Real-Time Inertia Estimation in Power Systems

Synchronous generators from thermal and hydro power plants supply most of the energy in traditional power. The rotors of the synchronous generators are mechanically large and heavy objects design to rotate at high speeds. Due their mechanical inertia constants and high rotating speeds, the rotors stores very large amounts of kinetic energy. Since the rotation speed defines frequency of the power systems, this kinetic energy stored in the rotors have stabilizing effect on the grid frequency.

With the wider adoption of renewable energy sources such as wind and solar that are typically interfaced with the grid through the power electronics converters, the traditional electric energy sources are slowly being phased out. Since power converters do not have rotating mechanical parts, the stabilizing effect provided by rotational masses and their inertia is being diminishing in modern power electronics dominated energy systems.

To ensure stable operation of the power system it is necessary to continuously monitor available inertia in the system. This thesis will explore innovative approaches in estimating inertia of the system. These methods are based on system identification theory.

The main goal of the thesis will be developing the inertia estimation algorithm and implanting in Matlab. In the final stage the methods will be validated in the CoSES laboratory in power hardware in the loop experiments.

Project Tasks

1) Review existing methods inertia estimation in power systems.
2) Create a Simulink model of a power system suitable with variable total inertia.
3) Simulate appropriate disturbances in the system.
4) Develop an algorithm for inertia estimation using prediction error system identification method.
5) Validate and assess performances of the developed method.
6) If suitable, perform power hardware in the loop experiments with the aim of validating the method.

Requirements

1) Background inElectrical Engineering, Mechanical or Software Engineering.
2) Strong background in control theory
3) Experience with system identification techniques is preferable
4) Strong programming skills.
5) Affinity to programming and structural thinking.
6) Good team-player and an attitude to learn and explore new approaches.

References

[1] L. Ljung, “System Identification: Theory for the User”, Prentice Hall
[2] L. Ljung, “System Identification Toolbox, User’s Guide,” in Matlab R 2015
[3] J. Schiffer, P. Aristidou, and R. Ortega, “Online Estimation of Power System Inertia Using Dynamic Regressor Extension and Mixing,” IEEE Trans. Power Syst., 2019.

Contact

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