## inf513 - Energy Informatics Practical

<table>
<thead>
<tr>
<th>Module label</th>
<th>Energy Informatics Practical</th>
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<tbody>
<tr>
<td>Module code</td>
<td>inf513</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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<tr>
<td></td>
<td>Master's Programme Business Informatics &gt; Bereichswahlmodule</td>
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<td></td>
<td>Master's Programme Computing Science &gt; Angewandte Informatik</td>
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<tr>
<td></td>
<td>Master's Programme Embedded Systems and Microrobotics &gt; Akzentsetzungsmodule</td>
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### Contact person

- Module responsibility
  - Andreas Hein
  - Jorge Marx Gomez
  - Sebastian Lehnhoff
  - Die im Modul Lehrenden

- Authorized examiners
  - Andreas Hein
  - Jorge Marx Gomez
  - Sebastian Lehnhoff
  - Die im Modul Lehrenden

### Entry requirements

- Programming with JAVA

### Skills to be acquired in this module

- Successfully completing this lecture will enable the students to mathematically model simple controllable electrical generators and consumers and to simulate them together with appropriate control algorithms within smart grid scenarios. To achieve this goal, students will start with deriving computational models from physical models and evaluate them. In order to manage the integration of control algorithms, students are taught the principles of cosimulation using the "mosaik" smart grid co-simulation framework as an example.

- Students will be able to understand and apply distributed, agent-based control schemes to decentralized energy generators and/or consumers. As a result, students are able to analyze the requirements for successful application to real power balancing regarding capacity utilization, robustness, and flexibility.

- In addition, students learn the foundations of planning and conducting simulation based experiments as well as the interpretation of the results. Special attention will be paid on establishing a balance between the results' precision and robustness and the necessary effort (design of experiments) in order to gain as much insight into interdependencies with as few experiments as possible.

### Professional competence

- The students:
  - derive and evaluate computational models from physical models
  - use the "mosaik" smart grid co-simulation framework
  - analyze the requirements for successful applications to real power balancing regarding capacity utilization, robustness, and flexibility
  - name the foundations of planning and conducting simulation based experiments as well as the interpretation of the results
  - are aware of the balance between the results' precision and robustness and the necessary effort (design of experiments) in order to gain as much insight into interdependencies with as few experiments.

### Methodological competence

- The students:
  - model simple controllable electrical generators and consumers
  - simulate simple controllable electrical generators and consumers with appropriate control algorithms within smart grid scenarios
  - apply distributed agent-based control schemes to decentralized energy generators and/or consumers
  - evaluate simulation results
  - search information and look into methods to implement models
  - propose hypothesis and check their validity with design of experiments methods

### Social competence

- The students:
apply the pair programming development technique
• discuss design decisions
• identify work packages and are responsible for it

Self-competence
The students:
• reflect on their own use of power as a limited resource
• accept and use criticism to develop their own behaviour

Module contents
In this practical course students:
• model controllable, modulating electrical energy generators and consumers,
• put their hands on mosaik (installation, description and configuration of scenarios, conduction of simulations),
• learn the principles of agent-based heuristics for optimization problems in future smart grid scenarios,
• learn about the challenges of implementing agent-based mechanisms (multi-criticality, convergency, quality) on the training.
• learn the foundations for choice and design of simulation based experiments.

Reader’s advisory
Suggested reading:

Smart Grids:

Multiagentensysteme:
• Ferber J.; Kirn, S.: "Multiagentensysteme: eine Einführung in die Verteilte Künstliche Intelligenz", Addison-Wesley, 2001

Co-Simulation

Versuchsplanung:
• Kleppmann, W.: "Versuchsplanung", Hanser, 2013
• Klein, B.: "Versuchsplanung - DoE", Oldenbourg, 2011

Links
http://mosaik.offis.de

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
jährlich

Module capacity
unlimited

Reference text
Elective module in the master specialization area (energy computer science).

Associated with the modules:
- Energieinformationssysteme
- Smart Grid Management

<table>
<thead>
<tr>
<th>Modullevel</th>
<th>AS (Akzentsetzung / Accentuation)</th>
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<tbody>
<tr>
<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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</table>
| Lern-/Lehrform / Type of program | - Programmierung mit Java 
|             | - Programmierung mit Python |
| Vorkenntnisse / Previous knowledge | |

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>At the end of the semester</td>
<td>Oral exam</td>
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<th>Practical</th>
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<tr>
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