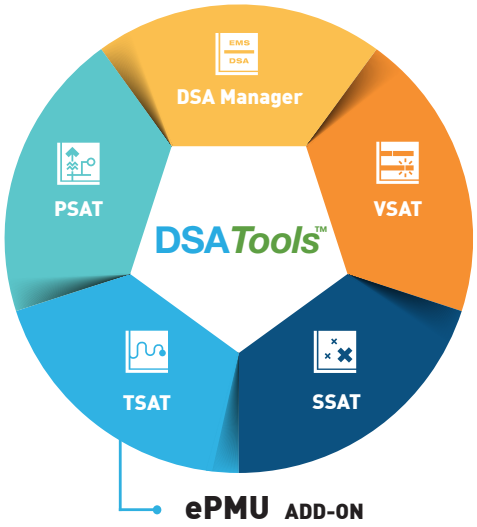
ePMU PMU Data Generator

The ePMU module is an add-on function for TSAT, which provides time-synchronized phasor data from a power system model, similar to those measured by PMU.



Because the simulations with TSAT are done with the positive sequence phasor model, ePMU is capable of simulating systems of very large sizes, up to 10,000 buses, in near real time. For even larger system models, a save/playback feature is available to generate PMU data.

APPROACH

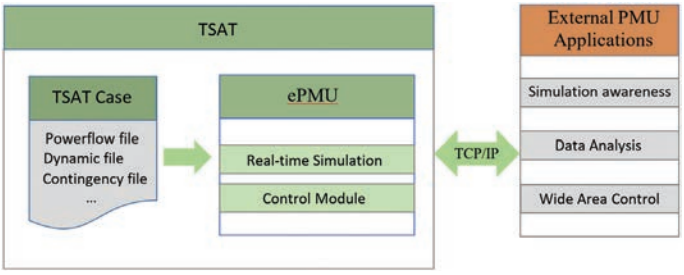
The ePMU module is based on the following techniques:

- Near real-time simulations using TSAT:
  - Simulations are controlled to progress at near real-time.
  - Virtual PMU can be placed at any locations in the system model to obtain emulated phasor data.
  - Emulated phasor data is streamed with accurate reporting rate.
- Capability of interacting with external switching/ control actions:
  - This can be done "on-the-fly" during simulations.
  - A rich set of switching/control commands are available.
- Compliancy with IEEE C37.118 standard:
  - Streamed phasor data at specific reporting rate and TCP port.
  - External switching/ control actions through extended command frame.

APPLICATIONS

The ePMU module can be used for a variety of applications, including:

- Testing and validation of situational awareness tools.
- Design and development of decision support, intelligent diagnoses, and analysis applications for grid events.
- Provision of data source for training purposes, such as Dispatcher Training Simulator (DTS).
- Determination of appropriate locations to install PMU.
- Design and study of wide-area controls.
- Assistance in planning studies and system model validation.

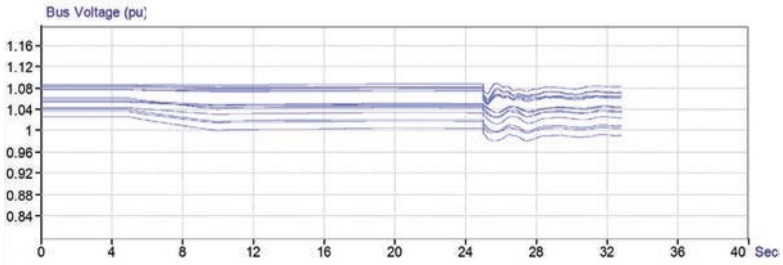


PRODUCT FEATURES:

- *Emulate synchrophasor data by time-domain simulations*
- *Simulate large system models in near real-time*
- *Support models necessary for stability/control analysis*
- *Assign virtual PMU at any system location*
- *Stream data in IEEE C37.118 format*
- *Support real-time external switching/control actions*
- *Ideal tool for designing, developing, and testing PMU applications*

Powertech

ePMU PMU Data Generator



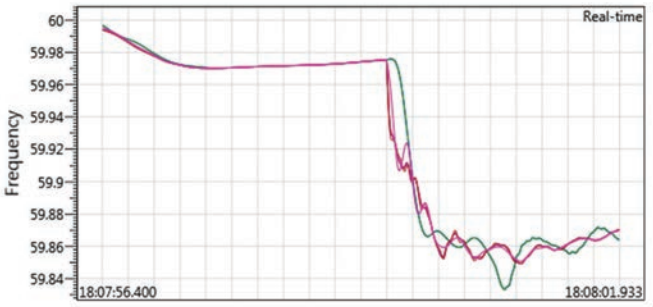
TSAT simulation

Run-time Statistics: BCH Refresh Interval: 2 sec

ID	Statistic	Value	TimeTag
STAT:19613	Minimum Latency	-21.000 ms	18:10:51.627
STAT:19614	Maximum Latency	-8.000 ms	18:10:51.627
STAT:19621	Average Latency	-20.000 ms	18:10:51.627
STAT:19622	Defined Frame Rate	30 frames / second	18:10:51.627
STAT:19623	Actual Frame Rate	29.988 frames / second	18:10:51.627

Simulated PMU data captured by PDC

COMPUTATION FLOW OF THE PMU DATA GENERATION



Visualization of simulated PMU data on PMU app

SPECIFICATIONS AND REQUIREMENTS

- Runs on MS Windows 7/10/server 2012 R2/server 2016
- Requires TSAT to run

OTHER POWERTECH SERVICES

- Licensing of the power system analysis software package DSA*Tools*™
- Licensing of other software products for utility applications
- Implementation of on-line dynamic security assessment (DSA) systems
- Development of custom software systems
- Development of models for use in power system analysis
- Generator field testing, model development and validation
- Training
- Technical consultancy studies including
  - Development of power system base cases
  - System planning and operation studies
  - Facility (including renewables) interconnection studies
  - Compliancy studies (such as NERC TPL, CIP, UFLS, etc.)
  - Post-mortem analysis of system disturbances

ABOUT POWERTECH LABS

Powertech Labs Inc. is one of the largest testing and research laboratories in North America, situated in beautiful British Columbia, Canada. Our 11-acre facility offers 15 different testing labs for a one-stop-shop approach to managing utility generation, transmission and distribution power systems.

Outside of the utilities industry, Powertech provides routine testing capabilities, product development, research and consulting services to support an array of industrial-type operations, electrical equipment manufacturers and automotive original equipment manufacturers.

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