Master Theses in Thermodynamic & Process Systems

Non-equilibrium Fuel Tanks

Aircraft fuel systems are an important contributor to aircraft fuel efficiency in modern aircraft. This is the case because with recent fuel-efficient aircraft the use of electrical power on-board the aircraft has increased and thermal management on-board the aircraft has become a limiting factor. When using system simulation to predict the behavior of fuel as heat sink, a wide-spread assumption is that of thermodynamic equilibrium. This implies that not only the pressure but also the temperature and the composition of the liquid and the vapor/gas instantaneously approach equilibrium. In reality, there are substantial differences between the temperatures however due to very low ambient temperature at high altitudes, and ever-increasing heat loads that are dumped into the fuel. Only if the actual non-equilibrium conditions of the fuel-air mixture are properly modeled and understood the safety, performance and fuel efficiency of aircraft can be pushed further in spite the increasing heat loads.

The task in this Master thesis project is to develop a non-equilibrium dynamic model of a fuel tank based on existing libraries and models from Modelon. The models are implemented in the equation-based modeling language Modelica.

Student profile: One or two motivated and skilled students with interest in chemical process engineering, mathematics, modeling of dynamic systems, and programming.

Contact: Michael Sielemann, Modelon AB

Gas Turbines for Power Generation

Turbines are main devices to convert thermal energy into electricity in the power generation industry. In particular, gas turbines provide higher efficiency and flexibility over steam turbines. Nowadays, flexibility is crucial not only for meeting the transient electricity and heating demand but also for integration of heterogeneous (renewable) sources onto the grid. Dynamic models of gas turbine will facilitate numerical experiments for technologies like IGCC (Integrated Gasification Combined Cycle) and will enable optimization on control strategies for the whole power plant.

The purpose of this master thesis is to develop a physical, dynamic model of a gas turbine in Modelica using Modelon's Jet Propulsion Library (JPL). The gas turbine model will then be integrated into a power plant system model built upon Modelon's Thermal Power Library (TPL). Student(s) will also collect published data to validate the model and benchmark the performance. Many base components and system examples can be found in JPL and TPL, so the students don't need to start from scratch. The developed models will be merged into a future release of the library products.

Student profile: One or two motivated and skilled students with interest in thermodynamics, power generation, controls, dynamical systems and modeling of physical systems.

Contact: Lixiang Li, Modelon Inc.

Microgrid Configurations and Optimization

A microgrid is a group of local energy sources and loads that can operate independently from the main grid. Using novel control techniques, it has potential for providing efficient, low-cost and clean energy with improved reliability.

The goal of this master thesis is to develop a tool for evaluation and optimization of microgrid configurations, based on criteria such as energy resource availability and operation cost.

A Modelica representation of the microgrid will therefore be developed, consisting of the components and controls of the system. The modeling will be based on physical laws and correlations, known control strategies from literature and existing models from Modelon.

By simulating different configurations of the system in varying operating conditions, the models will be used to evaluate the viability of the different setups. A new web-based platform under development at Modelon will be used for this purpose.

Email: student@modelon.com
Web: http://www.modelon.com

Please attach cover letter, CV, and course transcript to your application.

Student profile: Two motivated and skilled students with a strong background in at least two of the following areas: energy systems, mathematical modeling, automatic control and programming.

Contact: Håkan Runvik, Modelon AB

Next Generation of Energy and Power

Environmental considerations and renewable energy sources are changing the landscape for production, distribution and storage of energy. Modeling, simulation and optimization are crucial tools for this transition to sustainable solutions, which Modelon contributes to through tool development and services.

Motivated and skilled students are therefore invited to submit applications for master thesis projects in this area, utilizing modeling to develop the energy and power systems of tomorrow.

Possible topics include but are not limited to:

- Energy storage
- Fuel cell systems
- Solar power
- District heating
- Combustion
- Steam cycles

Contact: Håkan Runvik, Modelon AB

Theme of Choice

Modelon is constantly looking for motivated and skilled master thesis students with strong focus on modeling and simulation of physical systems as well as good knowledge in mathematics and thermodynamics. A suitable theme can always be discussed and agreed upon.

Contact: Mattias Olsson, Modelon AB

Modelon has well established academic cooperation with several departments at Lund Institute of Technology, LTH. Further, Modelon works together with other universities in and outside of Sweden.