

**TITLE:**

Equation-Based Physical Modeling of Electrical Power Systems using OpenIPSL and OpenModelica

**Teachers:**

Luigi Vanfretti, Associate Professor & Docent

<https://www.kth.se/profile/luigiv/>

Maxime Baudette, PhD Student

**Affiliations:**

KTH SmarTS Lab, KTH Royal Institute of Technology, Stockholm, Sweden

**Duration:** ~ 120 min.

**Abstract:**

The Modelica language is a standardized and equation-based modelling language has proven valuable for the for model exchange, simulation and even for model validation applications in actual power systems. These important features have been now recognized by the European Network of Transmission System Operators, which have adopted the Modelica language for dynamic model exchange in the Common Grid Model Exchange Standard (v2.5, Annex F).

Following previous FP7 project results, within the ITEA 3 openCPS project, the presenter has continued the efforts of using the Modelica language for power system modeling and simulation, by developing and maintaining the OpenIPSL library: <https://github.com/SmarTS-Lab/OpenIPSL>

The tutorial first gives an overview of the origins of the openIPSL and it's models, it contrasts it against typical power system tools, and an introduction the OpenIPSL library. The new project features that help in the OpenIPSL maintenance (use of continuous integration, regression testing, documentation, etc.) are also described.

The second part of the tutorial is aimed to help students start using OpenIPSL. It consists of working with three examples, we assume you have very little experience with OpenModelica and the Modelica language, so detailed instructions will be provided. **Bring your Laptop!**

In the first example, you will work setting up a power system from scratch and performing simulations using OpenModelica and the OpenIPSL. The second example consists on performing linear analysis and implementing a power system stabilizer for the model of example one. Finally, in the third example, you will perform simulations of a typical IEEE 9-Bus power systems and perform a

simple analysis of results.

### **Youtube Videos!**

See an overview of OpenIPSL here: <https://youtu.be/H6h9s4iMzA8?t=3616>

### **Bio:**

L. Vanfretti (IEEE SM'14) obtained the M.Sc. and Ph.D. degrees in electric power engineering from Rensselaer Polytechnic Institute, Troy, NY, USA, in 2007 and 2009, respectively.

He is an Associate Professor (Tenured) and Docent at KTH Royal Institute of Technology, Stockholm, Sweden. He was a Special Advisor for the R&D division of Statnett SF, the Norwegian power system operator, from 2013-2016; and external consultant during 2011-2012, and 2016-2017.

He is a member of the IEEE PES, where he has served in many technical leadership roles including Chair of the PSDP WG on Dynamic Measurements. He is a former member of CIGRE, where he contributed to several working groups in the area of synchrophasor technology.

His research interests are in the area of synchrophasor technology applications, cyber-physical power system modeling, simulation, stability and control; and model-based systems engineering (MBSE).

He is an advocate and evangelist for free/libre and open-source software, Associate Member of the Free Software Foundation, and member of the Open Source Modelica Consortium. To support Open Source Software, Prof. Vanfretti and his research team have made available different software tools in the following repositories in GitHub:

<https://github.com/SmarTS-Lab/>

<https://github.com/SmarTS-Lab-Parapluie>