

Xiang-Jie Liu

Research/academic activities

Xiang-Jie Liu is now a Professor in Department of Automatic Control, North China Electric Power University. He has been an associate professor in China Electric Power Research Institute(CEPRI), a research associate in University of HongKong, a professor with the center of applied science and technology development in National University of Mexico. His current research area includes: fuzzy control, neural network, filtering, predictive control, intelligent control theory and its application in industrial process. He has supervised/co-supervised several Ph.D Theses. He has also led many research project sponsored through local and international grants, including National Nature Science Foundation of China. He is a reviewer of several International Journals. He was a candidate for “application prize” in the 14th IFAC World Congress. He was several times session chair in International Conference.

Application of Advanced Control Strategy in Processing Industry

Continuous processes in power plant and power station are complex systems characterized by nonlinearity, uncertainty and load disturbance. These factors, which usually make the conventional PID control ineffective, need to be taken into account in the design, development and tuning of a distributed control system(DCS), or recently developed field-bus control system(FCS).

Advanced control technique has recently been developed in our research group concerning the following aspects:

Model predictive control in power plant process.

Model predictive control has emerged to be an effective method for process control. Considering power plant process, the practical implementation of the exact optimization approach is not so easy, since the on-line optimization problem is generally nonconvex, leading to high on-line computational demand. Also the inclusion of constraints could not be so straightforward. Incorporating some approximating method is one way to cope with this kind of nonlinearity.

Modelling and control of nonlinear system using neurofuzzy networks.

Fuzzy logic is capable of incorporating human experiences via the fuzzy rules. The design of fuzzy logic controllers is somehow time consuming, as the fuzzy rules are often obtained by trials and errors. In contrast, neural networks not only have the ability to approximate nonlinear functions with arbitrary accuracy, they can also be trained from experimental data. However, the training of neural networks is computing intensive, restricting their online applications. The neuro-fuzzy networks (NFNs) developed recently have the advantages of model transparency of fuzzy logic, and learning capability of neural networks. Since NFNs are linear-in-weights networks, they can be trained using linear least squares method. The NFNs have been used to develop self-tuning control.

Multiobjective optimal control of the co-ordinate system in steam-boiler generation incorporating fuzzy logic

The control performance of those sophisticated system, like the co-ordinate system in steam-boiler generation, is usually inferior to that of the experienced and skilled human operators. One reason is that these systems control the process according to only one predetermined objective, while the human operators control the process by evaluating multiple objectives. In practice, the multiple objectives on which the human operators issue the control are verbally expressed and are generally linguistic and imprecise. These linguistically imprecise objectives reflect the different aspects of the requirements on the process behavior. The larger and more complex the controlled process is, the more objectives there are to be satisfied to control the process with high quality. Although these linguistic objects on which the human controllers issue the control are difficult to deal with by the

conventional control approaches, they can be characterized by suitably defined fuzzy sets according to the knowledge and experience of the human operators concerned.