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Calibration of Stability Model Parameters using EnKF

presented by

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Developed Model Validation and Parameter Calibration Procedures

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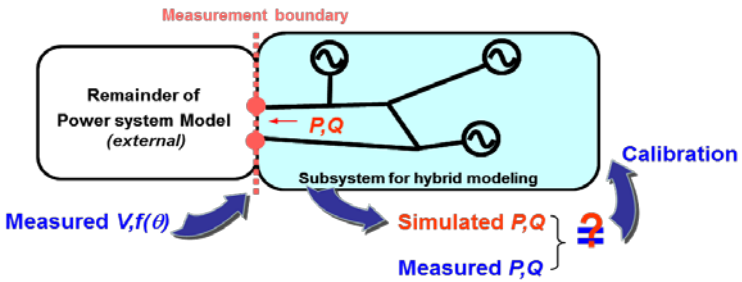
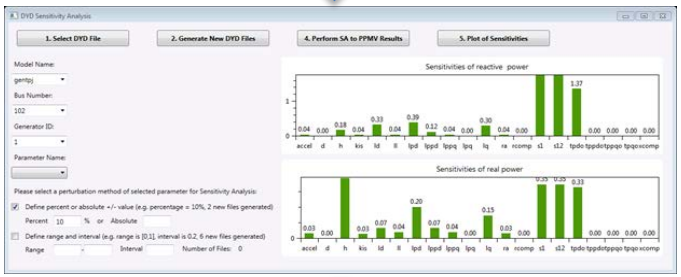
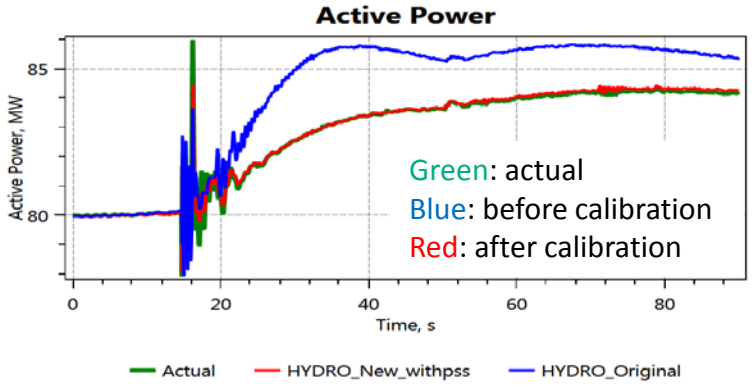
- **Step 1**: model validation via PPMV
  - Inputs: voltage, freq (or phase angle)
  - Outputs: active and reactive power
- **Step 2**: identification of problematic parameters
  - Sanity check: find unrealistic pars and status of controllers
  - A trajectory sensitivity approach
- **Step 3**: calibrating parameters using an ensemble Kalman filter approach
- **Step 4**: model verification using multiple events



$$\begin{cases}\alpha_1 = \alpha_0 + \Delta\alpha \\ \alpha_2 = \alpha_0 - \Delta\alpha\end{cases} \rightarrow s(t) = \frac{x_1(t) - x_2(t)}{2(\Delta\alpha / \alpha_0)} \rightarrow S = \frac{1}{n}\sum_{t=1}^{n}|s(t)|$$





EnKF-Based Calibration Algorithm

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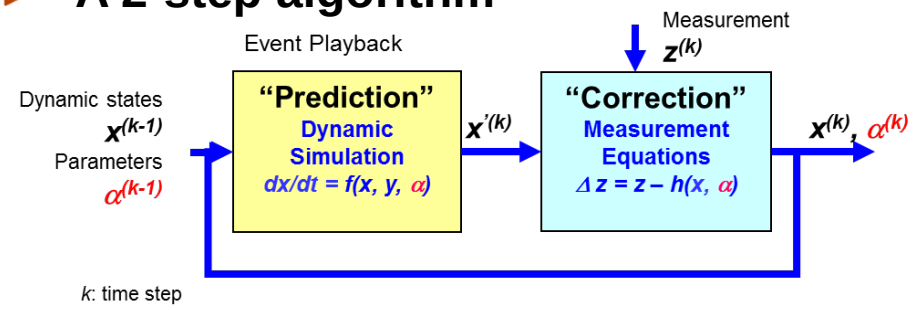
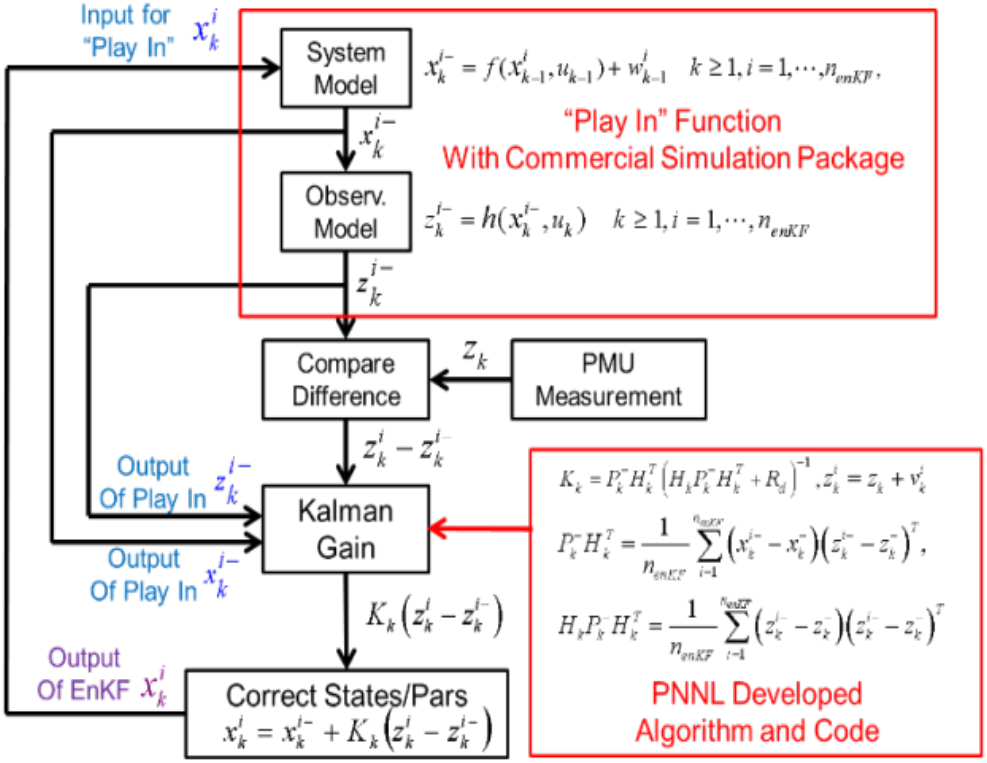
A 2-step algorithm



Main flowchart



Calibration performance - Hydro

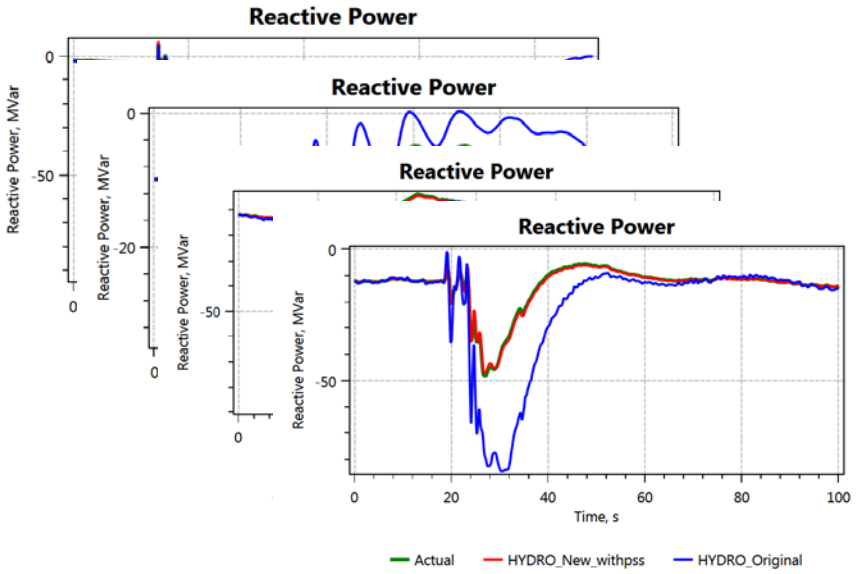


Table 1. root mean square errors

RMSE	P (MW)		Q (MVar)	
Events	Original pars	New pars	Original pars	New pars
01	1.61	0.15	17.80	0.76
02	0.52	0.14	3.53	0.28
03	1.08	0.07	13.07	0.50
04	0.55	0.13	12.93	1.14
05	0.63	0.12	6.99	0.29
06	0.55	0.14	2.91	0.29
07	1.61	0.24	14.69	0.68
08	0.28	0.06	11.20	0.49
09	1.61	0.22	14.22	0.79
10	0.40	0.13	2.52	0.59
11	0.73	0.07	9.24	0.13
12	0.19	0.08	16.66	0.21

THANK YOU!

Publication:

Y. Li, R. Diao, R. Huang, P. Etingov, J. Sanchez-Gasca, B. Thomas, X. Li, Z. Huang, S. Wang, "**An Innovative Software Tool Suite for Power Plant Model Validation and Parameter Calibration using PMU Measurements**," to be submitted to the 2017 IEEE PES general meeting.