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Title :
Static and Dynamic Graphs Modeling of a Boiler System

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Fuzzy State Space Model (FSSM) is a novel inverse modeling technique used for optimization of input parameters in multivariable dynamic systems whereby the uncertainty of the parameters is considered and incorporated with the crisp state space models proposed in the modern control theory. The model is succesfully implemented to the state space model of a furnace system of a combined cycle power plant. In this study, FSSM is further implemented to the other state space model of a subsystem in the boiler namely superheater, reheater, riser and drum. Since graph theory is rich in theoretical results especially for studying interconnection among elements in natural and man-made system, therefore, graph representing FSSM is initially developed which is based on the graph theoretic approach. However, the graph of FSSM is found to be a static graph where not much analysis of the graph could explain the model of FSSM of a boiler. Thus, other concept namely Autocatalytic Set (ACS) was applied in developing a new graph which could explain a dynamic nature of a processes in the boiler system. Since combustion process and evaporation process are the main process occurs in the system, therefore two graphs representing interaction among the species in each of the process in the boiler are constructed. These results lead to the development of the third graph which represent a combination of the two processes in the boiler. Adjacency matrix for each of the graph is investigated and and its relation to Perron-Frobenious Theorem is established. Next, to obtain an explanation of the dynamic nature of the system, a Dynamic Autocatalytic Set Graph Algorithm (DAGA) is presented which succesfully explained the dynamics of the real processes in the boiler. The dynamic graphs found from the implementation of DAGA to the boiler system are then further investigated where connection of the graphs to fuzzy graph of type-1 are established. Basic characteristics of the dynamic graphs which was developed in this study have resulted in the derivation of some propositions and proven theorems.

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