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GA-BASED MODEL PREDICTIVE CONTROL OF BOILER-TURBINE SYSTEMS

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Abstract. *This paper discusses the application of artificial intelligence based model predictive control of boiler-turbine systems. In particular, it is investigating how genetic algorithms can be used to develop an online optimal control taking the model's nonlinear constraints such as input saturation and rate limits into consideration. It is shown that the difficulties experienced in conventional control design due to the nonlinearities and constraints can be overcome by carefully setting up the genetic algorithm and a robust control can be guaranteed over a wide range of operation.*
Keywords: Artificial intelligence, Genetic algorithm, Receding horizon control, Boiler-turbine control, Optimal control

1. **Introduction.** Boiler-turbine units are widely used in modern power generation and can operate over a wide range of operation in accordance with the current power demand. These units can be considered highly nonlinear in multiple variables and are subject to input constraints [1]. Thus, a controller faces multiple control objectives, which makes its design a nontrivial task.

Several controller designs have been proposed in the past trying to meet specific design requirements. In [2, 3], the model of the plant is linearized about a nominal operating point and then linear robust H_∞ control techniques are applied. The H_∞ control is then approximated by a PI controller. This design shows a good system response as long as the change in operating points is sufficiently small.

Another approach is the application of nonlinear search techniques to tune a PI/PID controller for a linearized model and dealing with the nonlinearities via a gap measure [4]. The resulting linear controller is then applied to the nonlinear plant and performs well as long as the change in operating points is within certain limits. However, robust control cannot be guaranteed for a sudden large change in the reference signal.

A l^1-gain scheduling approach is presented in [5]. This approach considers the input constraints and uses a linear parameter varying representation of the boiler-turbine dynamics. A reference governor is implemented to overcome difficulties resulting from large changes in the reference signal and results in robust control over a wide range of operation.

The implementation of fuzzy-logic to control the boiler-turbine unit has been widely studied. In [6], a fuzzy supervisor is used as an autonomous plant controller to detect and handle faults within the plant while coordinating LQG/LTR local controllers. In [7, 8],