# PMU-BASED GENERATOR PARAMETER IDENTIFICATION

Chin-Chu Tsai Wei-Jen Lee

Energy Systems Research Center

University of Texas at Arlington

Shun-Hsien Huang John Adams

Electric Reliability Council of Texas

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# INTRODUCTION

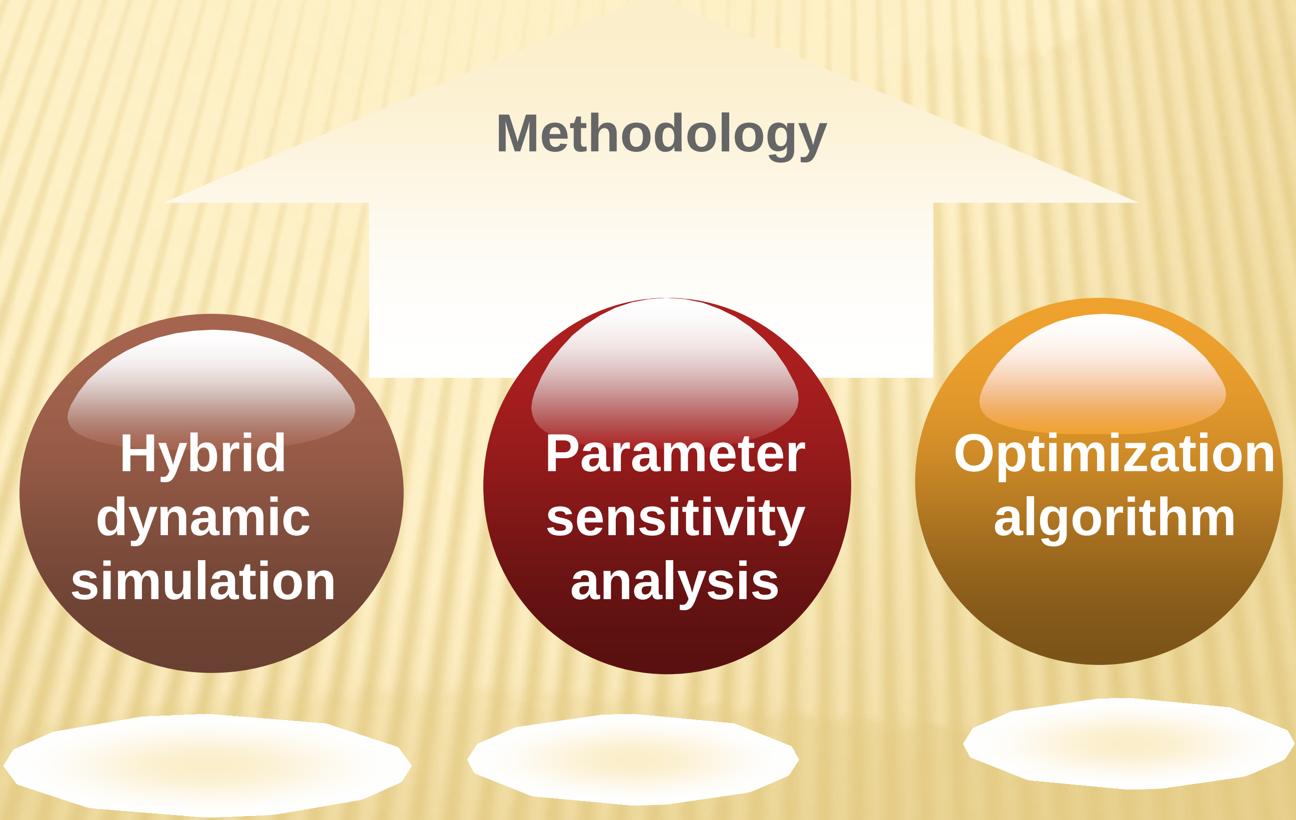
- Power system dynamic simulation, which provides significant insight into the dynamic characteristics of system, is one of the most important tools for both planning and operation.
- **Power System Planner** uses dynamic simulation to predict  system responses during different possible scenarios and make a rigorous expansion plan to solve system problems
- Based on simulation results, **System Operator** establishes countermeasures to ensure system operation security and the lowest cost.

# INTRODUCTION

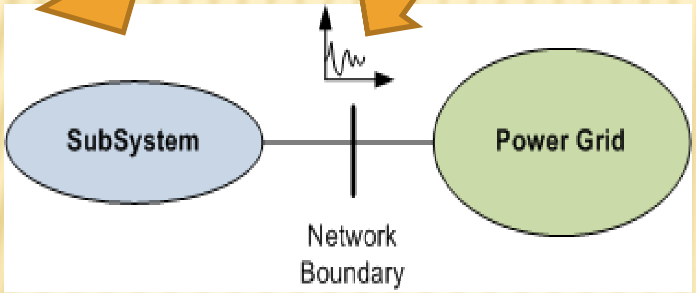
- However, it is common to see mismatches between simulation results and actual system response due to inaccurate parameters being used in the simulation software.
- The parameters **verification** and **identification** are extremely important for secure, reliable, and economical operation of power systems.
- This research proposes a PMU based approach and implementation process for generator parameter identification

# METHODOLOGY

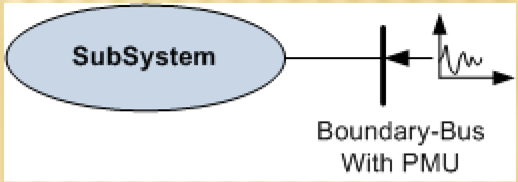
PMU-Based Generator Parameter Identification



# METHODOLOGY - HYBRID DYNAMIC SIMULATION




**Original System**




**Reduced System**

# METHODOLOGY - PARAMETER ANALYSIS

- Dozens of parameters in generator unit's models, each parameters has different influence on system response
- The **trajectory sensitivity analysis** is adopted to figure out how each parameter affects the output of simulation result
- A fairly accurate description of the power system model is represented by a set of differential and algebraic equation of the form

$$\frac{dx}{dt} = f(x, y, \lambda, u) \quad 0 = \begin{cases} g^{-}(x, y, \lambda, u) \\ g^{+}(x, y, \lambda, u) \end{cases}$$

# METHODOLOGY - PARAMETER ANALYSIS

- To obtain the sensitivity of the flows P and Q to both initial conditions and parameter variations:

$$\Delta P(t) = \frac{\partial P(t)}{\partial X_0}\Delta X_0 = P_{X_0}(t)\Delta X_0$$

$$\Delta Q(t) = \frac{\partial Q(t)}{\partial X_0}\Delta X_0 = Q_{X_0}(t)\Delta X_0$$

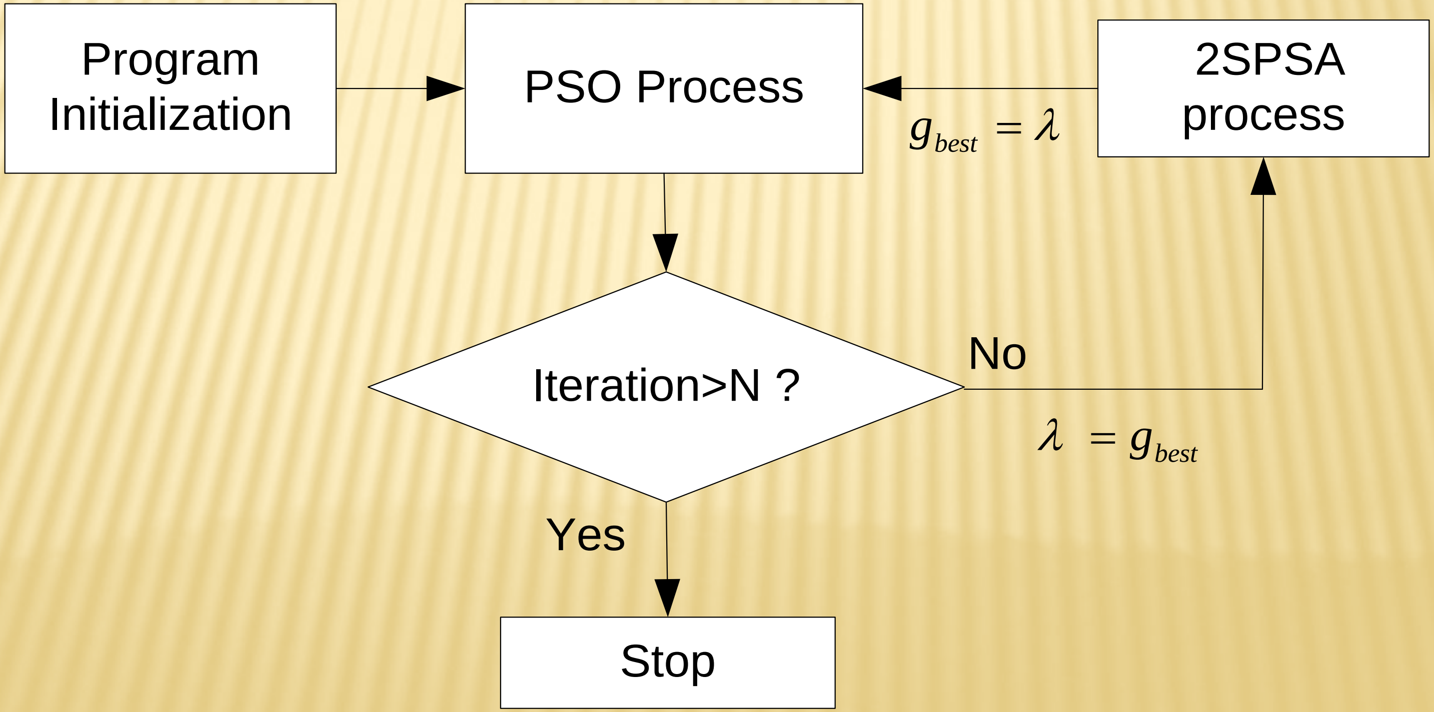
Note: that sensitivities incorporate parameters $\lambda$ to $X_0$

# METHODOLOGY - COOPERATIVE SPSA-PSO

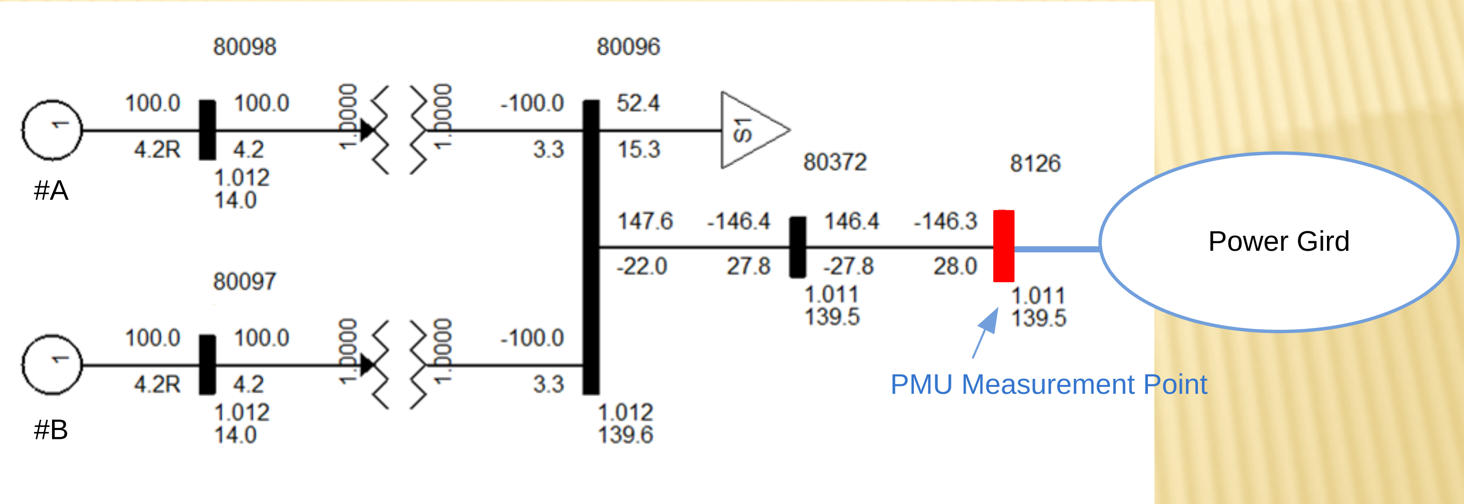
- Out optimization objective is to make the **simulation curves** fit with the **measured curves** by fine turning the parameters of models
- The conventional optimization methods depend on the quality of the **initial guess.** The intelligent method is not affected by the initial guess, but its **convergence rate is slow**
- A new intelligent optimization method, cooperative Simultaneous Perturbation Stochastic Approximation and Particle Swarm Optimization scheme (**SPSA-PSO)**, is proposed

# METHODOLOGY - COOPERATIVE SPSA-PSO

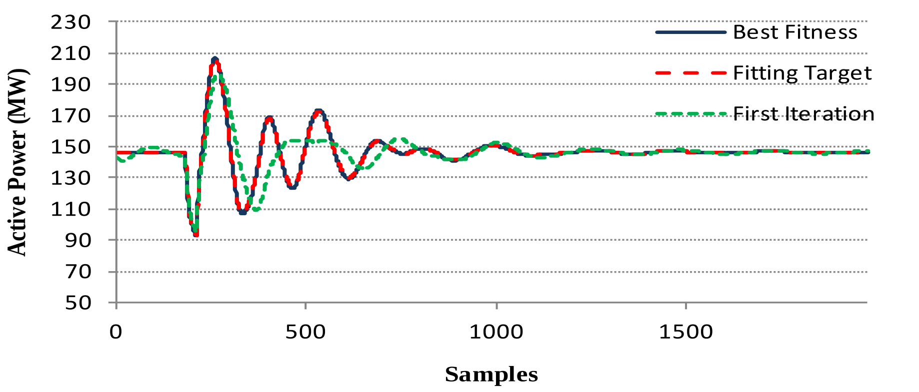
- This proposed SPSA-PSO cooperative algorithm can provide a balance between convergence and global search ability

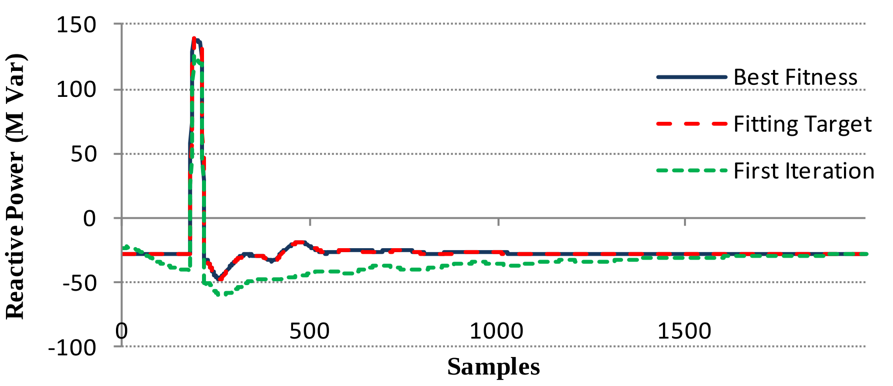


# CASE STUDY




One Line Diagram of Local System of the Test Case




Simulation results of best fitness