

Model Parameter Calibration Using Recorded Dynamics

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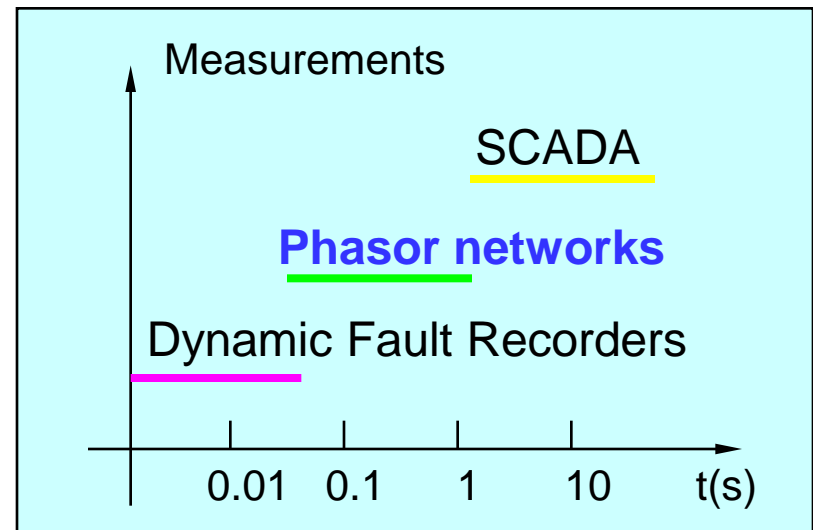
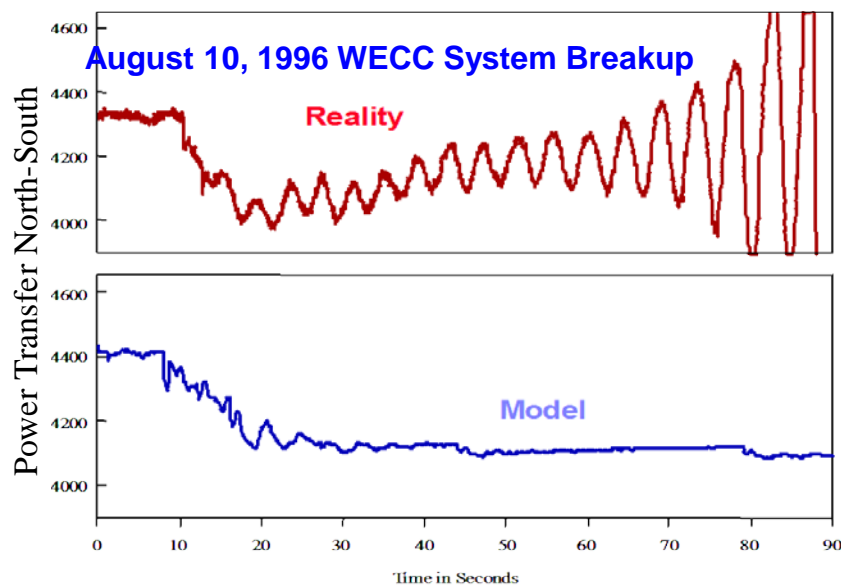
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Presentation Outline

- ▶ Model Validation Needs
- ▶ Model Validation Approach
- ▶ WECC Model Validation Example
- ▶ Model Parameter Calibration Using Extended Kalman Filter
- ▶ Case Studies
- ▶ Conclusion and Future Work

Dynamic Model Inadequacy

- ▶ Dynamic models are the basis for planning studies.
- ▶ However, dynamic models do not always reflect actual system dynamic behaviors due to parameter errors or configurations.
- ▶ Phasors record system dynamics and provide the opportunity to validate and calibrate dynamic models.

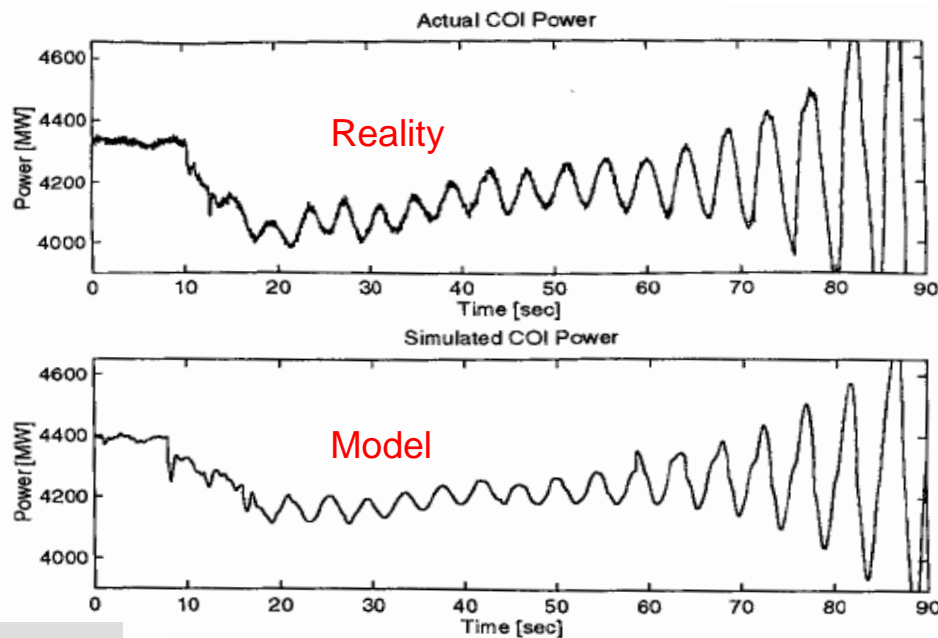


*Source: Kosterev, 1999.

System-Wide Model Validation for August 10, 1996 Breakup

- ▶ Excellent match of simulation and recorded dynamics.
- ▶ Challenges
 - Set up system-wide power flow condition prior to the event
 - Require sequence of events
 - Require strong expertise

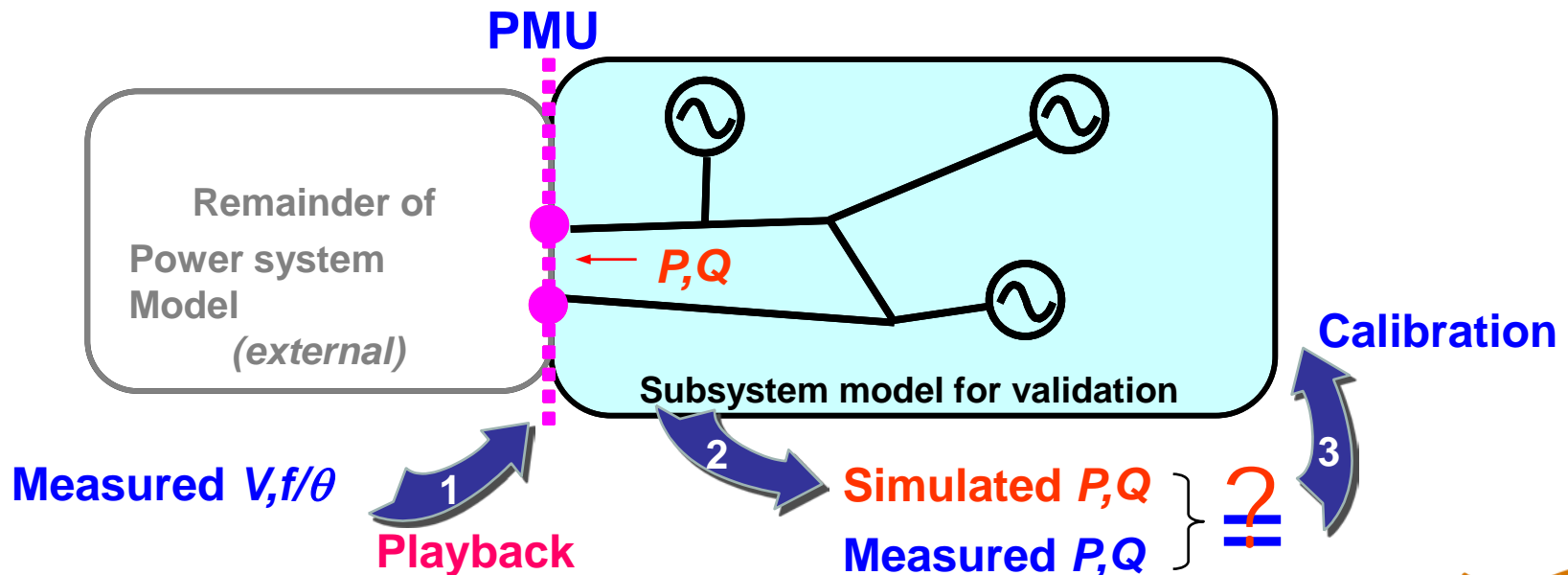
After Calibration



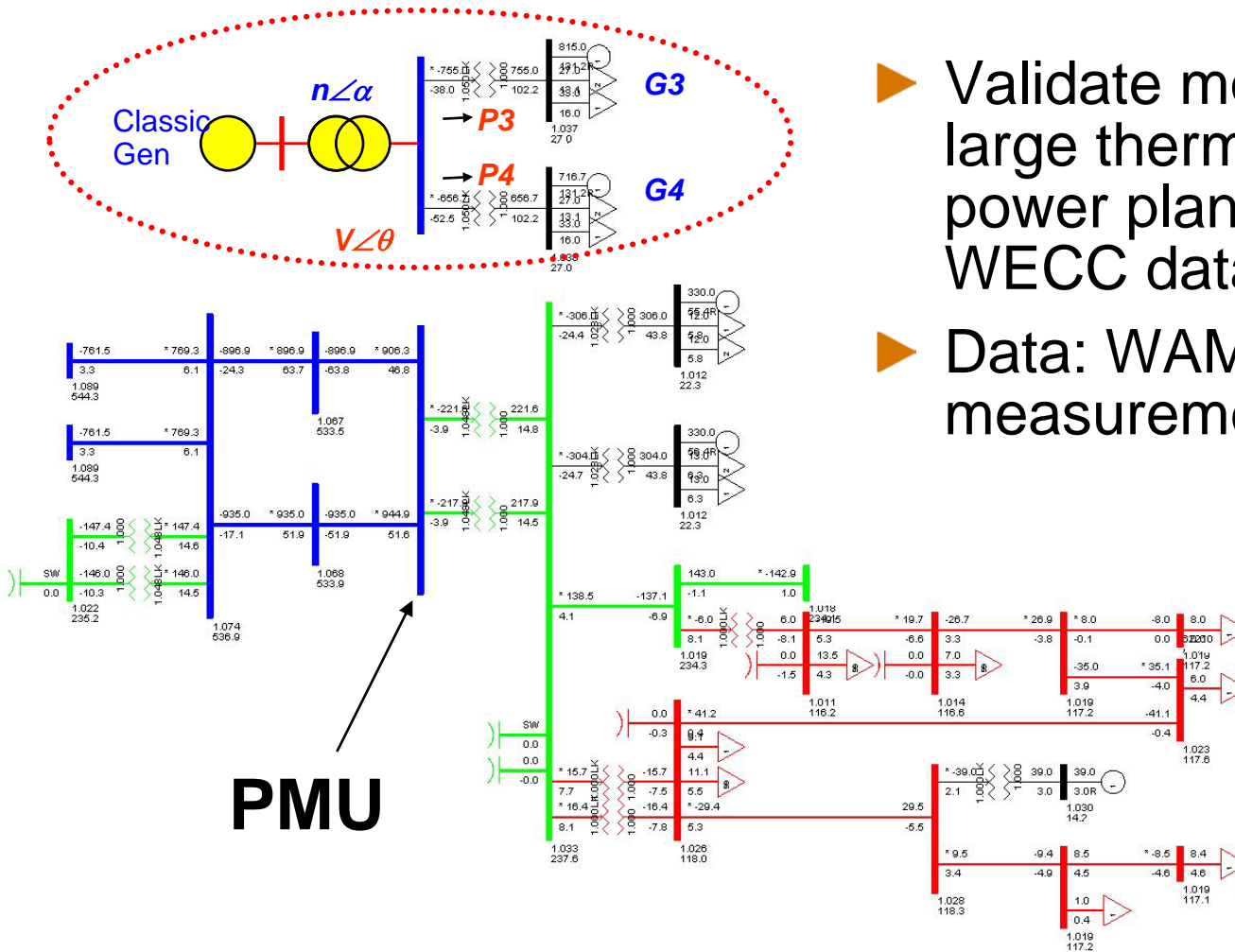
*Source: Kosterev, 1999.

Subsystem Model Validation

- ▶ Separate the subsystem to be validated at the measurement boundary.
- ▶ Inject measured bus quantities as boundary conditions.
- ▶ Simulate the subsystem and compare results against measurements.

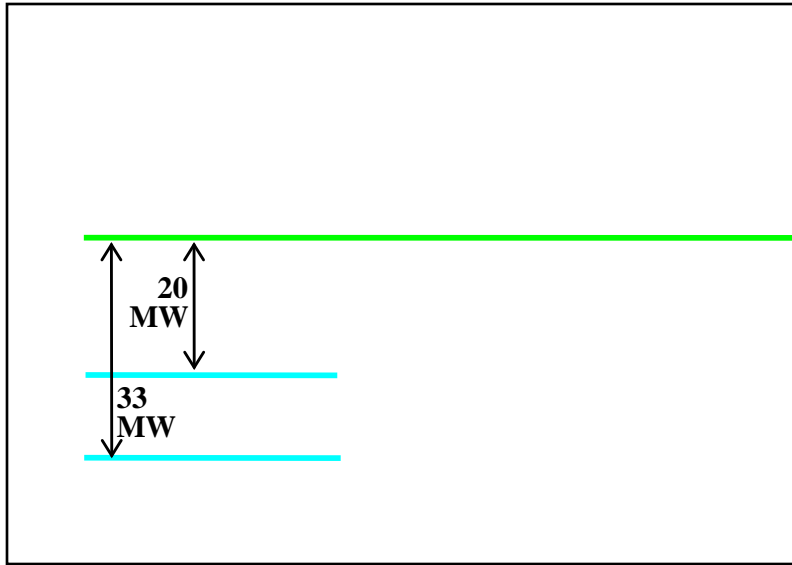


Application to WECC Generator Model Validation



- ▶ Validate model of a large thermal power plant in the WECC database
- ▶ Data: WAMS PMU measurements

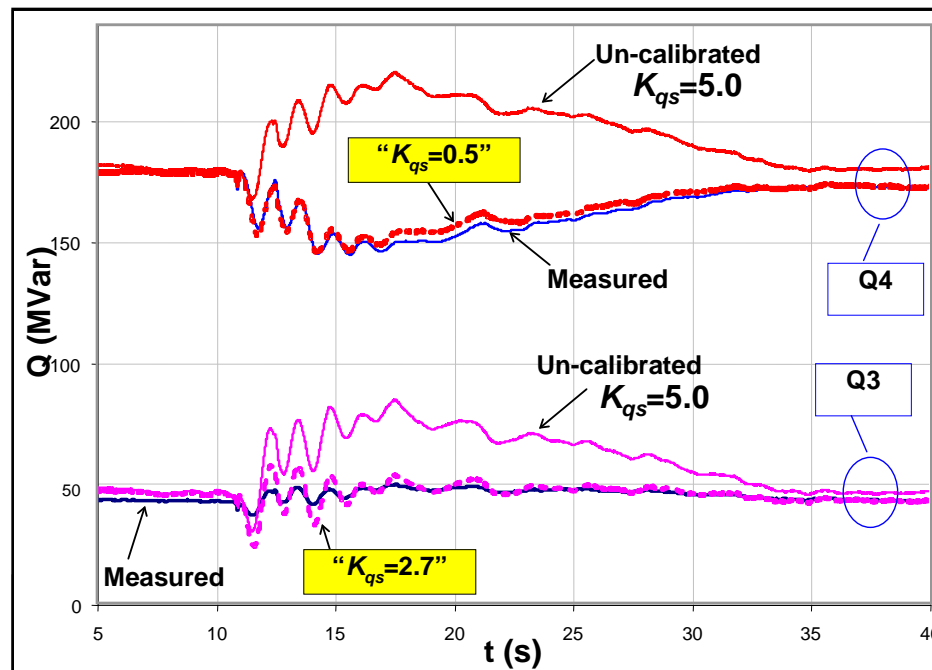
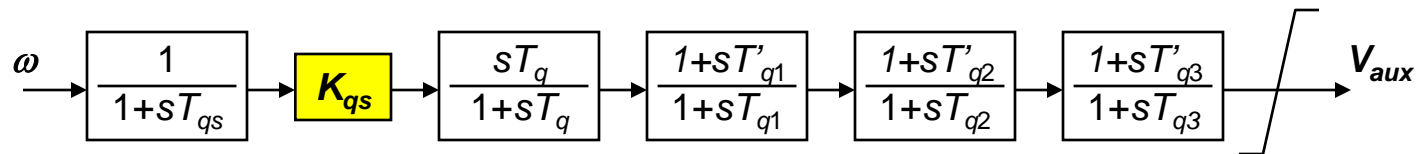
Application to WECC Generator Model Validation Event: July 29, 2003 – 1252 MW Palo Verde Unit Trip



- ▶ Consistent results obtained for multiple events!
- ▶ Many other WECC generators were validated using the same approach.
- ▶ *WECC Generator Monitoring and Model Validation Policy*: this model validation process satisfies the policy's requirements on model validation.

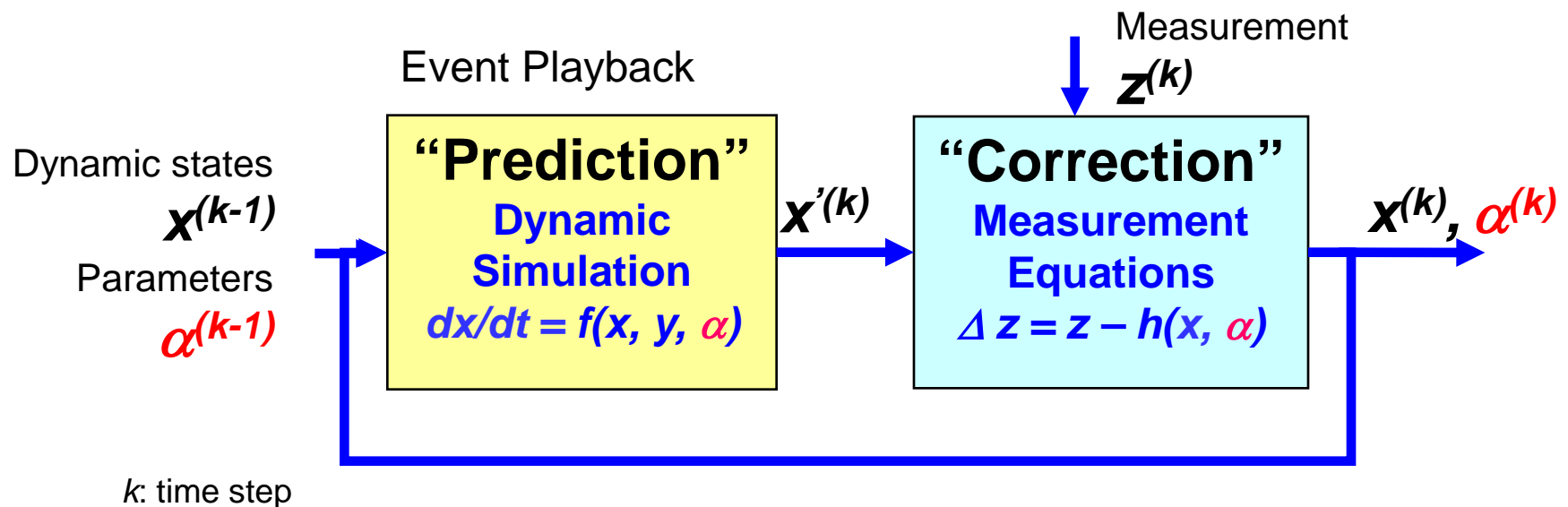
Model Parameter Calibration by Trial and Error

- ▶ Single parameter adjustment (PSS gain) provides satisfactory results in this case.

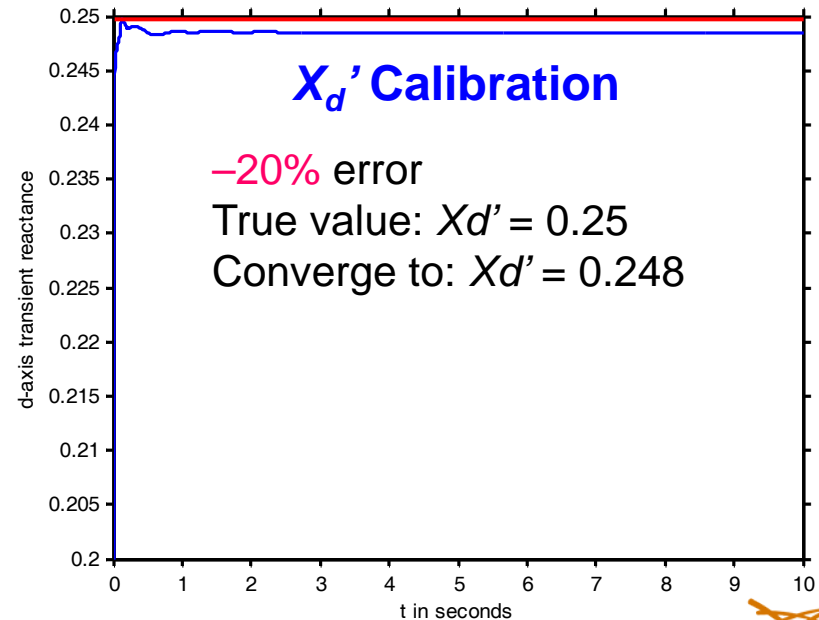
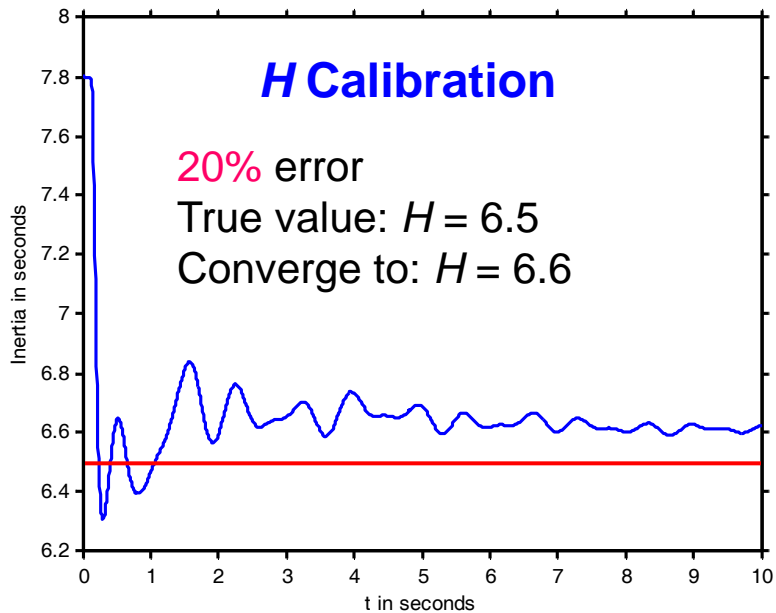
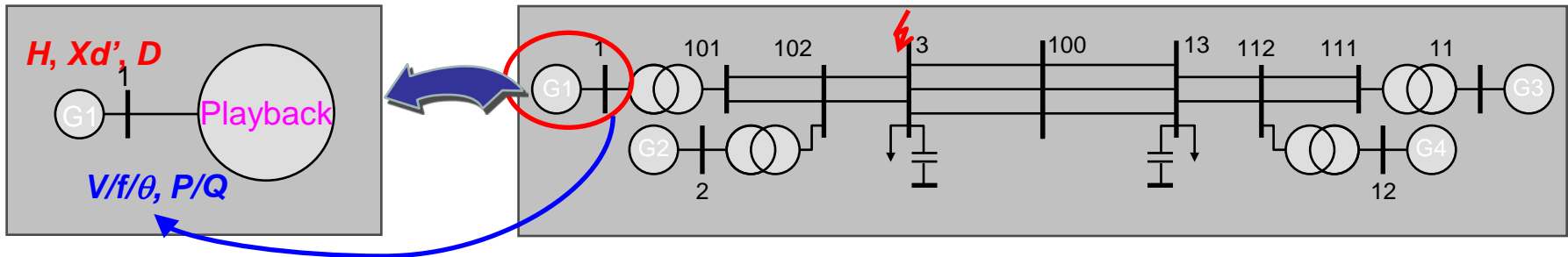


Model Parameter Calibration Using Extended Kalman Filter

- ▶ Application of Extended Kalman Filter techniques
 - Two-step process
 - Prediction and Correction



Model Parameter Calibration Using Extended Kalman Filter – *Example*



Conclusion and Future Work

Conclusion

- ▶ Model validation techniques becoming mature, with successful applications in WECC using phasor measurements.
- ▶ Parameter calibration techniques are being developed. Initial results are promising.

Future Work

- ▶ Improve the Extended Kalman Filter-based parameter calibration technique.
- ▶ Apply parameter calibration to actual WECC models.

Questions?

