Modelling of uncertain profiles for wind generation and solar irradiation

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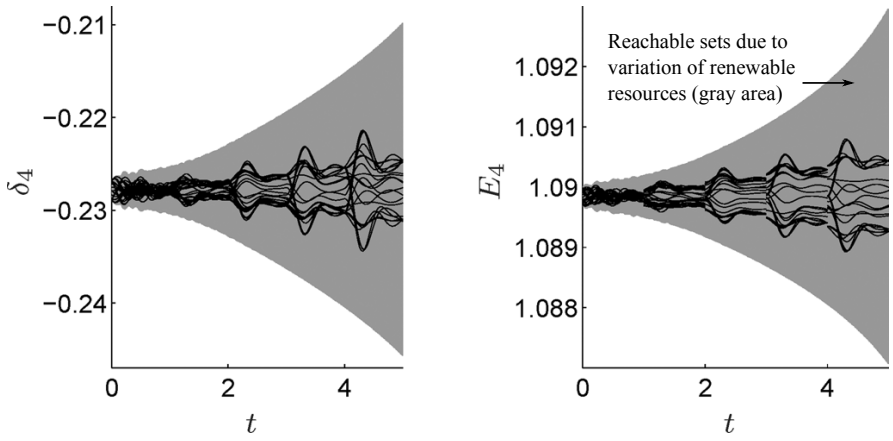
Description

The energy sector is currently in the midst of a transition from centralized conventional power generation towards decentralized generation with a considerable share of renewable energy sources. This transition introduces notable challenges in the operation of power systems as progressively intermittent and variable generators such as wind turbines and solar cells are adding uncertainty on the generation side. The uncertainty arising from renewable-based resources affects the operation of power systems across all time scales, from day-ahead scheduling to automatic generation control.



Projections of reachable sets for the IEEE 14-bus power system

Tasks

In this thesis, the student is expected to

- Present an overview about impact of renewable-based resources on power systems
- Develop simple models to capture the effects of uncertain generation associated with wind turbines and solar cells
- Model validation against measurement and forecast data from German Transmission System Operators (TSOs)
- Assess static constraints of power systems (e.g bus voltage and phase angle) using reachability analysis
- Compute reachable sets of differential and algebraic variables using the Continuous Reachability Analyser (CORA) toolbox

References

[1] Y. C. Chen and A. D. Domínguez-García, "A method to study the effect of renewable resource variability on power system dynamics," *IEEE Transactions on Power Systems*, vol. 27, no. 4, pp. 1978–1989, 2012.

[2] P. B. Eriksen, T. Ackermann, H. Abildgaard, P. Smith, W. Winter, and J. R. García, "System operation with high wind penetration," *Power and Energy Magazine, IEEE*, vol. 3, no. 6, pp. 65–74, 2005.

[3] M. Althoff, "An introduction to CORA 2015," in *Proc. of the Workshop on Applied Verification for Continuous and Hybrid Systems*, 2015.

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Research project:
ROCS-Grid
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B.Sc./M.Sc. thesis

Research area:
Power systems

Programming language:
MATLAB

Required skills:
Power systems, differential algebraic equations, control theory

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English

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