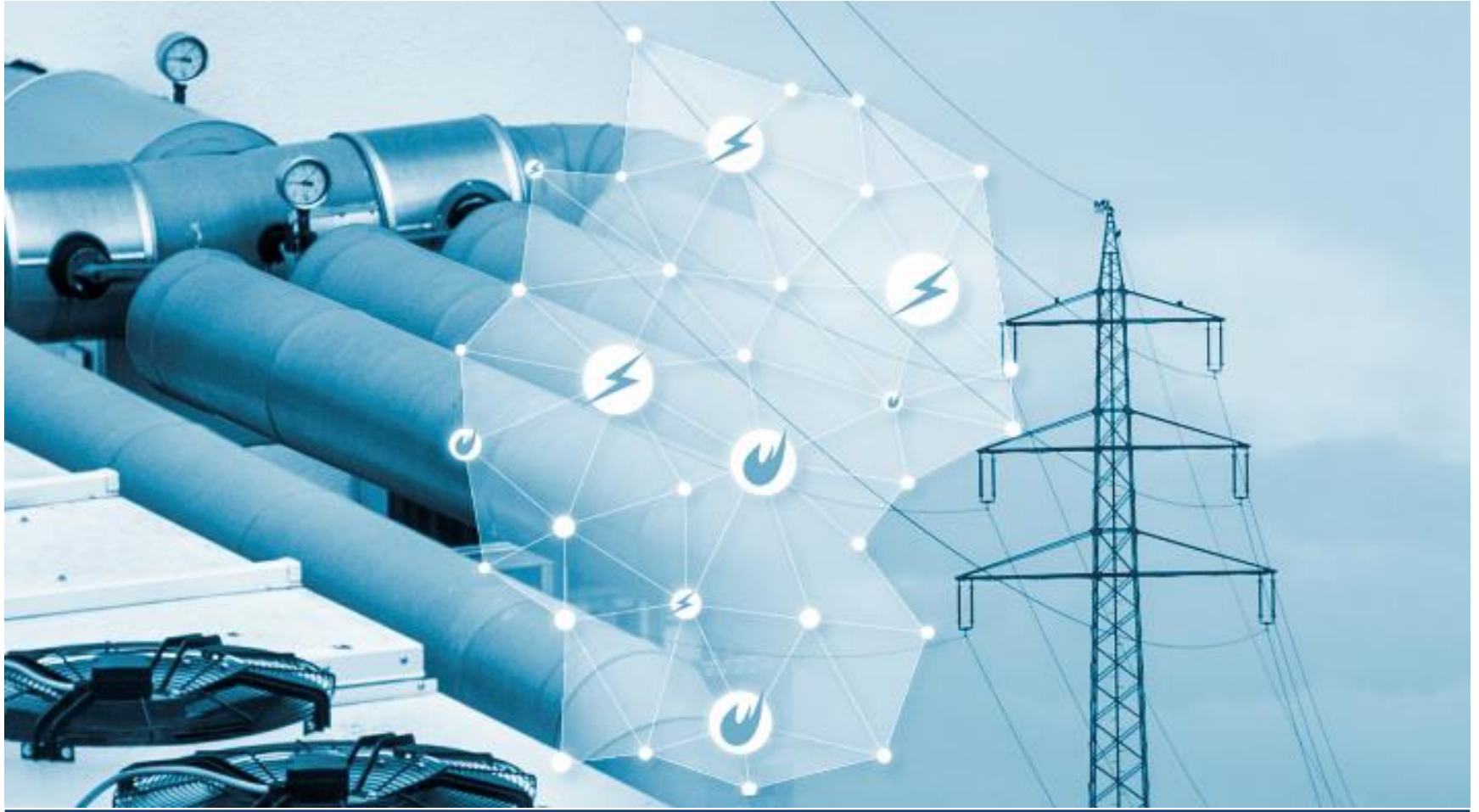
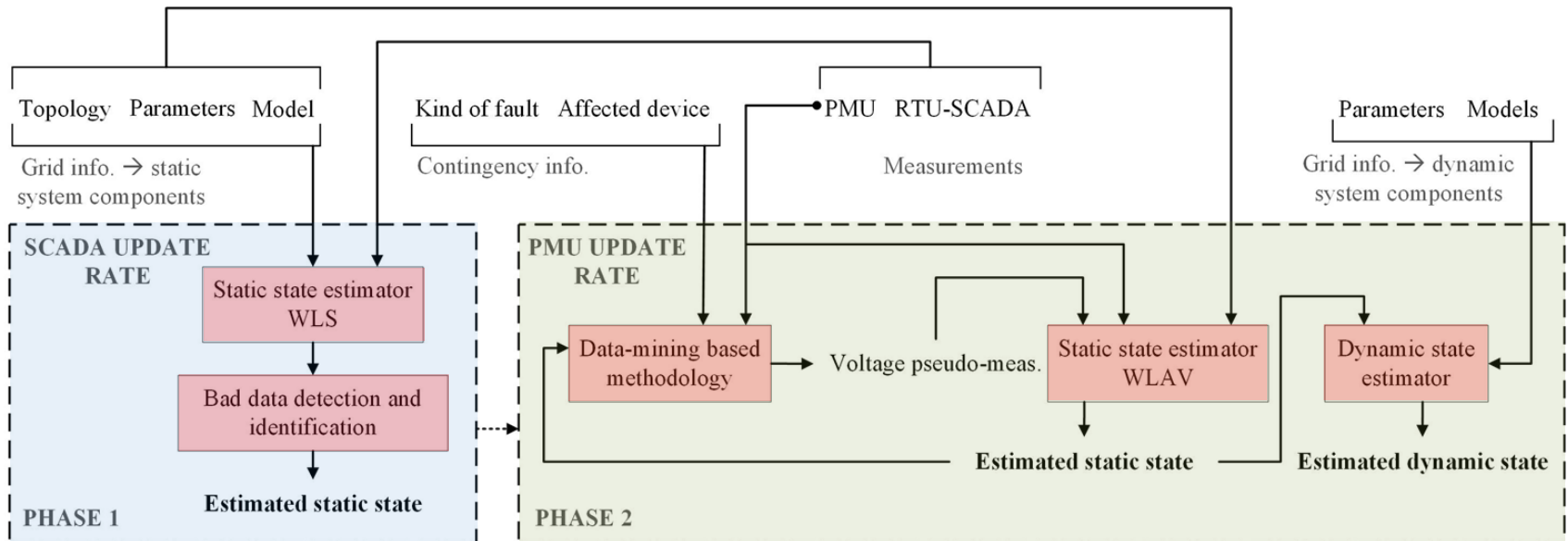


Monitoring of power system dynamics under incomplete PMU observability condition



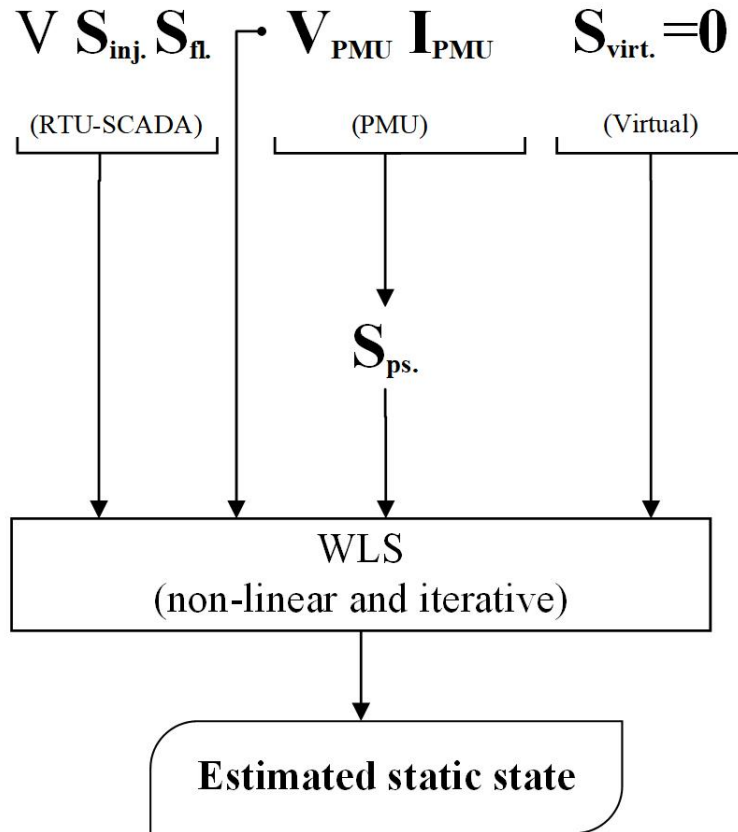
Hybrid state estimation scheme



Assumptions:

- Errors in measurements and models → normal distribution
- Uncertainties in network parameters → uniform distribution
- PMU and RTU-SCADA measurements → same estimation run (stationary regime)
- The contingency and its time of occurrence is known
- Balanced conditions
- The load composition at each bus (static-dynamic load ratio) is known

Phase 1



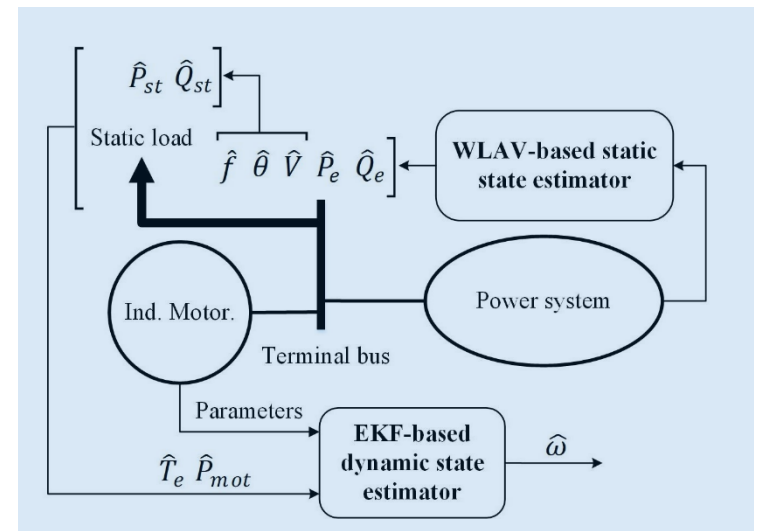
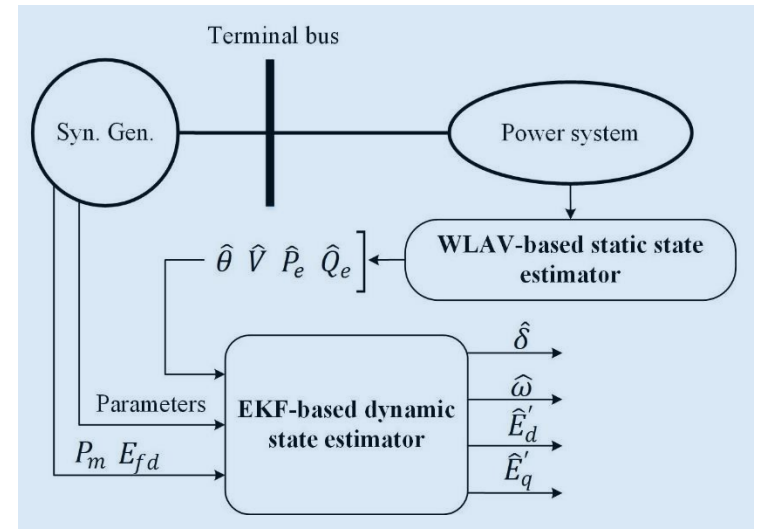
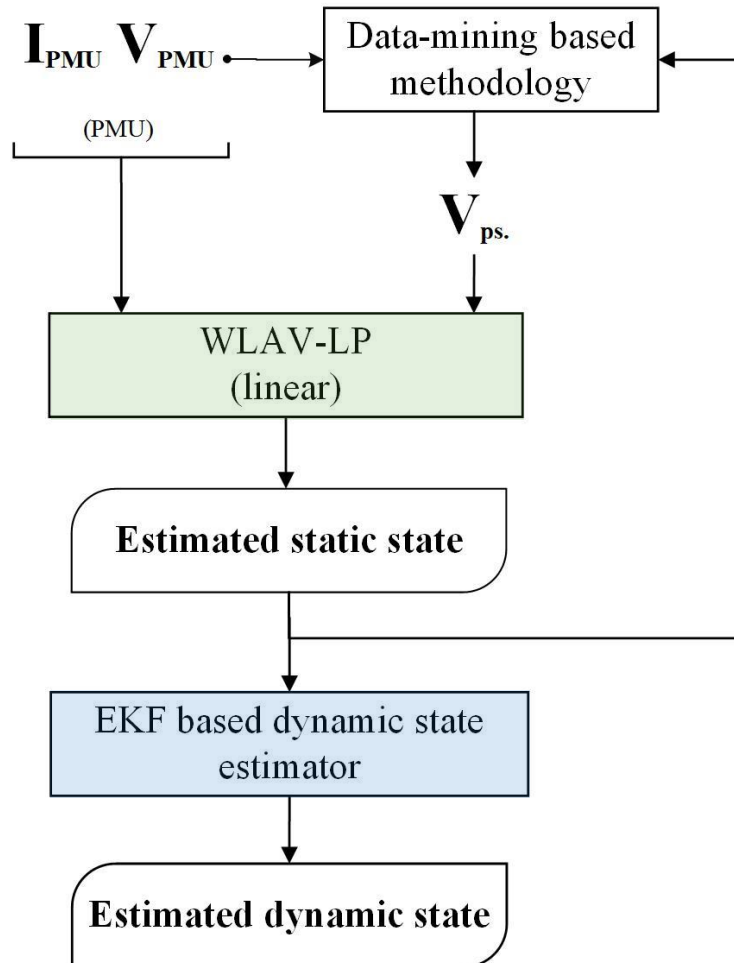
By using both kind of measurements →

- Accuracy improves
- Bad PMU data can be detected and identified

Bad data processor

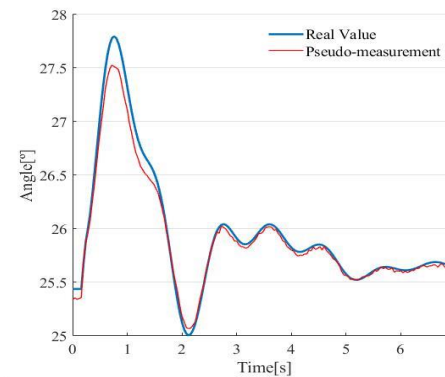
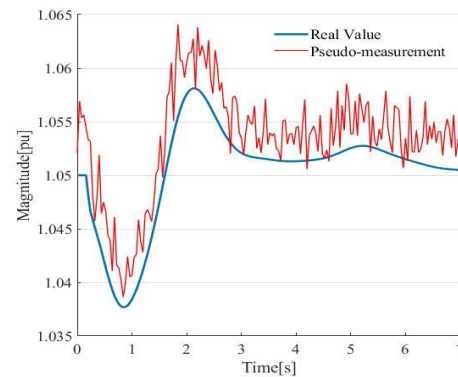
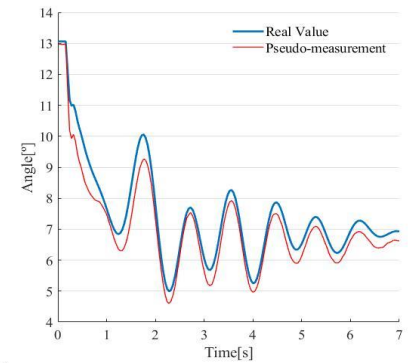
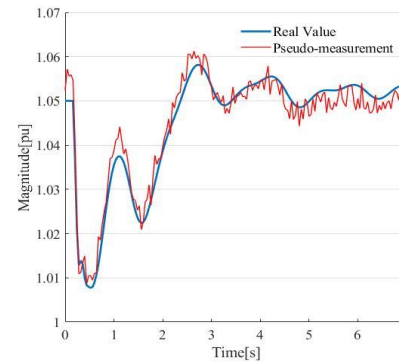
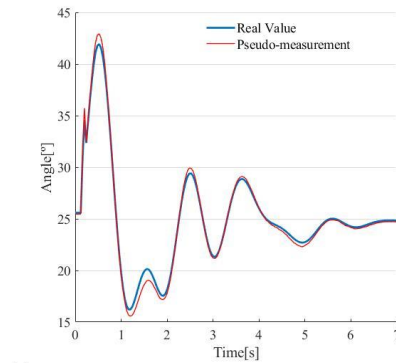
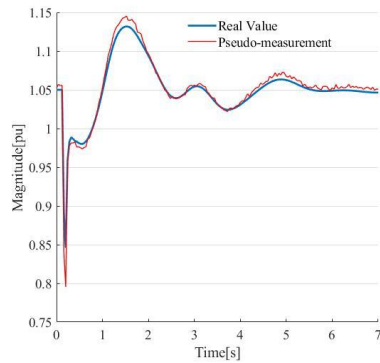
- Detection → Chi-square test
- Identification → largest normalized residual

Phase 2



Analysis of performance

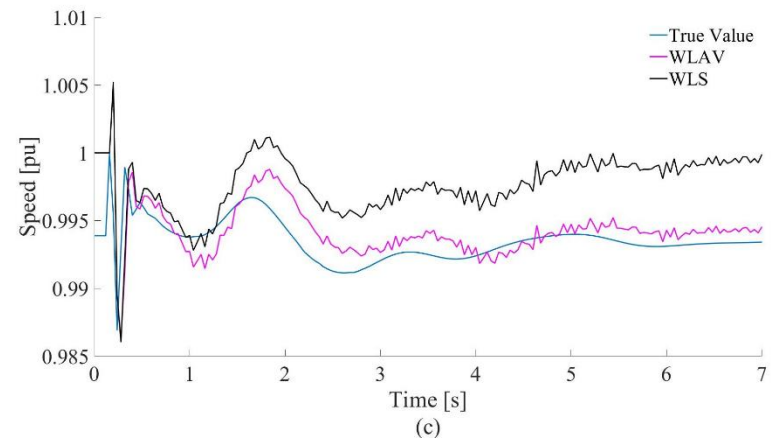
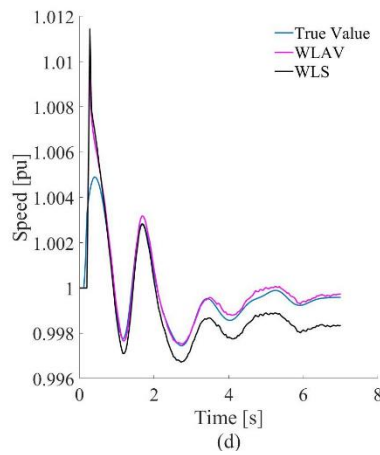
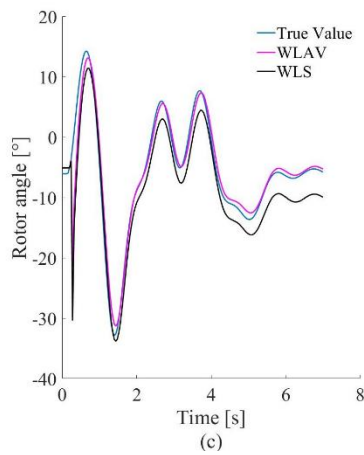
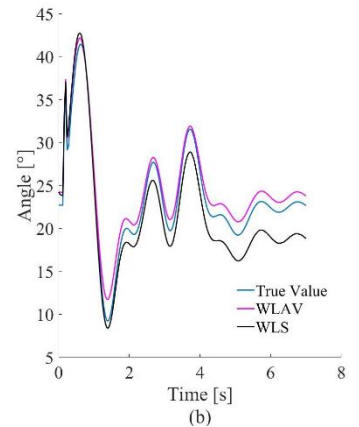
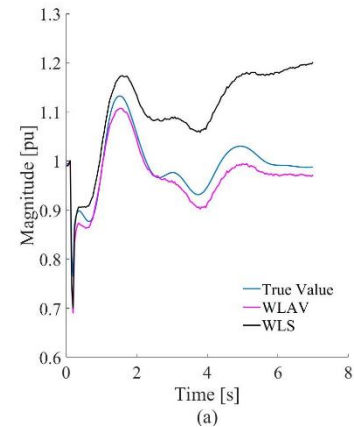
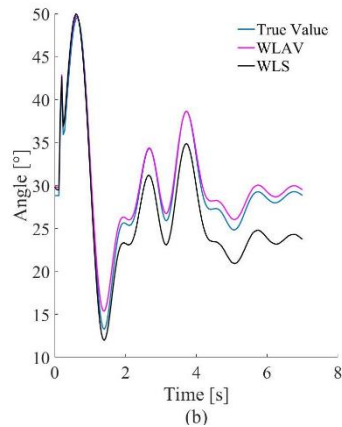
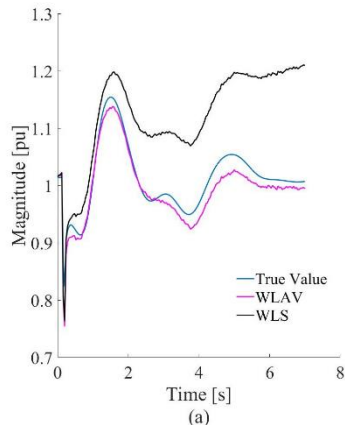
I. Bus voltage pseudo-measurements



(c)

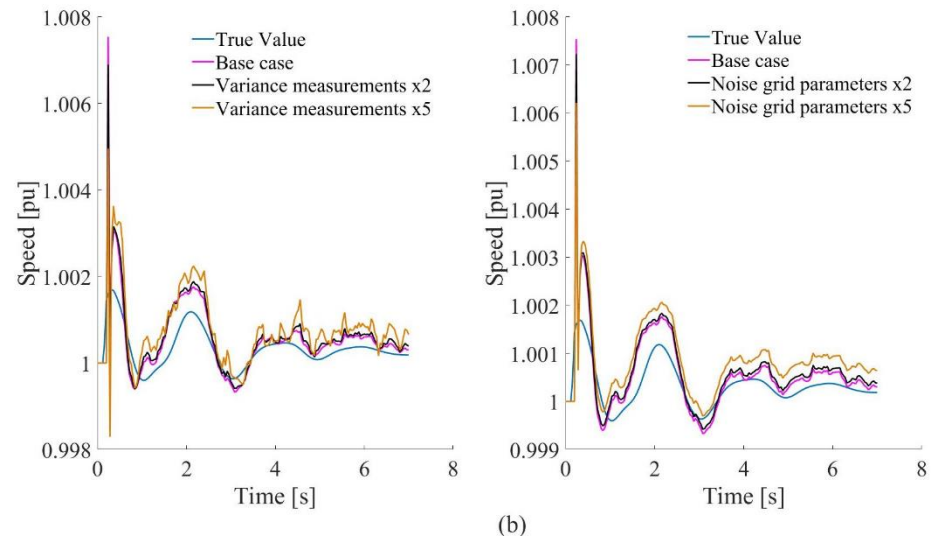
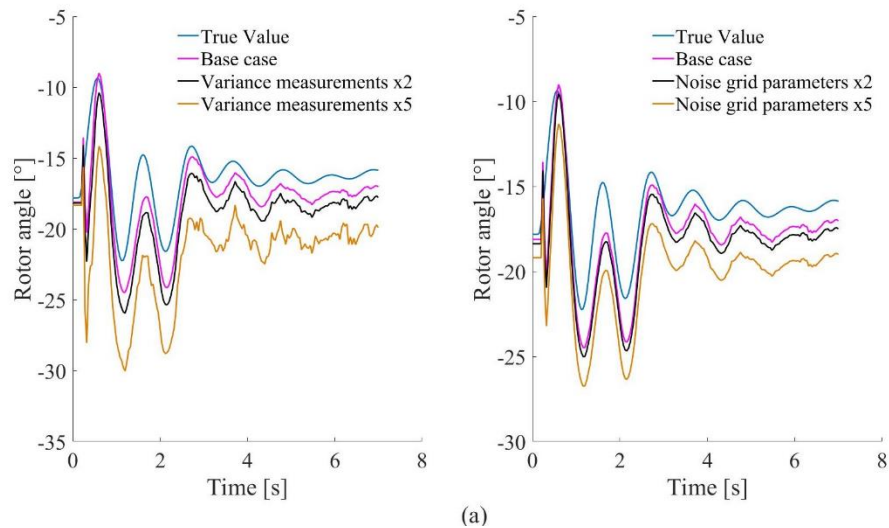
Analysis of performance

II. WLS vs. WLAV – Static and dynamic states



Analysis of performance

III. Robustness – dynamic states



Conclusions and aspects that should be further investigated

- HSE scheme that follows with accuracy the PS dynamics even in those buses that are not observed by PMUs
- The observability issue associated to the lack of PMUs is addressed through a data-mining based methodology
- The inclusion of a WLAV instead a conventional WLS improves the estimated results in transient regime
- The performance of the DSE is degraded when the system becomes unstable → More robust alternatives must be analyzed

Details about this work

- Ortiz G., Rehtanz C., Colomé G. Monitoring of power system dynamics under incomplete PMU observability condition. *IET Gener Transm Distrib.* 2020;1–16.
<https://doi.org/10.1049/gtd2.12111>