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MULTI-OBJECTIVE FUZZY OPTIMAL DESIGN OF ALPHA-BETA ESTIMATORS FOR NONLINEAR VARIABLE STRUCTURE CONTROL

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Abstract. *Given a tracking control problem for a class of cascade-connected nonlinear systems, we integrate an optimal alpha-beta estimator with a newly variable structure controller to provide excellent tracking performance. The significant feature of the designed alpha-beta estimator is using a multi-objective fuzzy optimization method to obtain the optimal parameters such that the estimated signals can be applied in the feedback controller. In the controller design, we integrate a new hard variable structure control law with a fuzzy-based soft switching control law to achieve the tracking control. To illustrate the effectiveness of the design, the proposed methods are verified through an experimental apparatus, named twin rotor multi-input multi-output system (TRMS). The experimental results strongly suggest that the developed optimal alpha-beta estimator and newly variable structure controller are encouraging for practical applications.*
Keywords: Alpha-beta estimator, Multi-objective optimization method, Fuzzy logic, Tracking control, Variable structure control, Twin rotor MIMO system

1. **Introduction.** One of the main concerns of motion control is how to design suitable controllers to operate moving objectives. Among various control schemes, variable structure control (VSC) has been recognized as an efficient method for dealing with the design of complex highly nonlinear systems [1,2]. By appropriate switch of control laws in different regions of state space, the resulting overall VSC system usually can be made stable even though the individual subsystem in corresponding regions is not stable [3,4,24]. In particular, a specially-designed VSC, called sliding mode control (SMC) [23], provides a simple process in the design. Being theoretically independent of parameter variations, model uncertainties and output disturbances, the SMC has been successfully applied to