Master Thesis Project
MODEST: **Mo**delica **D**riven Power System Mod**e**ling, **S**imulation and Valida**t**ion

Background

KTH participates in several work packages of the FP7 iTesla project. See: http://www.itesla-project.eu/

iTesla will utilize the Modelica language to describe dynamic components of power grids. Modelica is an object-oriented equation-based modeling language that allows for very detailed and consistent representation of system dynamics and is widely used by different industries such as the automotive industry, process control, and others.

To guarantee that the dynamic power system models represented within the iTesla toolbox, this project aims to develop different power system models to be used in model validation tasks primarily, and other tasks related to dynamic security assessment.

With this project, KTH will make a contribution to the iTesla project that will allow for a timely achievement of project milestones.

Project Outline

One student will be recruited for this project and carry out the work at the SmarTS Lab (at KTH) and to collaborate with other iTesla projects partners.

This project aims to develop Modelica classes for each of the models of the components and utilize these classes to represent the following:

- iMN01: the KTH Nordic 32 model,
- iMN02: the IEEE Nordic 32 Voltage Stability Test Model,
- iNGSVC: a model of a sub-set of National Grid's network including two SVCs and
- iGrGen: a model of a generator plant in Greece.

In addition, the project considers both Software-to-Software validations of the component classes using PSAT. Software-to-software validation of the full models iMN01, iMN02 and iNGSVC should be carried out using PSAT, Matlab/Simulink, and PowerFactory; according to the original software in

which they were developed. There is no reference model for model iGrGen – the Modelica model will be built based on specifications of the plant.

Finally, a measurement-based model validation will be performed for Models iNGSVC and iGrGen using the RaPId toolbox developed in iTesla by KTH, see this link for details on RaPId: http://www.eps.ee.kth.se/personal/vanfretti/Luigi_Vanfrettis_Website/Software.html

This will be carried out for selected scenarios available from data gathered for iTesla as a first attempt to develop methods for model validation.

The payment for this master thesis will be provided by the FP7 iTesla project.

The application for this master thesis should be sent to the main contacts (Tetiana Bogodorova and Rafael Segundo Sevilla) with the personal CV and transcripts of Bachelor and Master attached. The deadline for the application will be the end of November of 2013, but it is encouraged to begin you application as soon as possible because the interview might end before the deadline once the qualified candidate is found.

Objectives / Tasks

1. Software Model Development using Modelica:
    a. Development of Modelica power system component models corresponding to PSAT for model iMN01.
    b. Development of Modelica power system component models corresponding to the Matlab/Simulink models used in iMN02.
    c. Development of Modelica power system component models corresponding to the PowerFactory models used in iNGSVC.
    d. Development of Modelica power system component models for model iGrGen using PSAT component models as a reference.
2. Software-to-Software model validation
    a. Develop small-scale power system models and use generic model parameters to perform software-to-software validation.
    b. Perform a Modelica-to-reference software validation for the Modelica models developed in Task 1.
3. Modelica implementation of power system models for model validation.
    a. Utilize the classes developed above to set-up the Modelica models iMN01, iMN02, iNGSVC, and iGrGen.
    b. Perform validation tests against reference software for iMN01, iMN02, and iNGSVC.
4. Measurement-based Model Validation
    a. Perform model validation for models iNGSVC and iGrGen for selected scenarios available from data gathered for iTesla
5. Reporting as outlined below
    a. Preparation of digital files for transfer to KTH
    b. Prepare all the digital files for deliverance to different parties
6. Detailed documentation of models within the digital files

Deliverables

The reports on the progress of the work need to be presented to the supervisor during regular team meetings on weekly basis. These reports will serve as a basis for discussion and feedback on the work in progress.

At the end of the project a written report should be produced and a final presentation held.

The development of models should be clearly documented and any resulting models and software in any of the simulation platforms shall be provided to SmarTS Lab for further development.

Additionally, the students need to be part of the writing process of a paper on the subject with the results obtained and are required to enroll the course EG2011 "Publication of Mater´s Project within Electric Power Systems" simultaneously.

Summary of deliverables:

1. Software Models
    a. All developed Modelica system models
    b. All developed PSAT or similar system models for SW-to-SW validation
    c. All computer files used to perform simulations, scripts for plotting of results, and any other form of computer software developed during the project
2. Model Validation Methods and Results
    a. Thoroughly document model validation methods developed for Task 4
    b. Provide detailed results and computer files to reproduce the results of Task 4
3. Reporting to iTesla and coordination with iTesla project participants
    a. Produce quarterly reports in .pptx format to be used in iTesla
    b. Produce a report in LaTex or .docx form documenting the results obtained to be used in iTesla deliverables.
4. Reporting to KTH
    a. Produce a MSc thesis of high quality
    b. Prepare at a minimum (1) conference paper for publication in a reputable conference to be agreed upon with the Examiner and supervisors.
5. Delivering digital files with documentation

Time Plan

The master thesis will be carried out during 9-12 months (depending on project progress).

The project is thus planned in terms of the performance of each of the project Tasks and Deliverables as shown in the Table below.

Task	Duration/Completion	Deliverable	Completion
1: a, b, c, and d	Month 1-3	1: a., 3.a	Month 4
2: a, b, c, and d	Month 1-4	1: b. and c, 3.a	Month 5
3: a and b	Month 5-6	1: a., b, and c 3.a	Month 7
4: a	Month 7-9	2: a, b, 3.a	Month 9
5	Month 9-10	3. a., b.	Month 11
6	Month 10-11	All from 1-5	Month 11

Given that the project is planned for 1 year of duration, any expected delays will be considered and accounted for a maximum of 1 month.

Supervisors and Examiner Contact Information

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