



## **MECH 493 project: Advanced Air-Fuel-Ratio Control in Automotive Engines Using Two Wide-Band Oxygen Sensors**

### **Background and research goal**

Three Way Catalytic Converter (TWC) is an important component of any Spark Ignition (SI) Internal Combustion (IC) automotive engine. TWC is an exhaust emission control device that converts toxic substances in exhaust gas into less toxic ones. The cleanliness of the exhaust gas can be measured by means of two wide-band oxygen sensors installed upstream and downstream of TWC, and improved by adjusting the amount of injected fuel based on the oxygen sensor measurements.

The goal of this research project is to design advanced gain-scheduled controllers for SI-IC engines with two wide-band oxygen sensors. The mathematical models for controller design and analysis will be developed for both the engine and TWC processes, and validated using MATLAB Simulink. Advanced gain-scheduled controllers will be designed based on linear models and applied to non-linear models with dead-time. This control structure will be simulated using MATLAB Simulink, and implemented to an actual Sunbird engine installed on an engine dyno.

### **Tasks to be performed by the student**

- Modeling of engines with two wide-band oxygen sensors
- Model validation using data obtained from the Sunbird engine
- Design of advanced gain-scheduled controllers
- Simulation analyses using MATLAB Simulink
- Controller implementation using the MotoHawk microcontroller

### **Facilities and team:**

In collecting data for the modeling and analysis purpose, and in implementing designed controllers for the validation purpose, the student will work at Kaiser 1180 where the Sunbird engine is situated. The student will closely work with a 4<sup>th</sup> year capstone project team working on the development of an automotive engine control laboratory.