Model Predictive Control in Operational Energy Efficiency Optimization

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Abstract: The efficiency of energy systems can be characterised by the relevant efficiency components in terms of performance, operation, equipment and technology (POET). The overall energy efficiency of the system can be optimised by studying the POET energy efficiency components. For an existing energy system, the improvement of operational efficiency will usually be a quick win for energy efficiency. Therefore, operational efficiency improvement will be the main purpose of this talk. General procedures to establish operation efficiency optimisation models are reviewed. Model predictive control (MPC), a popular technique in modern control theory, is applied to solve obtained energy models. This is further illustrated by comprehensive case studies such as power generation economic dispatch; power plant generator maintenance scheduling; water pumping system on/off control and flow rate control for energy cost saving and maximum demand cost saving; rock winder system control; and conveyor belt system power modelling, on/off load control, and variable speed drive control. These examples show the prosperous future applications of MPC in energy efficiency problems.

Bio sketch of speaker: Xiaohua Xia is a professor in the Electrical, Electronic and Computer Engineering at the University of Pretoria, South Africa, director of the Centre of New Energy Systems, and the director of the National Hub for the Postgraduate Programme in Energy Efficiency and Demand-side Management. He was academically affiliated with the University of Stuttgart, Germany, the Ecole Centrale de Nantes, France, and the National University of Singapore before joining the University of Pretoria in 1998. Prof. Xia is a fellow of the Institute for Electronic and Electrical Engineers (IEEE), a fellow of the South African Academy of Engineering (SAAE), and a member of the Academy of Science of South Africa (ASSAf). He has an A rating from the South African National Research Foundation (NRF). Prof Xia is a registered professional engineering with the Engineering Council of South Africa. He consults extensively for the industry. He is a certified measurement and verification professional, and leads the measurement and verification team of the University of Pretoria. He served as the chair of the Technical Committee of Non-linear Systems of the International Federation of Automatic Control (IFAC). He has been an associate editor of Automatica, IEEE Transactions on Circuits and Systems II, IEEE Transactions on Automatic Control, and specialist editor (control) of the SAIEE Africa Research Journal. His research interests are control systems and automation, and more recently, the modeling and optimization of energy systems.