ROBUST CONTROLLER DESIGN FOR MULTIPLE BOILERS AND BOILER TURBINE UNITS

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CERTIFICATE OF AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of the requirements for a degree except as fully acknowledged with the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and in the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are specified in the thesis.

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ABSTRACT

Boilers or boiler turbine units are the main source of energy for almost every industrial installation. In most cases, the fuel cost of a power plant is a key factor in the total budget of any industrial unit. Also the major part of the running expense of any plant consists of the total fuel expense of a power plant. Due to this fact, the control of boilers and boiler turbine units confirm their significance. Improving the performance of a power plant and making it cost-effective becomes extremely important for engineers.

Over the last few decades, power plant control has been the focus of attention for academic researchers, scientists and control engineers. Many innovative control techniques have been experimented with on boilers. It is seen that in order to meet the vast utility demand of the plant, more than one boiler or boiler-turbine unit is usually installed in a power plant. The control of such a system becomes sensitive due to the mutual dependency and interactions between one unit and another. The research reported in this thesis mostly focuses on implementing control systems with multiple boilers and multiple boiler turbine units. $H\infty$ robust controllers are designed for systems where multiple boilers and boiler-turbine units are installed and operate in parallel to each other. These controllers maintain power and steam supply in the presence of sudden changes in process parameters and external disturbances in the power plant.

These days due to the vast usage of steam in a production unit, power plants consist of more than one boiler. Furthermore control of this kind of system becomes extremely sensitive when the plant is subjected to frequent variations in operating conditions. A loop shaping technique is used to synthesise robust controllers for the set point tracking, disturbance rejection and robust stability of the system against variations of the operational conditions and nonlinearity of the plant. Designed robust controllers are of high orders and, compared to PID controllers these are still not the industry favourite . That is why, to make the controllers in this study industrial favourable, these higher-order controllers are reduced to approximate the multivariable PID controllers structure. This is done for practical implementation by using eigenvalue decomposition technique. Simulation results show that the resulting PID structure displays a good robust stability and performance in the time domain, achieving steam demand and electricity demand from the boiler header and power grid stations for multiple boilers and multiple boiler-turbine units system.

PREFACE

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