ABSTRACT

Structural Decomposition and its Use in Qualitative Model-based Diagnosis of Complex Systems

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Decomposition offers the potential to reduce the complexity of model-based optimization, prediction, control and diagnosis by accounting for the structure and sparsity of the describing model. Motivated by this fact, a rich and powerful collection of decomposition methods are available for model based diagnosis of large-scale complex dynamic systems, too. At the same time, one usually does not have enough information about a large-scale complex dynamic system to construct its precise enough model, so a kind of qualitative dynamic model is often used for the diagnosis. Two structural decomposition based qualitative diagnostic methods are presented in this lecture, together with their component-driven system decomposition techniques.

Firstly, a model-based diagnostic method is described that is able to detect and isolate non-technical losses (illegal loads) in low voltage electrical grids of one transformer area. As a preliminary off-line step of the diagnosis, a powerful electrical decomposition method is proposed, which breaks down the overall network to subsystems with one feeder layout enabling to make the necessary computations efficient. The diagnostic method is based on analyzing the differences between the measured and model-predicted voltages. The uncertainty in the model parameters together with the measurement uncertainties are also taken into account to make the approach applicable in real-world cases. The proposed method is able to detect and localize multiple illegal loads, and the amount of the illegal consumption can also be estimated.

As a second case study, a high level decomposition approach for process system fault diagnosis using event traces is given. Using a simple component graph model behind the process system and the measured trace applied for the diagnosis, the method can find the root cause(s) of propagating failures between separate components. The method can connect individually operating lower-level component-specific diagnosers of possibly different type (e.g. P-HAZID and clustering based ones) with each other by performing a more efficient diagnosis component-wise and combining the results.

Short CV

Katalin Maria Hangos received her M.Sc. degree in chemistry, B.Sc. degree in computer science from the Loránd Eötvös University in Budapest, Hungary in 1977 and 1980, respectively. Her Ph.D. and D.Sc. degrees in process systems engineering were obtained from the Hungarian Academy of Sciences in 1984 and 1993, respectively. Currently, she is a research professor of the Systems and Control Laboratory at the Research Institute for Computer Science and Control of the Hungarian Academy of

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She has a strong interdisciplinary background in systems and control theory and computer science, as well. Her main research interest lies in dynamic modeling of process systems for control and diagnostic purposes. She is a co-author of four books, and more that 100 papers in international journals together with more that 180 papers in referred international conferences.