Microgrid Dynamic Model Reduction Techniques

Microgrids are becoming more important part of modern power systems. The microgrids are enabling more efficient and cost effective operation of grids through optimal control of small networks.

Since microgrids consist of large number of components that have very different dynamic behavior detail modeling of the microgrids within a bulk power systems is often not feasible approach due to its complexity. This complexity is reflected in the size of the model but also in extensive efforts needed for maintaining the model.

This thesis will investigate dynamic model reduction methods applicable for microgrids. The project will develop a detailed model of a microgrid in Modelica modeling language and apply different model reduction techniques with the aim of finding an optimal balance between model complexity and it's accuracy. The candidate will have opportunity to learn modern modeling approaches applicable in large spectrum of analyses of power system dynamics.

Project Tasks

1) Literature review of dynamic model reduction techniques
2) Develop a detailed dynamic model of a microgrid.
3) Develop and apply several model reduction techniques.
4) Critically analyze obtained results and draw conclusion on the most suitable techniques.

Requirements

1) Background in Electrical Engineering, Control Theory or Software Engineering.
2) Solid background in dynamic modeling, differential equations and numerical methods for solving differential equations.
3) Previous experience with Modelica is preferable.
4) Affinity to programming and structural thinking.
5) Good team-player and an attitude to learn and explore new approaches.

References

[1] U. D. Annakkage *et al.*, "Dynamic system equivalents: A survey of available techniques," *IEEE Trans. Power Deliv.*, vol. 27, no. 1, pp. 411–420, 2012.

[2] S. Djukic and A. Saric, "Dynamic model reduction: An overview of available techniques with application to power systems," *Serbian J. Electr. Eng.*, vol. 9, no. 2, pp. 131–169, 2012.

[3] J. V. Milanovic and S. Mat Zali, "Validation of equivalent dynamic model of active distribution network cell," *IEEE Trans. Power Syst.*, vol. 28, no. 3, pp. 2101–2110, 2013.

[4] Z. Shuai, Y. Peng, X. Liu, Z. Li, J. M. Guerrero, and Z. J. Shen, "Dynamic Equivalent Modeling for Multi-Microgrid Based on Structure Preservation Method," *IEEE Trans. Smart Grid*, vol. 10, no. 4, pp. 3929–3942, 2019.

Contact

Vedran Perić
vedran.peric@tum.de