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Model Validation of SVC and STATCOM Using PMU Data

Pouyan Pourbeik, EPRI

George Stefopoulos, NYPA

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Rosemont, IL

New York Power Authority

Generating more than electricity

AGENDA

- Project scope and information
- Model development background
- Model identification and validation process
- Example validation results

PROJECT BACKGROUND

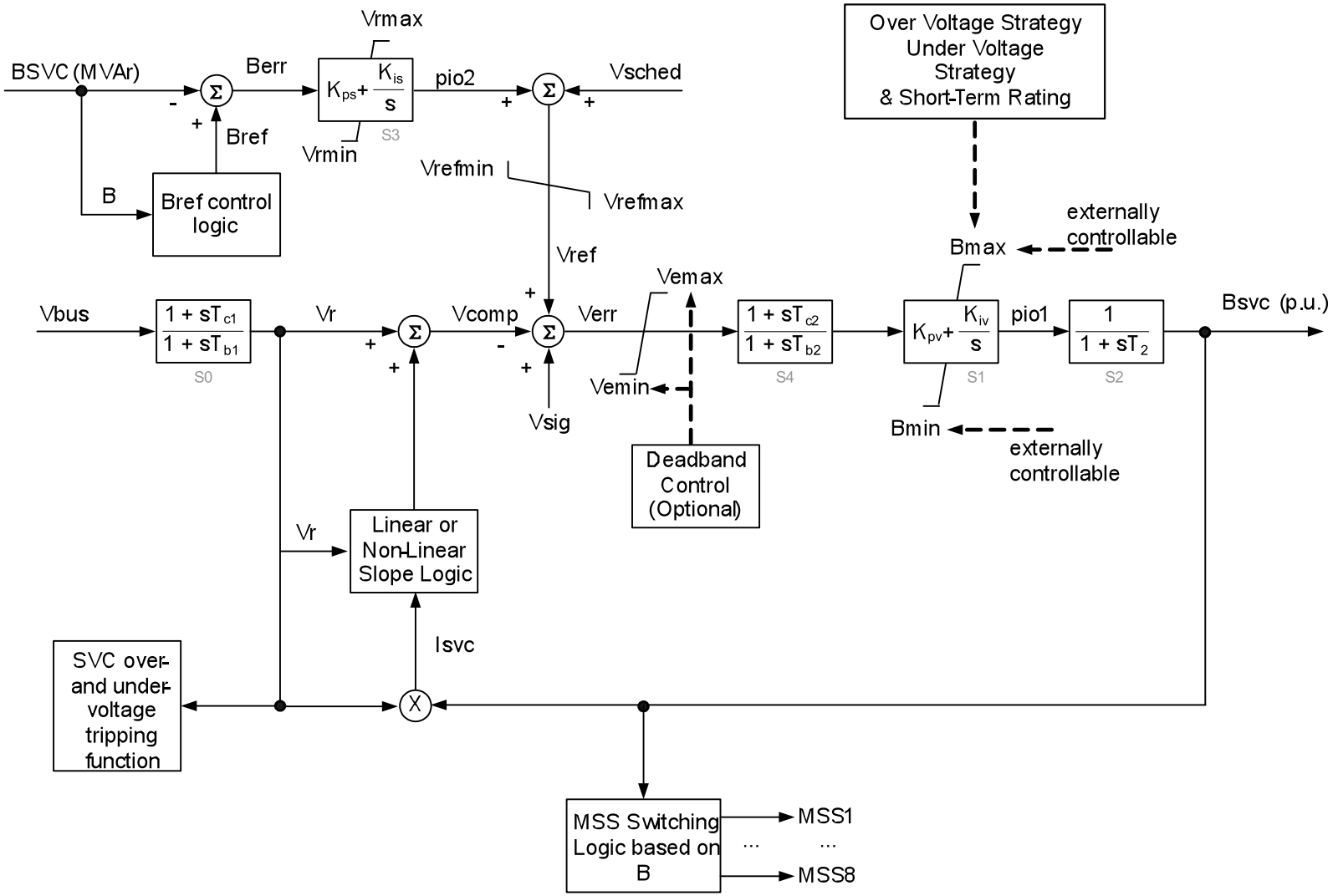
- Identify dynamic models for NYPA's static VAr systems:
  - STATCOM (Marcy Convertible Static Compensator)
  - SVC (Refurbished device)
- Use generic models previously developed by EPRI
- Utilize phasor measurements obtained by NYPA's synchrophasor network
  - Part of synchrophasor research
  - Supported via NYISO's SGIG project

BACKGROUND ON TECHNOLOGIES AND MODELS

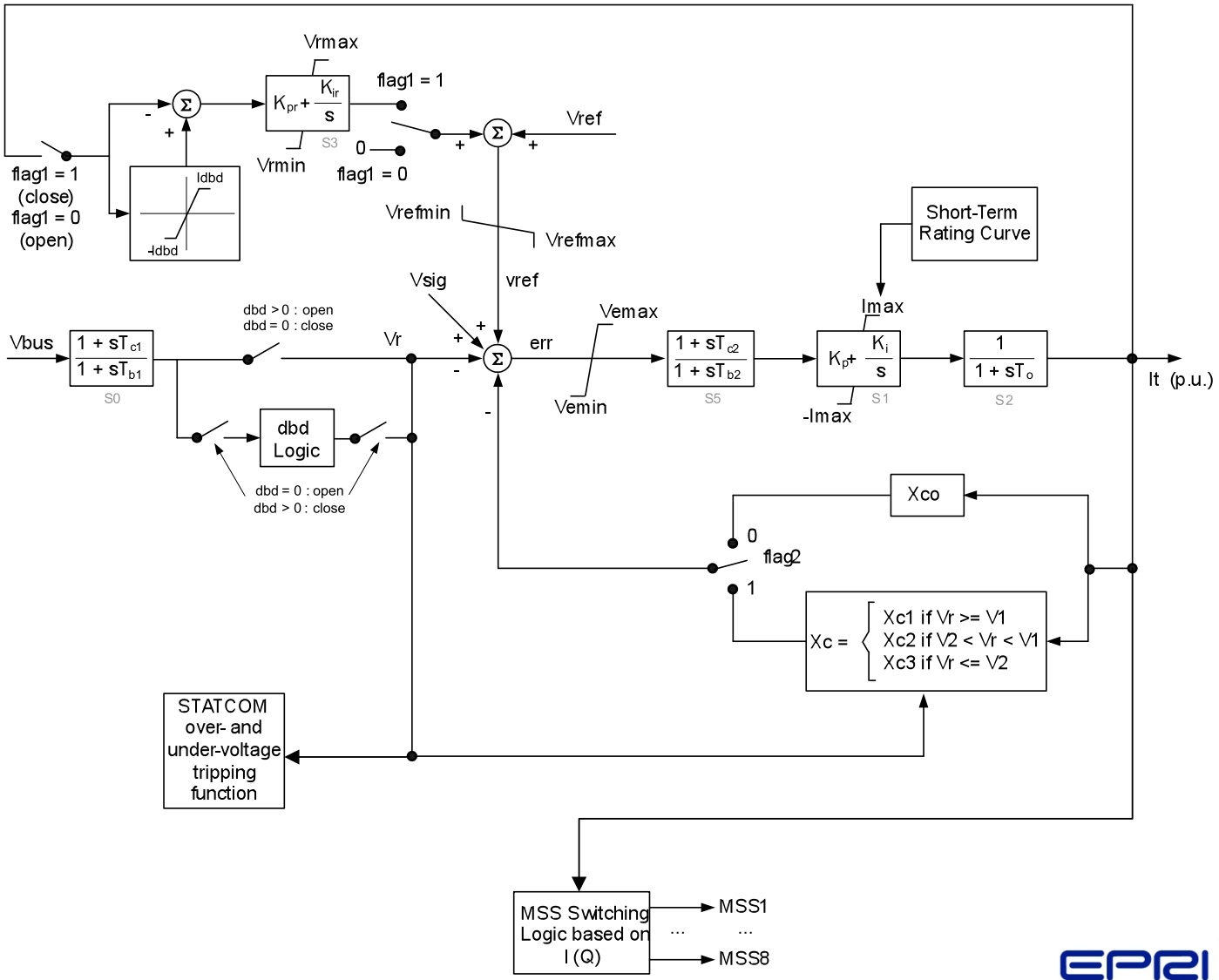
NEW MODELS DEVELOPED IN 2010/2011

- Developed thorough collaboration with WECC and vendors [1] & [2]
- Released in major commercial tools (GE PSLF™, Siemens PTI PSS®E)
  - SVSMO1 – model of a TCR-based SVS
  - SVSMO2 – model of a TSC/TSR-based SVS
  - SVSMO3 – model of a VSC-based SVS
- **These are generic models intended for emulating the majority of SVS systems, they are NOT an exact representation of any actual control strategy**

GENERIC MODEL SVSMO1 – FOR SVC

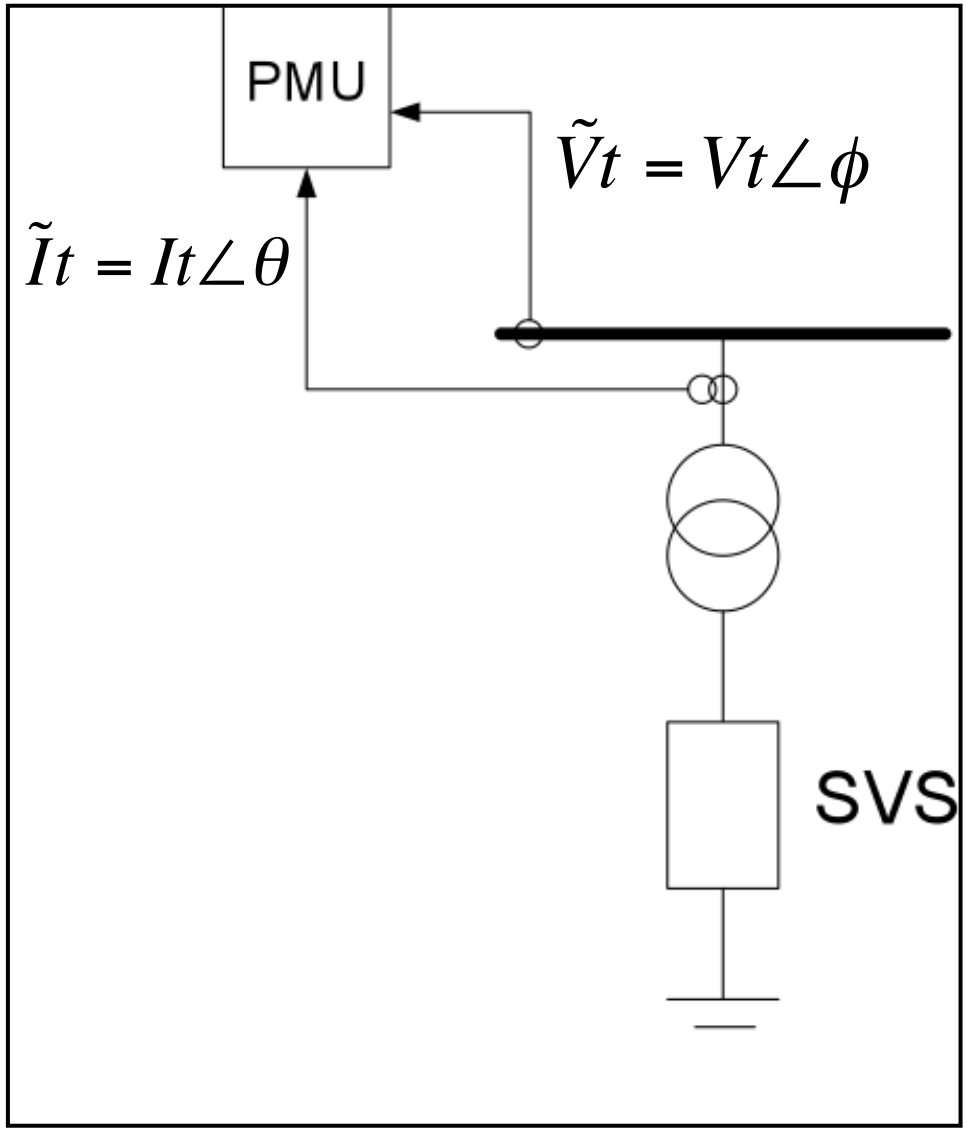


GENERIC MODEL SVSMO3 – FOR STATCOM



THE VALIDATION PROCESS

PMU RECORDINGS



Calculating P, Q, I, and B

$$S = \sqrt{3} \times \tilde{V}t \times \tilde{I}t^{*}$$

$$P = real(S)$$

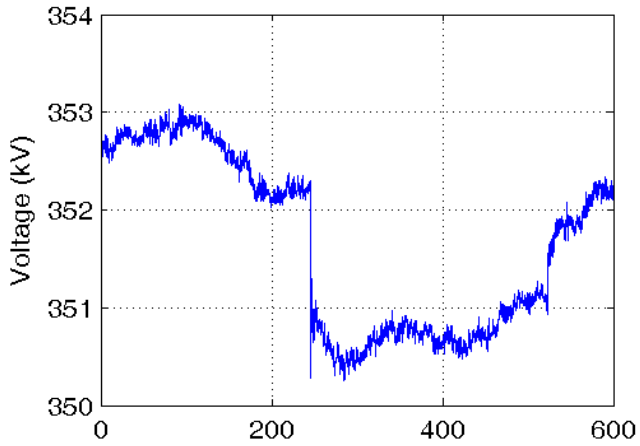
$$Q = imag(S)$$

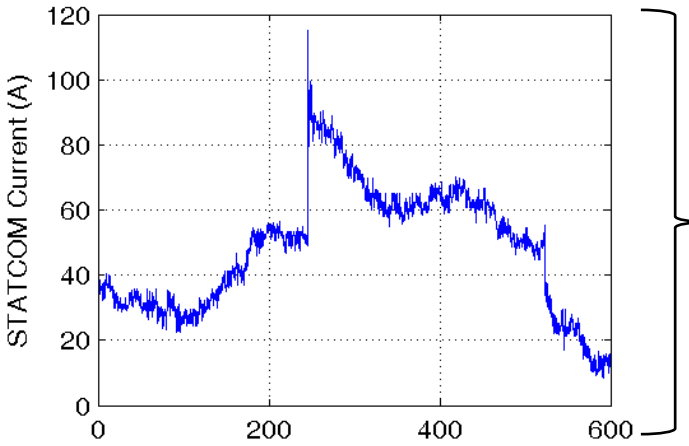
$$\overline{V}t = Vt/V_{nom}$$

$$I_{SVS} = Q/Vt$$

$$B_{SVS} = Q/Vt^{2}$$

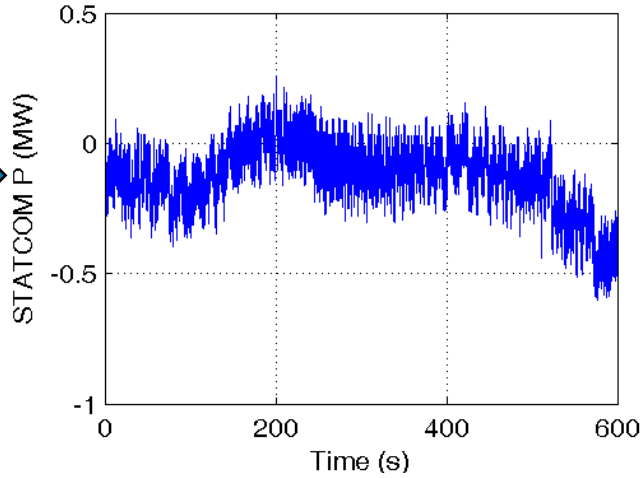
TYPICAL EVENT RECORDINGS

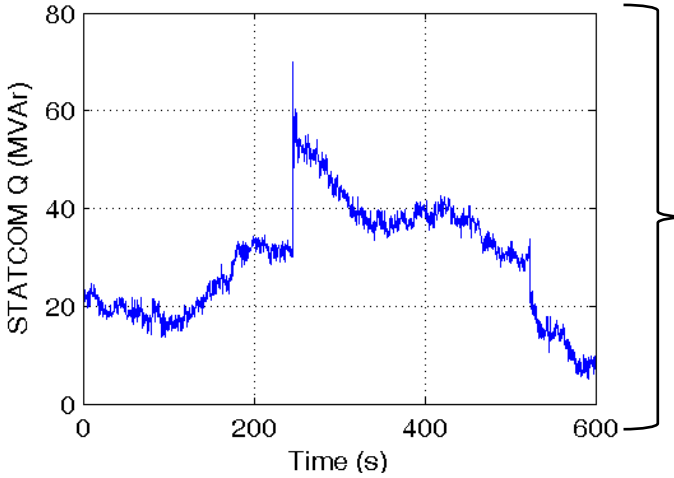




PMU

Losses (neglected in stability simulations)





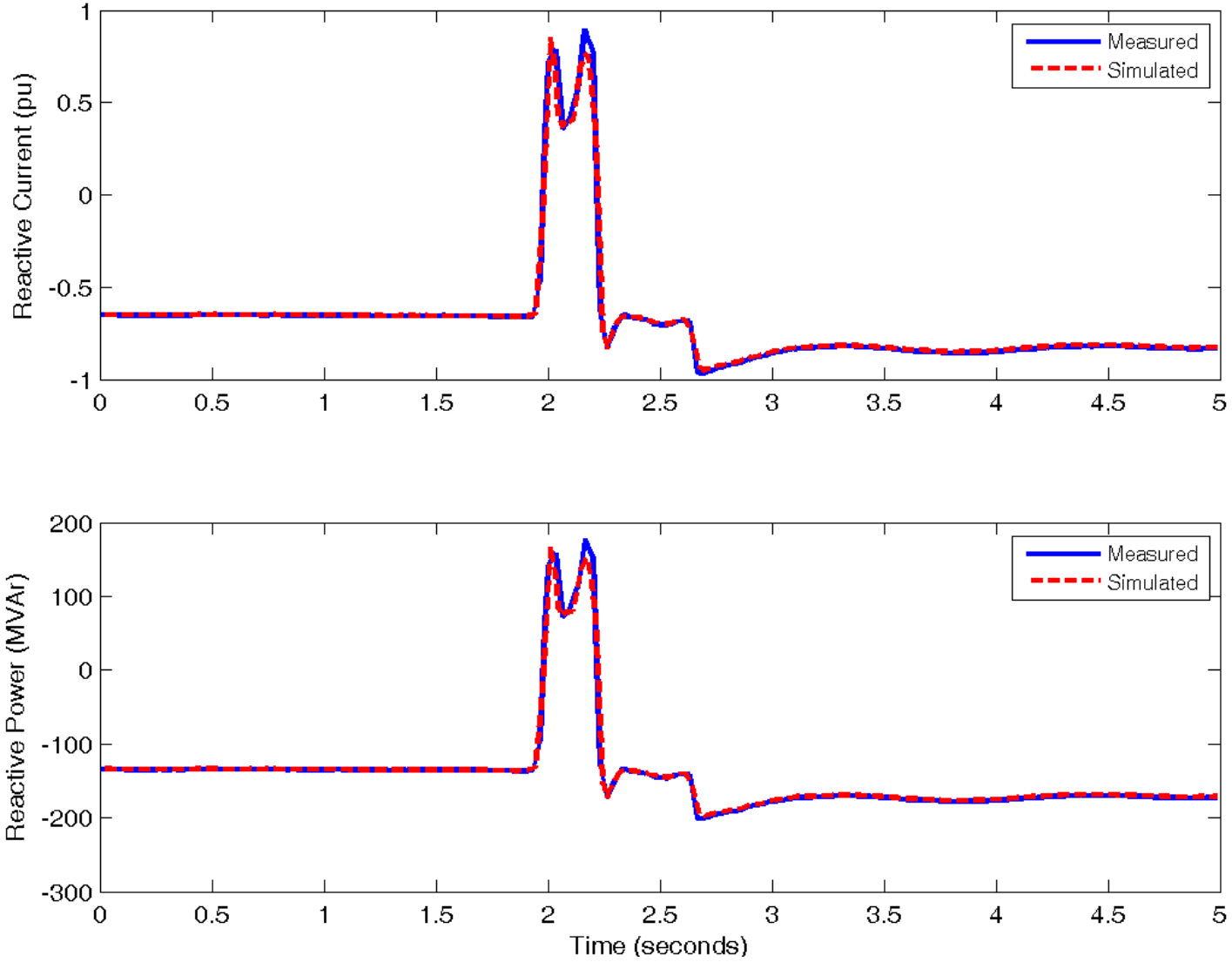
Calculated

THE VALIDATION PROCESS

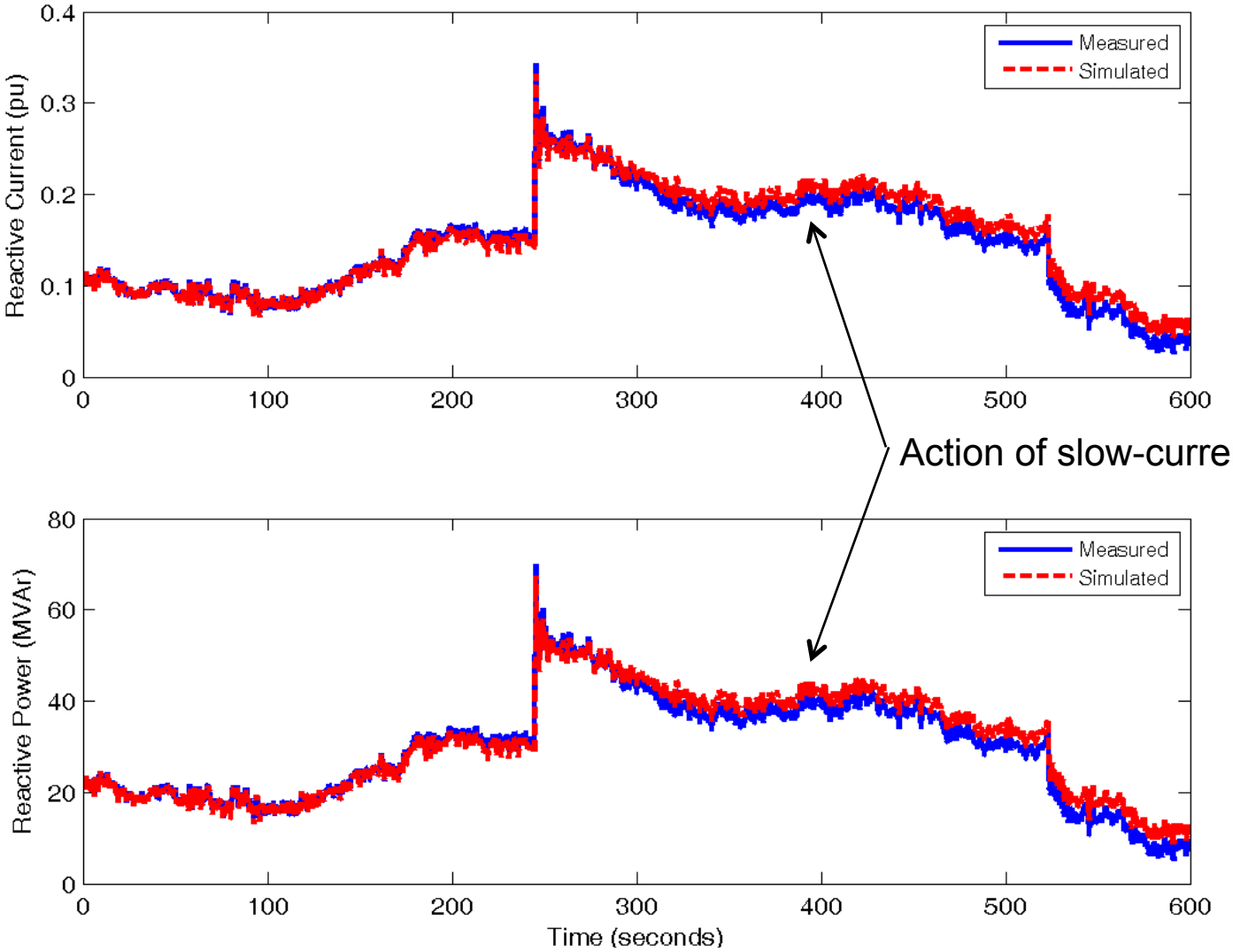
- Take data recorded by the PMU during disturbance events
- Calculate from the PMU data the injected reactive current (or susceptance for SVC) and reactive power of SVS
- Choose the appropriate model for the device
- Play the measured voltage back into the model and fit the simulated reactive current I (or susceptance B) and Q to the measured values
- Optimize the gains of the controllers to get a good match via least squares estimation
- The optimization process is automated – this is done in a simple standalone software tool that was developed and is called Static Var System Model Validation (SVSMV) [3]

EXAMPLE VALIDATION RESULTS

MODEL VALIDATION – STATCOM Using SVSMO3 Model



MODEL VALIDATION – STATCOM Using SVSMO3 Model



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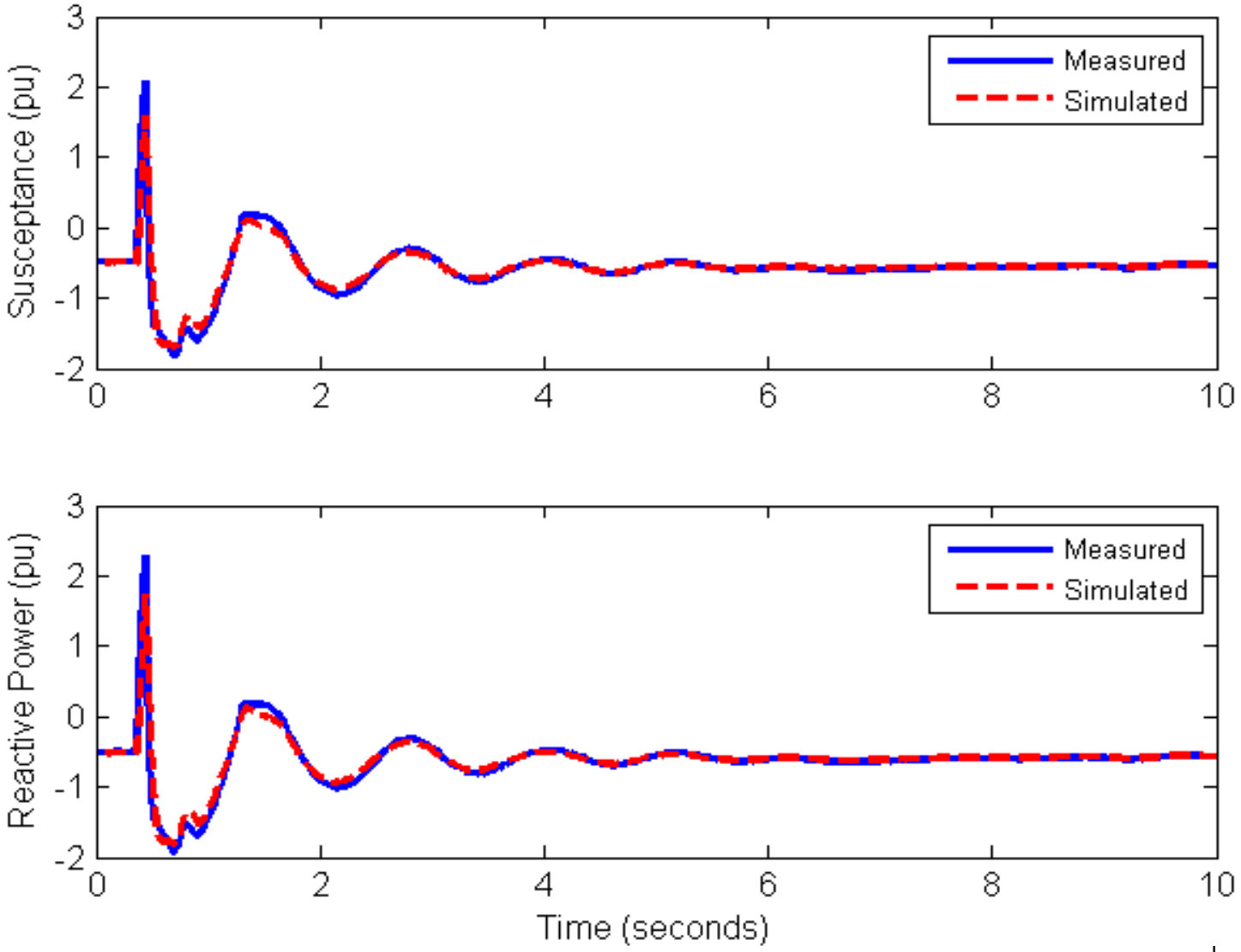
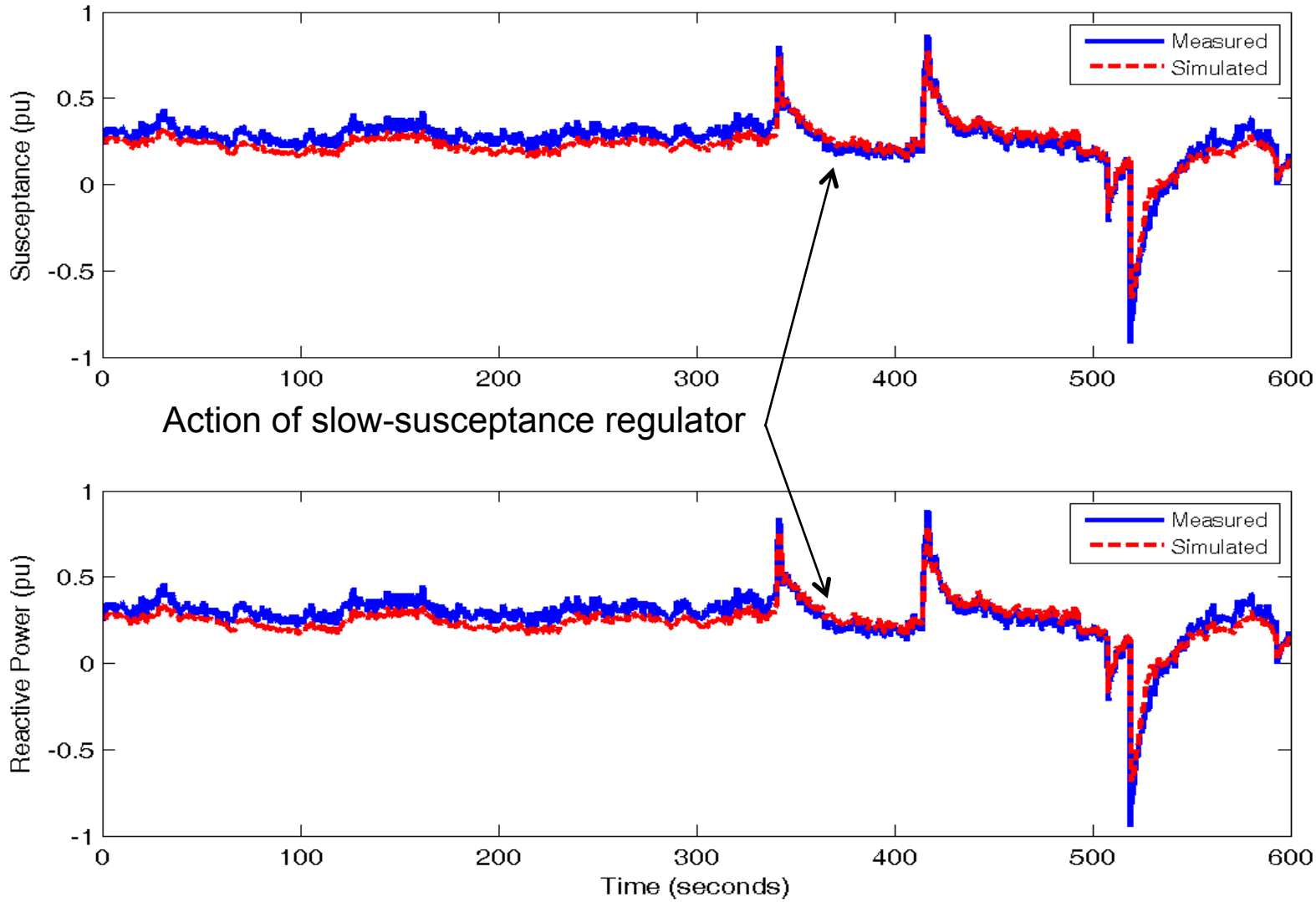
MODEL VALIDATION – SVC Using SVSMO1 Model



MODEL VALIDATION – SVC Using SVSMO1 Model



REFERENCES

[1] P. Pourbeik, D. Sullivan, A. Boström, J. Sanchez-Gasca, Y. Kazachkov, J. Kowalski, A. Salazar, A. Meyer, R. Lau, D. Davies and E. Allen, "Generic Model Structures for Simulating Static Var Systems in Power System Studies – A WECC Task Force Effort", *IEEE Transactions on Power Systems*, August 2012.

[2] Generic Static Var System Models for the Western Electricity Coordinating Council, April 2011. http://www.wecc.biz/committees/StandingCommittees/PCC/TSS/MVWG/SVCTF/Shared%20Documents/GenericStaticVarSystemModelsforWECC.pdf

[3] *Static Var System Model Validation (SVSMV) Version 2.0*, June 2013, EPRI Product ID 3002001009. http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002001009

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Pouyan Pourbeik
Technical Executive
Electric Power Research Institute
ppourbeik@epri.com
www.epri.com

George Stefopoulos
Research and Technology Development Engineer I
New York Power Authority
george.stefopoulos@nypa.gov
www.nypa.gov

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