Tutorial: Getting Started with Power System Modeling using Modelica and OpenIPSL

General Information:

Date	Tuesday May 26th, 2026
Location	S108 (FAN D), Campus University of Bayreuth, Universitätsstr. 30, 95447 Bayreuth
Time	From 9:30 am to 5:00 pm
Instructor	Prof. Luigi Vanfretti, Rensselaer Polytechnic Institute, USA
Cost	Free of Charge (including lunch)
Registration	Send an email to iem@uni-bayreuth.de with the subject "Modelica Tutorial Registration" and include your full name, affiliation, position, and contact details in the message.

Introduction:

Modeling and simulation are essential for a myriad of power engineering functions, from planning power grid expansions to real-time market operations. However, existing modeling and simulation technologies lack portability requiring reimplementation and creating ambiguity, while locking-in data and analysts to a few domain-specific tools.

The open access Modelica language offers a new paradigm when applied for power system dynamic simulation. Modelica provides an opportunity to build interoperable object-oriented equation-based models that are supported by multiple tools and that take advantage of advanced modeling constructs and simulation innovations. This has the potential of drastically reducing modeling costs, especially those required to meet the rapid changes that power grids are undergoing to introduce more renewable energy sources.

Built using the Modelica language, the Open-Instance Power Systems Library, OpenIPSL (online http://openipsl.org), allows for phasor-based modeling (also known as RMS modeling) of electric power generation, transmission and distribution networks.

Consistent with utility practices on modeling and parameter data, the library aims to provide a complement for researchers to exploit capabilities either not available in domain specific tools or difficult to leverage.

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Objectives:

This one-day tutorial will introduce the Modelica language and the OpenIPSL.org library for power system dynamic modelling and simulation. The tutorial will provide hands-on examples for beginners, present the new developments from v.1.5 to v.2.0 and towards v.3.x which should be released during 2026. The tutorial will be conducted with the OpenModelica software, one of the Modelica-compliant tools that can use OpenIPSL, so that all attendees can participate in hands-on exercises. The tutorial will introduce Modelica language concepts and features of the OpenModelica environment throughout the tutorial, no prior experience is necessary.

Tentative Tutorial Schedule:

10:00	12:00	***Part 1 – Introduction and Basics***
		• Preparations:
		  ○ Checking your SW installation
		  ○ Installing SW if you have not done so yet
		• Generalities:
		  ○ Modelica in Brief
		  ○ OpenModelica Overview
		  ○ OpenIPSL Overview
		  ○ A look into the new features in the development/recent release version of OpenIPSL
		Part 2 – Building your own models!
		• Example 1: SMIB Model Implementation and Simulation
		  ○ Creating a Modelica package
		  ○ Using inheritance graphically and in the text layer
		  ○ Creating a power plant model using the "Generator" interface and including its voltage regular controls

12:00	13:30	Lunch (included)

14:00	16:00	***Part 2 – Building your own models!***
		• Example 1: SMIB Model Implementation and Simulation
		  ○ Creating a power system model and parametrizing the model's components
		  ○ Running simulations with OpenModelica's GUI
		• Example 2: Creating model variants
		  ○ Creating a new model variant of the power plant
		  ○ Using inheritance to build a new power system model with the variant
		• Interactive Analysis with OM Notebook
		  ○ Introduction to OMNotebook
		  ○ Basic commands of OpenModelica's Scripting API to load models and run simulations through OMNotebook
		  ○ Linearizing models
		  ○ Parametric Sweep and Plotting

16:00	17:00	Q&A Session

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Important Notes:

- Instructions to download and install the required SW will be given prior to the event.
- The participants must bring their own computer.
- The participants **must** have the ability to install software on their own computer and have the proper user rights to run the software.
- Internet access will be provided.
- The tutorial will only take place in-person, it will not be streamed for remote participation.

Instructor Bio:

Luigi Vanfretti (Senior Member, IEEE) was born in Guatemala and obtained his Engineering Degree with a concentration in Electrical Power in 2005 from Universidad de San Carlos de Guatemala. He then received the M.Sc. and Ph.D. degrees in electric power engineering from the Rensselaer Polytechnic Institute (RPI), Troy, NY, USA, in 2007 and 2009, respectively. He held postdoctoral research posts both at RPI and KTH Royal Institute of Technology, Sweden, in 2010.

He is currently a Full Professor at Rensselaer Polytechnic Institute, since July 2022, where he was a tenured Associate Professor from 2017-6/2022-6. At RPI, he leads research projects in his laboratory and with his research team, ALSETLab, in the domains of electrical power and energy systems in the context of utility networks and electrified transportation.

Professor Vanfretti has held temporary posts in prestigious international institutions, in 2019 he was a Visiting Faculty at the King Abdullah University of Science and Technology, Thuwal, Saudi Arabia; in 2022 he was a Visiting Professor at both the Laboratoire Ampère of the École Centrale de Lyon in 2022 and 2025, and at the SuperGrid Institute in 2022, both located in Lyon, France; and in 2023-2024 he was Visiting Faculty at the Mitsubishi Electric Research Labs., in Cambridge, MA.

In addition to his academic duties, through Vanfretti Consulting LLC, Dr. Vanfretti he has served as a consultant for utilities and research institutions, including Dominion Energy in Virginia, USA, the SuperGrid Institute in Lyon, France, and CENACE (the power system operator of Ecuador), Quito, Ecuador, to name a few.

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Professor Vanfretti was an Assistant Professor, Associate Professor (tenured) and a Docent with the KTH Royal Institute of Technology, Stockholm, Sweden, from 2010 to 2013 and from 2013 to 2017, respectively, where he led the SmarTS Lab (a research group). He was with Statnett SF, the Norwegian transmission system operator, from 2013 to 2016, as a Special Advisor with the Research and Development Department and as a consultant, from 2011 to 2012 and in 2017.

His research interests are in “electrified systems,”’ and include physics-based system modeling, simulation, stability and control in the domains of power grid and electrified transportation, both vehicles and infrastructure. In addition, he performs research on synchrophasor technologies, both on technology development and data analytics, and is interested in the application of software technologies, signal processing, system identification and machine learning for design and operation analytics for energy systems.

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