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OPTIMAL TUNING OF A NETWORKED LINEAR CONTROLLER USING A MULTI-OBJECTIVE GENETIC ALGORITHM AND ITS APPLICATION TO ONE COMPLEX ELECTROMECHANICAL PROCESS

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Abstract. *A genetic algorithm for optimal tuning of a linear controller is presented hin this note. This method is applied to the networked control of a high performance drilling process, one example of a class of complex electromechanical process. A multi-objective optimisation criterion is presented for maximising the tool's working life and the material removal rate. A modified mutation operator is implemented to carry out the search among P, PI, PD and PID controllers simultaneously in an efficient way. Simulations and real experiments with the resulting controllers are presented. The results corroborate the advantages of the proposed strategy with regard to a classic optimisation technique.*
Keywords: Networked linear control, Genetic algorithm, Optimisation

1. **Introduction.** Genetic algorithms (GA) are used as a stochastic computational technique for finding approximate solutions in optimisation and search problems. GA are based on the Darwinian theory of evolution by the means of natural selection, reproduction and mutation. A GA starts with a population of randomly generated possible solutions (called individuals) which evolve towards an optimum. The evolution is achieved as a result of three basic processes: selection, crossover and mutation.

GA are basically applied to optimisation problems in the field of control systems, specifically for the optimal tuning of linear and nonlinear controllers [1,2]. Linear controllers are broadly used in many industrial applications, and there are well known manual tuning methods available for linear regulators [3]. The application of robust control techniques and fault identification techniques is covered in the literature [4-6]. However, the work reported in this paper goes back to classic control techniques and is focused on the optimal tuning of a linear controller (i.e. PID control) for networked control of a complex electromechanical process. A high performance drilling (HPD) process was selected as a case study, and the maximisation of the tool's working life was set as the main objective of the optimal tuning. In order to carry out the optimisation an objective function is required (e.g. a cost function). Two well known criteria related to the closed-loop dynamic response and controller accuracy were selected. The integral of weighted time absolute