The Engine Research Center (ERC) at the University of Wisconsin-Madison is a world-class research facility dedicated to furthering the knowledge of the thermofluid aspects of internal combustion engines. The ERC is internationally recognized for both experimental and computational research. A fellowship competition is being offered to allow undergraduates to be involved in the research activities of the ERC. If desired this can be incorporated into your degree program as an independent study project. It is anticipated that the successful applicant will be paired with a current graduate student (to help facilitate day-to-day needs) and a faculty advisor.

The ERC undergraduate research fellowship (URF) provides a stipend of $500 to the student, makes available up to $500 for research supplies, and there will be $500 'Best Project' award that will be decided upon by the faculty based on the final presentations. A list of projects suggested by the ERC faculty can be found below, or acquired from Prof. Ghandhi (rm. 125 ERB, ghandhi@engr.wisc.edu). Additionally, the ERC faculty are interested in hearing your project ideas.

Application Procedure:
1. Applications will be due November 3, 2010 and winners will be announced by November 11, 2010.
2. The application consists of:
   a) A 3 page (maximum) research proposal that clearly identifies the area of study, includes relevant background material, and provides details of the proposed investigation.
   b) A current resume.
   c) A transcript.
   d) Submission to Prof. Ghandhi in room 125 ERB.

It is expected that the work will be performed either during the semester break, or during the spring semester. The culmination of the work will be a short presentation made at an Engine Research Center seminar.

How to get started?
The first step in the process is to contact the faculty member in charge of projects that you are interested in (the most efficient method would be to email them to set up a meeting time). Based on these discussions, choose the project of greatest interest and work with the faculty member on the development of the proposal.

ERC Faculty and Staff

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**High temperature gas cell heater testing** (Prof. Ghandhi)
A high temperature, high pressure gas cell has been built in the ERC for testing the optical (absorption and fluorescence) properties of gases at elevated temperature and pressure, and a gas heater that will preheat the mixture prior to the cell has been designed, and mostly built. In this project, the construction of the heater will be completed, and the performance of the design will be evaluated.

**Passive particle advection** (Prof. Trujillo)
The objective is to test in a practical flow field, hopefully one closely related to engine flows, the criteria developed for departure from passive particle advection. The basis of the analysis stems from a local linearization of the flow field and a Lagrangian treatment for particles trajectories, rather than the Eulerian-Eulerian framework typically employed. The first task is to check the extent of the neighborhood for which this linearization holds. This has already been derived and applied to analytical flow fields, but now we would like to apply this to a real flow field. The second and third tasks involved checking the degree of departure both computationally using the experimental flow field and analytically using the expressions derived from current work.

**High sensitivity schlieren system development** (Prof. Ghandhi)
The schlieren technique enables the visualization of density gradients in a flow, and is being used in the ERC to measure gas jet properties. In this project a high sensitivity schlieren system will be designed so that very small gradients can be detected. The objective is to be able to measure the jet tip penetration of a nitrogen jet into an ambient environment of air. The proposed system will make use of existing optical parts and a fiber-based broadband light supply that closely approximates a point source.

**Thermophoretic Soot Sampling System Setup and Testing** (Prof. Rothamer)
A system for rapidly inserting and removing a transmission electron microscope (TEM) grid in a flame has been designed. Portions of the system have been built, and only a sampling probe needs to be constructed to complete the system. This project will focus on setting up and testing the sampling system. Measurements using the system will be performed in a coflow laminar diffusion flame fueled with fuel mixtures of varying composition. TEM imaging of the sampled soot will be performed to optimize the operation of the sampling system.

**Measurements of the Sooting Propensity of Fuel Mixtures** (Prof. Rothamer)
A laminar coflow diffusion flame with capability for seeding evaporated liquid fuels has been developed. This project will focus on extending current measurements to a wider range of fuel mixtures. The measurements involve measuring the light extinction of a laser beam traversing the flame which is directly related to the volume fraction of soot present in the flame. To measure the spatial distribution of soot in the flame a planar laser-induced incandescence technique will also be employed.

**Research Applications of a 1 W, 445 nm laser pointer (Wicked Spyder III Pro Arctic)** (Prof. Sanders)
Modify the laser pointer so it can run off of wallplug power rather than a battery. Couple the laser beam into a standard optical fiber. Use the fiber-coupled source to illuminate various fiber-optic test articles for testing and/or photographing. Develop one or more demonstrations / exhibits based on the source.

**Thermocouple analysis of a large-format propane burner** (Prof. Sanders)
Arrange multiple thermocouples in a 1-m long ribbon burner to map the temperature uniformity and its evolution over time. Use the system to identify the most uniform and stable operating points for the flame.

**Support multiple-laser-path imaging tests** (Prof. Sanders)
Use a weather station to characterize the stability of temperature and humidity in ERC labs. Identify a lab with sufficient stability, or modify one so that it has sufficient stability. Assist graduate students in setting up test equipment in the identified lab to perform laser-based temperature imaging.

**Design and model 3-D pipe fiber-optic access system** (Prof. Sanders)
Design a pipe with 100s of holes in it that can be used to perform 3-D temperature imaging over the internal volume of the pipe. Ultimately, a fiber-optic lead will be inserted into each hole. Some of the fibers will transmit light into the pipe, and the remainder will receive light from the transmitting fibers. The system must be designed so that the total received light is at least 1% of the total transmitted light. Make a 3-D model for the final design.