

Project Summary

1. Title:

Collaborative educational program on synchrophasor applications for the smart electric grid

2. Principal Investigators (PI):

Prof. Anurag K Srivastava, Prof. Mani Venkatasubramaniam, Prof. Dave Bakken, and Prof. Chen-Ching Liu

3. University:

Washington State University

4. Contact information:

Anurag K Srivastava

Assistant Professor, School of Electrical Engineering and Computer Science

Director, Smart Grid Demonstration and Research Investigation Lab (SGDRIL)

Energy System Innovation Center (ESIC)

EME 31, 355 Spokane St

Washington State University

Pullman, Washington 99164-2752

phone: 509-335-2348

email: asrivast@eecs.wsu.edu

<http://www.eecs.wsu.edu/~asrivast/SGDRIL/index.html>

5. Project Description:

Education and training will play a critical role in the successful deployment of synchrophasor technology and meeting real time operational goals. Business value of these measurements can only be realized by dedicated trained personnel with better understanding of synchrophasor technologies. Our industry project partners include: Entergy Services, OSIsoft, Schweitzer Engineering Lab, and Southern California Edison. This project focuses on following specific objectives:

- Objective 1. Develop collaborative model among Washington State University and industry members
- Objective 2. Advancing engineering curriculum related to synchrophasors applications
- Objective 3. Develop training module for industry members

To achieve these objectives, we plan to:

- Involve Industry Collaborators in Course Development and Course Delivery
- Create Internship opportunity for Students with Access to Real Time data
- Develop Collaborative Senior Design Projects
- Access to Synchrophasor Data Collected from Utility Distribution System
- Access to PI Server and SEL Synchrophasor Devices
- Integrate Synchrophasors Topics and Research into Power Engineering Curriculum
- Develop Hands-on Module Utilizing RTDS based PMU Experiments
- Develop Course Module for Real Time Computation and Visualization
- Integrate PMU Track within WSU Annual Hands-On Relay School
- Develop Youtube Educational Short Videos on Synchrophasor Application

- Develop Training Module Targeted for Industry Member

We will install PMU's at couple of WSU campuses in WA State using office power outlet. Additionally, we are working with industry partners to get distribution system PMU data from OSIsoft and SEL office. PMU data will be also generated using smart grid test bed at WSU Pullman campus. All these data will be archived using OSIsoft PI server and frequency information will be analyzed for events. Using real time digital simulator based simulation; several hands-on-module will be developed to learn key concepts as part of engineering courses. Fig. 1 shows the real time smart grid test bed at WSU with PMU from several vendors.



Figure 1: Real time smart grid test bed at WSU

Additionally, senior design team will work on key problems with industry collaborations. Developed courses will be available online through WSU global campus. Also, training module and youtube video with basic demonstrations will be available for industry training.

Progress achieved to date:

A Server for PI System has been acquired and placed at Smart Grid Demonstration and Research Investigation Lab (SGDRIL), WSU. The server can analyze and visualize all of the collected PMU data by 8 PI clients. PI system will collect not only local PMU data but also PMU data remotely by network. Schweitzer Engineering Lab, one of the industry partners, already shipped PMU and clock to SGDRIL as planned to be installed at remote location. Another PMU order is in place from national Instruments. A graduate student and an undergraduate student are being trained on PI System at SGDRIL, WSU via OSIsoft vCampus.

A senior design team funded by this project started to work on designing prototype PMU using National Instruments devices.

A new lecture track on PMU will be offered in WSU hands-on relay school, which is generally attended by more than 500 industry employees. Development of course modules are in progress and courses will be offered online through WSU global campus as new online power engineering program.

6. Expected research outcomes:

- Senior design project and deliverables: New phasor estimation algorithms for better performance in steady state and dynamic state, industry solution related to synchrophasor applications
- Graduate student: Phasor estimation algorithm for distribution system
- Enhanced research and analysis lab at WSU

7. Expected education outcomes:

- Enhanced educational lab at WSU
- Student Internship
- Improved courses contents and new course modules
- PMU track as part of WSU hands-on relay school for professional development
- Educational Training Module and short videos for industry (Start: Year 2, Q1; End: Year 2, Q3)
- Students training
- Publications and Presentations

8. Areas offered as opportunities for possible collaboration:

- Smart grid test bed can be used for PMU testing, PMU based application testing including communication infrastructure
- Any participants can take online courses available through global campus. Additionally course module can be adopted by other instructors or for training purpose
- Enhanced test bed can collect data from other PMU's for further analysis using PI server interface