The Energy and Environment Research Laboratory (EERL) is offering a number of research projects in the 2009-2010 Academic Year.

Topic 1. Computational fluid dynamics (CFD) simulations of near-road air pollution

Approximately 30 to 45% of urban populations in the U.S. are directly exposed to elevated air pollution from traffic emissions near roadways. Does planting trees help? Recent studies indicate that vegetation present along roadways may help to mitigate air pollutant concentrations near roads. EERL has developed CFD tools (using FLUENT®) to simulate the dispersion of traffic emissions from tailpipes to near-road environments. We are seeking motivated students to create vegetation models (numerically), incorporate the models into the CFD modeling framework, and run simulations to elucidate the effects of vegetation on mitigating near-road air pollution. This project will provide scientific guidance for effective air quality regulations and sustainable landscaping management.

Contact: Prof. Max Zhang (kz33; 287 Grumman), Yan Wang (yw365; 130 Upson), Jonathan Steffens

Topic 2. Designing an automated Traffic-Emission-Dispersion (TED) system

EERL is operating two real-time traffic imaging systems (Autoscope®) at the intersection of I-81 and I-690 in Downtown Syracuse. The Autoscope systems generate real-time information on traffic speed, traffic volume and vehicle speed, which we can access remotely in Ithaca. Previously we have developed a Java-based platform to convert traffic information to emissions. We are seeking motivated students to further develop this platform so that it can process data automatically and in real-time. It can also predict the dispersion of traffic emissions to nearby buildings. The so called TED system will become an integral component of an intelligent building control system which activates/deactivates natural ventilation based on outdoor air quality.

Contact: Prof. Max Zhang (kz33; 287 Grumman), Xing Wang (xw66; 130 Upson)

Topic 3. Developing an energy management model in sustainable communities

Buildings consume more than 40% of primary energy in the world. The current research in this area has been focusing on improving the energy efficiency of single buildings. However, "the focus on individual buildings ignores the fact that it's not buildings, but systems of buildings that offer some of the best opportunities for innovative high-efficiency design." EERL has initiated the research on sustainable community design. We designed a 700-acre sustainable community in Hawaii in 2007-2008. We are seeking motivated students to develop an energy management model which describe the distributed energy generation, energy distribution through smart grid, district heating/cooling systems, and energy storage using either batteries or thermal materials. This model will serve as a decision-making tool for community developers and energy aggregators.

Contact: Prof. Max Zhang (kz33; 287 Grumman), Santiago Naranjo (sn377)

Topic 4. Energy systems analysis

EERL is conducting energy systems analysis on the following areas critical to a sustainable energy structure: **Electrifying transportation**; **Converting waste to energy**; and **Adding renewable generations to the power systems**. We employ advanced simulation tools such as MatPower model for power systems dispatch, CMAQ for chemical transport modeling, and

supplicated spreadsheet models for economic analysis. We are seeking motivated students to work on all three areas listed above.
Contact: Prof. Max Zhang (kz33; 287 Grumman), Keenan Valentine

Topic 5. Designing a portable dilutor for emission characterization
Essential to almost all current emission measurement systems, dilution tunnels are primarily used to reduce the concentrations and temperature of the raw exhaust to the levels at which repeatable speciation and quantification of emissions properties can be conducted by analytical instruments. Current dilution tunnels are cumbersome and not able to simulate different turbulent mixing processes relevant to atmospheric conditions. Previously, EERL has proposed a new portable dilution tunnel design based on CFD simulations. We are seeking motivated students to further improve the design, fabricate a portable dilutor, and test it in emission measurements. This is part of a new research project in collaboration with Profs Fisher and Gouldin on developing a micropower biomass combustor.
Contact: Prof. Max Zhang (kz33; 287 Grumman), Prof. Elizabeth Fisher (emf4), Prof. Fred Gouldin (fcg2)

We expect the research results from the research projects to be published in the ASME Conference on Energy and Sustainability in May 2010.