design project to investigate the feasibility and challenges of using mechatronic systems to control the motions of an active suspension seat for use in a large agriculture tractor. Previous phases of this project have proved feasibility of the concept but have not been designed for true application loads or manufacturing. The working hardware and software from phase two are available and will be used as the benchmark and starting point for the phase 3 project.



Project Requirements:

This project will build on the work done by the Phase 2 team of UNCC students who built a seat suspension platform capable of leveling 2-axes of motion. Various parts of the hardware showed limitations which prevented full function of the seat suspension. The prototype from phase 2 should be evaluated and tested by this new team using quantitative measurements so a baseline can be established showing the shortcomings and identifying what can be kept and what needs to be redesigned.

New mechatronic actuators will be designed and built, using brushless DC motors and motion hardware such as linear slides, screws, and gears. All the motor control software must be designed and written. Schaeffler engineers will guide the technical aspects and provide the necessary training to support the student needs.

An Adams multibody dynamic simulation model will be created of the seat suspension and used to understand the system level control needs so that software can be designed to provide the active seat suspension.

The final prototype system must be tested using quantitative measurements to document the canceling effects provided by the seat suspension.

Detailed requirements will be developed together with Schaeffler engineers. Schaeffler will supply available actuation components at no charge to the project team and will support with some machine shop work free of charge.

Expected Deliverables/Results:

- Benchmark phase 2 hardware and software to document performance and determine shortcomings.
- Replace the off-the-shelf actuators in the phase 2 hardware with custom designed actuators utilizing “Schaeffler type” components – ie. BLDC motor, ball screw, etc.
- Create an Adams multibody dynamic simulation model.
- Write actuator control software as well as system level suspension software
- Test finished system for vibration canceling response using quantitative measurements
- CAD models, drawings, and calculations used during design and construction.

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team’s work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter’s location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.



List here any specific skills, requirements, specific courses, knowledge needed or suggested (if none please state none):

- Design of kinematic systems is required
- Knowledge of controls software will be needed
- Ability to design and safely install power electronics is needed
- Instrumentation knowledge for data acquisition is needed
- CAD modeling and 3D printing will be required