International MINTernship-Program
Transatlantic Energy Research Experiment (TE-REX)

October 14, 2016

Projects available at KIT for research interns from the University of North Carolina at Charlotte (UNCC)

Summer 2017

General Contact
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1. Helium Cooled First Wall and Plasma-Facing Components

Abstract of the project
The First Wall (FW) of fusion power reactor covers the plasma chamber and shields the Breeding Blanket modules from the high heat fluxes generated by nuclear fusion. Ongoing research focuses on the development of cooling channel designs for an effective cooling of the plasma-faced First Wall (FW) of the DEMO fusion power reactor. Structuring fluid-solid-interfaces of the cooling channels by ‘artificial roughness’ elements is an appropriate method for enhancing the heat transfer at the thermally highly loaded, increasing the cooling performance and maintaining the structural temperature of the First Wall below the structural temperature upper limit.

Tasks
- Numerical simulation of turbulent flow and conjugated heat transfer in FW cooling channels with surfaces structured by dimples or structured by flow adapted and structure stress optimized rib-elements.

Requirements
Experience and interest in thermal-hydraulics and fluid dynamics, Basics in CFD

Language Skills
English

Software Skills
-

Other skills
-

Minimum Duration of the project
10 weeks

Type of research project
Project in a research institute

Responsible Professor
Prof. Robert Stieglitz

Supervisor/Mentor of the project
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Faculty, Institute or Name of the Company
Division 3, Institute for Neutron Physics and Reactor Technology

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Campus Nord
Institute for Neutron Physics and Reactor Technology (INR), Building 521
Hermann-von-Helmholtz-Platz 1
D-76344 Eggenstein Leopoldshafen
Germany
## 2. Structured Heat Transfer Surfaces for Highly Loaded Cooling Devices

**Abstract of the project**

Structuring fluid-solid-interfaces of the cooling channels by ‘artificial roughness’ elements (rib-elements, dimples, protrusions) is an appropriate method for enhancing the heat transfer and increasing the thermal performance and efficiency. Although turbulent flows and heat transfer in structured channels have been investigated extensively in the past, the archival literature is deficient for high Reynolds number flows \((Re > 9 \times 10^4)\), as occurring for a multitude of gas-cooled heat exchangers. An experimental setup for non-invasive laser-based measurement techniques was designed that will provide fundamental benchmark data of velocity fields, turbulent quantities and temperature fields of turbulent flow in a one-sided structured, heated square channel. Result will be facilitated an extensive validation and qualification of numerical methods. In the frame of the project, tasks for internship are:

### Tasks

- Design of a test channel made of acrylic glass for flow visualization and pressures drop measurements. Integration of the test channel into the FLEX air loop.
- Numerical simulation (DES, LES) of turbulent flow and heat transfer in the heated channel with transversally oriented rib-elements placed at one channel wall.
- Setup and instrumentation of the test section for performing laser-based flow measurements (Laser-Doppler-Anemometry or Particle Image Velocimetry).

### Requirements

**Language Skills**

English

**Software Skills**

- 

**Other skills**

- 

**Minimum Duration of the project**

10 weeks

**Type of research project**

Project in a research institute

**Responsible Professor**

Prof. Robert Stieglitz

**Supervisor/Mentor of the project**

Dr. Sebastian Ruck

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sebastian.ruck@kit.edu

**Faculty, Institute or Name of the Company**

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Germany
### 3. Power market design US vs EU

**Abstract of the project**
The two largest market areas for electricity are in the US and the EU respectively. Both are liberalized markets in contrast to a state owned, monopoly driven electricity supply system. However, there are still great differences between separate market areas within those two regions and even greater between the US and the EU. An example is the locational pricing in the PJM which is opposed to the approach of a uniform market price for the whole German market area.

**Tasks**
The student will study the market design of the European electricity market mostly by reading reports and papers. He will create an active discussion about the differences in market design within the EU and compared to the US by preparing a discussion on a regularly basis (e.g. weekly). The student will develop a framework in order to identify important differences in market design in an easy-to-comprehend way.

**Requirements**
A deep understanding of energy economics is imperative. Knowledge about electricity markets and different designs (e.g. nodal pricing, zonal pricing, congestion management) will prove very helpful. Most important is a desire to learn more about electricity market designs and the ability to communicate open questions and results.

**Language Skills**
Fluency in English

**Software Skills**
MS Office (Word, Power Point, Excel)

**Other skills**
Curiosity, structured way of working, ability to work independently and autonomously, communication

**Minimum Duration of the project**
4 weeks, 6 weeks

**Type of research project**
Project in a research institute

**Responsible Professor**
Prof. Wolf Fichtner

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Chair of Energy Economics

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Lehrstuhl für Energiewirtschaft
Forschungsgruppe Dezentrale Energiesysteme und Netze
Hertzstraße 16
76187 Karlsruhe
# 4. Integration of European energy markets to an agent-based spot market model

## Abstract of the project
The integration of European energy markets is proceeding in a high pace. Modelling the energy system in order to shape energy and climate policy only on a national level is becoming more and more difficult. This is why the student can, depending on the individual skills, contribute to the integration of different European countries into an agent-based energy market model.

## Tasks
Different tasks can include:
- research of relevant data on electricity market data platforms
- insert/update data in the databases
- literature research regarding different methodologies to include the modelling of different technologies (e.g. renewables, hydropower) or market designs into the model
- implementation of different methods in Java code (depending on personal preferences/coding skills)

## Requirements
- computer skills: some knowledge on data processing/handling
- preferably some background in energy economics, market design or relevant technologies
- Relevant software includes: Java, SQL, Matlab and the like, depending on the individual knowledge, the extend of programming or data handling work can be adjusted

## Language Skills
Fluency in English

## Software Skills
- computer skills: knowledge on data processing/handling
- Additionally, coding skills in java are advantageous
- Relevant software includes: Java, SQL, Matlab and the like, but also Excel, Word, and Power Point. Depending on the individual knowledge, the extend of programming or data handling work can be adjusted.

## Other skills
- enthusiasm for energy related topics, especially economic aspects related to market design
- capable and willing to work in a team

## Minimum Duration of the project
10 weeks, up to six months

## Type of research project
Project in a research institute

## Responsible Professor
Prof. Wolf Fichtner

## Supervisor/Mentor of the project
Florian Zimmermann, Dogan Keles, Joris Dehler

## Supervisor’s Telephone Number
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## Supervisor’s Email
Florian.zimmermann@kit.edu, dogan.keles@kit.edu, joris.dehler@kit.edu

## Faculty, Institute or Name of the Company
KIT - Chair of Energy Economics at IIP

## Address
Building 06.33
Hertzstraße 16
D-76187 Karlsruhe
## 5. Synthesis of lignin model compounds for upgrading in batch reactor

### Abstract of the project

The bio-oil obtained from fast pyrolysis of biomass residues cannot be applied directly as a fuel or petroleum-derived chemicals replacement, due to its high content of oxygen, acidity, high viscosity, lignin fragments as well as high water content. For that reason, further treatment such as Hydrodeoxygenation (which involves the reaction under high temperatures, catalysts and high pressure of hydrogen), are necessary in order to obtain value-added products. Due to the complexity of the bio-oil mixture, model compounds are preliminarily employed, allowing an in-depth understanding of the reactions pathways and providing valuable insights about the conversion of lignin fragments into specific chemicals. The application of synthetized lignin model compounds with higher levels of complexity could bring more realistic understanding related to the reaction pathways as well as the stability and chemoselectivity of the catalyst applied.

### Tasks

The project proposed will synthetize, characterize and compare the application of two lignin model compounds with different levels of complexity, in order to evaluate its conversion in value-added products through Hydrodeoxygenation reactions. Important information about the underlying reaction mechanisms should be investigated. A deep understanding of the model compounds conversion into high value-added chemicals compounds is expected.

### Requirements

Chemistry, Chemical Engineering student or related areas, with knowledge and interest in organic synthesis, able to work and think independently. The candidate must be curious and able to investigate new methods.

### Language Skills

The candidate should be able to communicate and exchange experience with colleagues in English.

### Software Skills

- 

### Other skills

Curiosity, structured way of working, ability to work independently and autonomously.

### Minimum Duration of the project

at least 10 weeks

### Type of research project

Project in a research institute

### Responsible Professor

Prof. Dr. Nicolaus Dahmen

### Supervisor/Mentor of the project

Dr. Klaus Raffelt

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### Supervisor’s Email

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### Faculty, Institute or Name of the Company

Institute of Catalysis Research and Technology (IKFT), Karlsruhe Institute of Technology (KIT)

### Address

Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen
### 6. Implementation of an optimized table lookup algorithm for speeding up in-house thermal-hydraulic codes

**Abstract of the project**
IAPWS ([http://www.iapws.org/](http://www.iapws.org/)) is an international non-profit association of national organizations concerned with the properties of water and steam, particularly thermophysical properties, cycle chemistry guidelines, and other aspects of high-temperature steam, water and aqueous mixtures relevant to thermal power cycles and other industrial and scientific applications. In 1997, IAPWS approved a new formulation of the thermodynamic properties of water and steam for industrial use (referred to as IAPWS-IF97). Read [http://www.iapws.org/reldguide/IF97-Rev.pdf](http://www.iapws.org/reldguide/IF97-Rev.pdf) file for more details about the formulation. These thermophysical properties are used in several in-house codes which share a FORTRAN implementation of the functions. These functions are called a lot of times during a code run and they are responsible of a big portion of the total execution time. In order to speed up the codes that use those properties, an efficient implementation is needed. The idea is to implement a multidimensional table lookup algorithm for fast interpolation of water and steam thermophysical properties (such as viscosity, enthalpy, ...). The table will be based on the existing subroutines which implement the exact solution coming from the IAPWS formulation. The code user, when using the new option, should specify the maximum error allowed for the adjustment of the fitting functions, then the tables will be pre-generated for the given accuracy and then a fast isotropic/anisotropic interpolation will be used during code run. In this way, the code initialization will take longer but then it will run faster. It would also be possible to pre-generate those tables previously and load them into memory for the given range of operating conditions and the required accuracy. Also one can think that the fitting functions should be smooth enough to avoid introducing numerical instabilities during code run.

**Tasks**
- Familiarize with the current implementation of the IAPWS-97 formulation.
- Study the feasibility of implementing different interpolation algorithms and estimate the implementation effort.
- Implementation of the new algorithm, optimization and benchmarking.

**Requirements**
- Programing skills, MATLAB (the first version could be initially implemented in MATLAB)
- Sound mathematics background.

**Language Skills**
- Fluency in English

**Software Skills**
- Programing skills in C or FORTRAN will be welcome.

**Other skills**
- None

**Minimum Duration of the project**
- From 10 weeks to 6 months

**Type of research project**
- Project in a research institute

**Responsible Professor**
- Prof. Robert Stieglitz

**Supervisor/Mentor of the project**
- Dr. Javier Jimenez

**Supervisor’s Telephone**
- +49 721 60822700
<table>
<thead>
<tr>
<th>Number</th>
<th>Supervisor`s Email</th>
<th>Faculty, Institute or Name of the Company</th>
<th>Address</th>
</tr>
</thead>
</table>
|        | javier.jimenez@kit.edu | KIT-INR | Karlsruhe Institute of Technology  
Institute for Neutron Physics and Reactor Technology (INR)  
Campus Nord, Bldg. 521  
Hermann-von-Helmholtz-Platz 1  
D-76344 Eggenstein Leopoldshafen  
Germany |
SUBCHANFLOW is a sub-channel thermal-hydraulic code that solves the three mixture balance equations for single and two-phase for stationary and time dependent conditions. It is being developed at the Institute for Neutron Physics and Reactor Technology (INR) of the Karlsruhe Institute of Technology. SUBCHANFLOW is completely programmed in FORTRAN 95 with global variables and dynamic allocation. The problems addressed are 3D configurations of fuel bundles in Cartesian and hexagonal geometry which are cooled by an upward coolant flow. The code is able to compute the heat transfer between the structures and the fluid as well as the coolant heat up along the axial direction.

Currently, the pressure equation in SUBCHANFLOW can be solved by direct or iterative methods being the last one, the more suitable for large problems with lots of mesh points. This system is solved on each axial layer per iteration. Right now, each axial layer is coupled with the previous one and the solution is done sequentially following the axial direction. The idea is to have an alternative to the current solution method where the axial layers are decoupled, by removing the prerequisite of having computed the previous one, and hence, each layer could be computed in parallel. Possible candidates are a red-black approach or a domain decomposition using MPI on the axial coordinate. This is illustrated in figure 1.

Tasks
- Familiarize with the current solution scheme of SUBCHANFLOW.
- Study the feasibility of implementing different algorithms and estimate the implementation effort.
- Implementation of the algorithm, optimization and benchmarking.

Requirements
- Good programing skills.
- Sound mathematics background.
- Knowledge in C/FORTRAN programing languages

Language Skills
Fluency in English

Software Skills
Knowledge of Unix/Linux

Other skills
None
<table>
<thead>
<tr>
<th><strong>Minimum Duration of the project</strong></th>
<th>From 10 weeks to 6 months</th>
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</thead>
<tbody>
<tr>
<td><strong>Type of research project</strong></td>
<td>Project in a research institute</td>
</tr>
<tr>
<td><strong>Responsible Professor</strong></td>
<td>Prof. Robert Stieglitz</td>
</tr>
<tr>
<td><strong>Supervisor/Mentor of the project</strong></td>
<td>Dr. Javier Jimenez</td>
</tr>
<tr>
<td><strong>Supervisor’s Telephone Number</strong></td>
<td>+49 721 60822700</td>
</tr>
<tr>
<td><strong>Supervisor’s Email</strong></td>
<td><a href="mailto:javier.jimenez@kit.edu">javier.jimenez@kit.edu</a></td>
</tr>
<tr>
<td><strong>Faculty, Institute or Name of the Company</strong></td>
<td>KIT-INR</td>
</tr>
</tbody>
</table>
| **Address**                       | Karlsruhe Institute of Technology  
Institute for Neutron Physics and Reactor Technology (INR)  
Campus Nord, Bldg. 521  
Hermann-von-Helmholtz-Platz 1  
D-76344 Eggenstein Leopoldshafen  
Germany |
### 8. Investigation of CuCr Contact Material for Vacuum Interrupters

#### Abstract of the project
Vacuum interrupters are currently widely used for switching in medium voltage systems. They protect households from over currents and maintain the electrical power supply. During a break an arc is formed which carries the current for a short time of maximum 10 ms. The contact material is melted and resolidified during current breaking. The switching properties depend in large part on the overall chemical composition, particle sizes of the used powders, manufacturing process and geometry of the contacts. However, the physics behind the switching behavior is still not yet completely understood, even though this would be necessary for optimizing the interrupting capacity. This project contributes to shed light on this issue by focusing on the microstructural changes during switching of simple geometry butt-type contacts.

#### Tasks
Investigation of switched CuCr contact material with different composition and Cr-powders
1. Documentation of the samples with light microscopy
2. Examination of chromium particle size as a function of charge and energy with SEM
3. Characterization of the profile and roughness of the melted regions
4. Cross sections and investigation of the melted and heat-influenced volume
The student will read papers to get a basic knowledge and work in the laboratories especially metallographic lab.

#### Requirements
Desire to work practical in a lab, basic knowledge of vacuum interrupters and materials science is beneficial

#### Language Skills
English (or German)

#### Software Skills
MS Office, OriginLab is beneficial

#### Other skills
Experience in material science, metallography is beneficial. Ability to work independently and autonomously.

#### Minimum Duration of the project
8-10 weeks

#### Type of research project
Project in a research institute

#### Responsible Professor
Prof. Dr.-Ing. Martin Heilmaier

#### Supervisor/Mentor of the project
Ulla Hauf

#### Supervisor’s Telephone Number
0721-608 46556

#### Supervisor’s Email
ulla.hauf@kit.edu

#### Faculty, Institute or Name of the Company
Institute for applied materials, material science

#### Address
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Institut für Angewandte Materialien – Werkstoffkunde (IAM–WK) 
Campus Süd 
Gebäude 10.91 
Engelbert-Arnold-Straße 4 
76131 Karlsruhe
# 9. Data Management Services for Energy Lab 2.0

## Abstract of the project
The Institute for Applied Computer Science of the KIT develops a microservice-based software platform for managing data from an energy lab project (Energy Lab 2.0) that studies the challenges and possible solutions for future energy systems. It contains services for time series, master data, digital assets, schema, and internal organizational functions. Data management is driven by semantic model based technologies. The data management platform serves for data analysis, simulation and optimization applications.

## Tasks
Service development with REST (object-oriented software development with Java). Databases (time series databases, MongoDB, SQL, Neo4J, Hadoop – Hbase)

## Requirements
Programming language Java, object oriented software engineering. Database experience is helpful

## Language Skills
Fluency in English

## Software Skills
See requirements

## Other skills
No other requirements

## Minimum Duration of the project
10 weeks

## Type of research project
Project in a research institute

## Responsible Professor

## Supervisor/Mentor of the project
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## Faculty, Institute or Name of the Company
Institute for Applied Computer Science (IAI)

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Karlsruher Institute for Technology (KIT)  
Institute for Applied Computer Science (IAI)  
Dr. Karl-Uwe Stucky  
Hermann-von-Helmholtz-Platz 1  
76344 Eggenstein-Leopoldshafen
### 10. Thermal-hydraulic simulation of liquid metal cooled loop

**Abstract of the project**

Liquid metal thermal hydraulics is a key issue for nuclear and fusion engineering, as well as for solar thermal applications and thermal storages. Currently, several liquid metal cooled loops are in commissioning and construction. To support these processes thermal hydraulic simulations will be performed. Steady state and transient scenarios will be investigated with system codes. The results of the system codes will be used for optimization and operation of the various liquid metal loops. The tool for the simulation is TRACE. TRACE is the thermal hydraulic reference code of the U.S. NRC for analysis of light water reactors during normal operation, transients and accidents. Currently, TRACE is in the process of validation for Generation IV reactors like the liquid metal cooled reactors.

**Tasks**

- Development and/or update of the simulation models
- Identification of transient scenarios
- Simulation of the transients
- Evaluation of the results

Depending on the duration of the internship the following points may be also addressed

- Uncertainty and sensitivity studies to identify the input and boundary conditions with the highest influence on the simulation result

**Requirements**

- Experience and interest in thermal hydraulics and fluid dynamics

**Language Skills**

- English

**Software Skills**

- MS Office

**Other skills**

- none

**Minimum Duration of the project**

- 10 weeks (up to 6 months)

**Type of research project**

- Project in a research institute

**Responsible Professor**

- Prof. Stieglitz

**Supervisor/Mentor of the project**

- Dr. Jaeger

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**Supervisor’s Email**

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**Faculty, Institute or Name of the Company**

- Institute for Neutron Physics and Reactor Technology (INR)

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- Institute for Neutron Physics and Reactor Technology (INR)
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- D-76344 Eggenstein Leopoldshafen
- Germany
## 11. Dynamic behavior of liquid metal systems

**Abstract of the project**
Liquid metal thermal hydraulics is a key issue for next generation energy systems including thermal storage devices. At KIT several liquid metal cooled loops are in commissioning and set-into operation on different scales and topologies. Experiments are performed and have to be analyzed to support qualification and improvement of thermal hydraulic simulation codes on system and CFD level s. The work is performed together with the responsible scientist and the operational team. ([http://www.inr.kit.edu/238.php](http://www.inr.kit.edu/238.php))

**Tasks**
- Analysis and interpretation of experimental data using different tools
- Discussion with operational team
- Documentation / Evaluation of the results

Depending on the duration of the internship the following points may be also addressed
- Proposal of new tests and their performance (after approval)

**Requirements**
- Experience and interest in thermal hydraulics and fluid dynamics

**Language Skills**
- English

**Software Skills**
- MS Office, MATLAB

**Other skills**
- None

**Minimum Duration of the project**
- 10 weeks (up to 6 months)

**Type of research project**
- Project in a research institute

**Responsible Professor**
- Prof. Stieglitz

**Supervisor/Mentor of the project**
- Dr. Wolfgang Hering

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**Supervisor’s Email**
- Wolfgang.Hering@kit.edu

**Faculty, Institute or Name of the Company**
- Institute for Neutron Physics and Reactor Technology (INR)

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- Institute for Neutron Physics and Reactor Technology (INR)
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- D-76344 Eggenstein Leopoldshafen
- Germany
### 12. Radiant and convection heating systems: CFD and experimental study of the performances and thermal comfort

**Abstract of the project**

The main objective of the core project called “LowEx” is to develop energy-efficient heating concepts and systems for existing multi-family houses. In order to achieve this goal, novel low-temperature supply heating systems including electric/gas heat pumps and improved radiant and convection heating systems are evaluated.

Towards the goal of LowEx project, the building science group (fbta) of KIT develops simulation and experimental techniques in order to evaluate performances of the radiant and convection heating systems in terms of thermal comfort, air temperature distribution and air draft.

In this study, human models are integrated with building models in order to provide more insight into the thermal comfort issues. Simulation techniques are applied for the simulation and visualization of thermal comfort parameters. Experimental analyses are performed in an advanced laboratory for occupant behavior called LOBSTER (www.lobster-fbta.de).

**Tasks**
- To perform thermal comfort experiments
- To evaluate different radiant and convection heating systems

**Requirements**
- Basic understanding/interest of/in human thermal comfort analysis
- Interested in simulation software

**Language Skills**
Fluency in English

**Software Skills**
Data analysis software such as excel, R and MATLAB

**Other skills**
N.A

**Minimum Duration of the project**
6 weeks

**Type of research project**
Project in a research institute

**Responsible Professor**
Prof. Andreas Wagner

**Supervisor/Mentor of the project**
Dr. Reza Safizadeh

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Faculty of Architecture, IEB, fbta

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76131 Karlsruhe
# 13. Data-Driven Forecasting Approaches with Applications in Energy Systems

<table>
<thead>
<tr>
<th>Abstract of the project</th>
<th>The current installation increase in weather dependent renewable energy systems (e.g. photovoltaic, wind) as well as the -in correspondence- desired increment of automation in the electrical grid, have made accurate forecasting models (for both power generation and load) a necessity. For such reason, the Institute for Applied Computer Science at the KIT is currently researching novel data-driven forecasting approaches which could help the future developments of the electrical grid. The researched approaches can more specifically be divided into probabilistic forecasting (i.e. models able to quantify their forecast uncertainty) and structured forecasting (i.e. exploiting the information hidden in the structure underlying an energy system) methods.</th>
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<tbody>
<tr>
<td>Tasks</td>
<td>Investigation and development of novel data-driven – probabilistic and/or structured - forecasting models on the basis of electrical and heat load data from KIT’s North Campus.</td>
</tr>
<tr>
<td>Requirements</td>
<td>Knowledge in data-driven modelling as well as forecasting approaches is preferred but not required</td>
</tr>
<tr>
<td>Language Skills</td>
<td>Fluency in English</td>
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<tr>
<td>Software Skills</td>
<td>Programming knowledge in MATLAB and/or R</td>
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<td>Other skills</td>
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<td>10 weeks</td>
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<td>Type of research project</td>
<td>Project in a research institute</td>
</tr>
<tr>
<td>Responsible Professor</td>
<td>Ralf Mikut</td>
</tr>
<tr>
<td>Supervisor/Mentor of the project</td>
<td>Jorge Ángel González Ordiano Nicole Ludwig</td>
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<td><a href="mailto:jorge.ordiano@kit.edu">jorge.ordiano@kit.edu</a> or <a href="mailto:nicole.ludwig@kit.edu">nicole.ludwig@kit.edu</a></td>
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<tr>
<td>Faculty, Institute or Name of the Company</td>
<td>Department of Mechanical Engineering, Institute for Applied Computer Science (IAI)</td>
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<td>Address</td>
<td>Karlsruhe Institute of Technology (KIT) Institute for Applied Computer Science Hermann-von-Helmholtz-Platz 1 76344 Eggenstein-Leopoldshafen</td>
</tr>
</tbody>
</table>
### 14. Fuels from Microalgae by hydrothermal liquefaction

#### Abstract of the project

Biofuels production is expected to provide new opportunities for environment friendly renewable energy. Compared to other types of biomass sources, the interest in microalgae has been constantly increasing in the last few years due to its high photosynthetic ability, high growth rates and adaptability to a variety of environment conditions. However the high cost for algae cultivating, harvesting, and down-stream processing still remains as a handicap for its industrial application. In order to make microalgae based biofuels economically viable, in this project, hydrothermal liquefaction (HTL) will be applied as the major conversion method. HTL is a thermal depolymerization process for converting high water content biomass into bio-oil or biocrude, at temperatures of 280-370 °C and high pressures of 10-25MPa. By avoiding the energy consuming drying process, an economic benefit of the HTL process can be expected when compared to other thermochemical conversion methods. A continuous HTL process is of great importance to microalgae based biofuel application. At IKFT, micro autoclaves and a continuous stirring tank reactor, is used to liquefy micro algae.

#### Tasks

Possible tasks to be assigned to the research assistant, also depending on the individual interests of the student:
- Cultivation and harvesting of microalgae biomass
- Batch scale HTL and continuous HTL (major work, the HTL dependence of reaction temperature, feedstock concentration, holding time and so on)
- Product extraction and separation
- Reporting

#### Requirements

- Chemistry, Biology or Chemical engineering background is preferred
- English fluently
- MS Office(Word, Power Point, Excel),Origin
- Basic chemical lab working skill is welcome
- 10 weeks
- Project in a research institute
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