

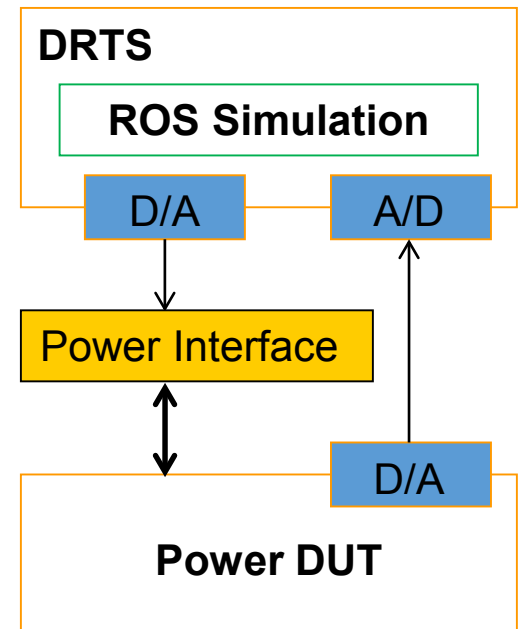
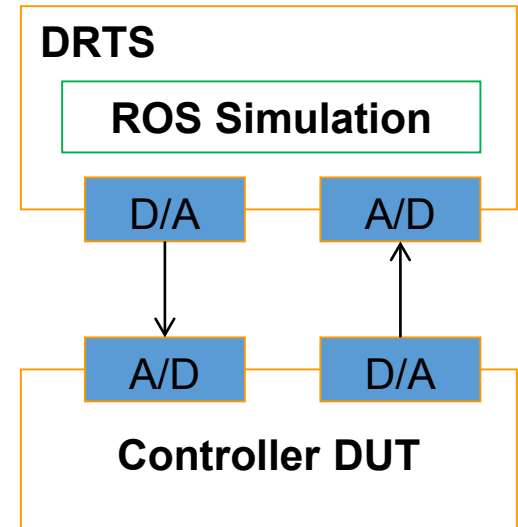
Recommended Practice for Hardware-in-the-Loop (HIL) Simulation Based Testing of Electric Power Apparatus and Controls

Newly established IEEE WG P2004



Background

- In HIL based testing a device under test (**DUT**) is **interconnected** with a rest-of-system (**ROS**) simulation executed on a digital real-time simulator (**DRTS**).
- In case of the **DUT** being a **controller** the interconnection between the DUT and the HIL simulation typically requires signal level interfacing and results in a controller-HIL (**CHIL**) simulation.
- If the **DUT** is a **power apparatus**, appropriate **power amplifiers** are required to arrive at a power-HIL (**PHIL**) simulation



Need & Scope

- Need:
 - Hardware-in-the-Loop (HIL) simulation (in power systems) has been researched for +15 years
 - HIL is used in industry and academia for **cost effective evaluation of new technology** in a **system relevant environment**.
 - However, **no standard exists** that provides guidance and recommends **best practices** for the application of HIL simulation.
- Scope:

This recommended practice provides **established practices** for the use of the method of **Hardware-in-the-Loop (HIL) Simulation based Testing** of **Electric Power Apparatus and Controls**. It is intended to be **generically applicable** in synergy (in conjunction) with any specific testing standard (if applicable).

IEEE WG P2004 Basics

- Chair: **Michael “Mischa” Steurer**
Florida State University, Tallahassee, FL, USA,
- Co-Chair: **Georg Lauss**,
Austrian Institute of Technology,
Vienna, Austria
- Secretary: **Blake Lundstrom**,
National Renewable Energy Laboratory,
Golden, CO, USA
- Sponsor: **PELS**
- Co-sponsor: **IAS, IES**
- PAR ends **12/31/2021**



The philosophy of P2004

- In the development phase WG P2004 will **bring together all the stakeholders** interested in HIL such as HIL equipment manufacturers, users, consultants, testing facilities, regulatory agencies, research facilities, and members of academia.
- This WG will **draw extensively upon previous work** conducted by the IEEE task force (TF) on “Real-Time Simulation of Power and Energy Systems”, chaired by Dr. Omar Faruque, under the IEEE WG 15.08.09 on “Modeling and Analysis of System Transients Using Digital Programs” (within the General System Subcommittee of the IEEE PES T&D Committee)
- P2004 will serve as a **platform** to further **promote HIL testing** and **educate** the broader audience about this method

The philosophy of P2004

- The intent of WG P2004 is to remain **agnostic to the specific real-time simulation and power amplifier technologies** but focus on the **structures, models, and procedures** specific to **conducting HIL based testing**
 - One challenge P2004 will have to overcome is to keep the document as generic as possible so it does not conflict with existing testing standards
- P2004 will
 - Establish **practices for ROS model development**
 - Discuss **HIL specific documentation, verification and validation**
 - Provide **guidance on requirements for power amplifiers, DRTS, and HIL interface algorithms** for **classes of HIL testing needs**

IEEE WG P2004 meetings

Proposal for meetings / Web-Co's:

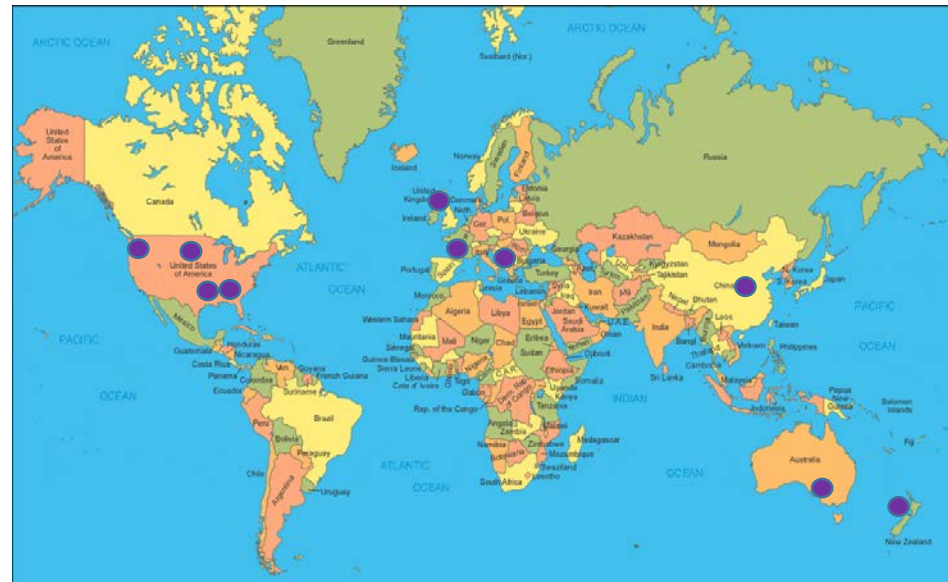
- 2 face-to-face meetings per year
- 1 web-conference per month

Meetings can be organized in combination with major conferences or international workshops as follows:

- IEEE ECCE (Sept/Oct)
- IEEE IES ISIE (June)
- IEEE IES IECON (Oct/Nov)
- IEEE PES GM (July/Aug)
- IEEE PES ISGT (all year)
- and many more ...to be announced

Possible IEEE WG P2004 meeting locations

- **Oct., 2017, Cincinnati, USA (IEEE ECCE)**
- June, 2017, Edinburgh, Scotland (IEEE ISIE)
- July, 2017, Chicago, USA (PES GM)
- Nov., 2017, Beijing, China (IES IECON)
- Feb., 2018, Hamilton, New Zealand (IESES)
- Feb., 2018, Lyon, France, (ICIT)
- Apr., 2018, USA, (Grid Simulator WS)
- Aug., 2018, Portland, USA (PES GM)
- Sept., 2018, Portland, USA (IEEE ECCE)
- Oct., 2018, Washington, USA (IECON)
- Oct., 2018, Sarajevo, Bosnia (ISGT)
- Feb., 2019, Melbourne, Australia (ICIT)
- Apr., 2019, USA, (Grid Simulator WS)
- ... and many more



Contact IEEE WG P2004

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- Data repository and web site: IEEE iMeet work space

How to sign up?

- Sheet is passing around right now
- Email Blake Lundstrom