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SUBSPACE-BASED ADAPTIVE PREDICTIVE CONTROL FOR A CLASS OF NONLINEAR SYSTEMS

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Abstract. *For a class of nonlinear systems whose current states can be reconstructed with N past measurements, a new subspace-based predictive controller is designed based directly on input-output data. This method combines the characteristics of subspace method with predictive control, such as the minimize request of prior knowledge, applicability for multi-input multi-output (MIMO) process, and the minimization of multi-step prediction errors, to result in the model-free subspace predictive controller. To add an adaptive mechanism to predictive control, this paper uses receding window mechanism to capture nonlinear dynamic characteristics, updates subspace predictor at every time step, and implements predictive control of nonlinear process. A case study proves the efficiency of the proposed algorithm.*

Keywords: Predictive control, Subspace identification, Adaptive control, Nonlinear systems

1. **Introduction.** Predictive control has been attractive for decades in control theory field and has become one of the main methods of modern control and achieved wide applications in industry processes [1]. However, it is noticed that control performance is closely dependant on the accuracy of predictive model. When the model is inaccurate, an adaptive mechanism is introduced to predictive control to adapt model parameters. Therefore, as the representation of adaptive predictive control, generalized predictive control (GPC) et al. control algorithms appeared [2].

Recently, focus is on the research of nonlinear adaptive predictive control. Adding an adaptive mechanism to predictive control has been approached in several ways. A popular approach for adaptive model predictive control (MPC) is to linearize nonlinear analysis model at each sampling instance [3]. Some researchers also use nonlinear analysis model to obtain state space model at different operating levels. Recursive formulation updates process parameters to adapt internal process model [4]. But the analysis model of nonlinear systems is difficult to obtain. A more practical adaptive strategy uses a gain and time constant schedule for updating the process model. An extension of this method is multiple model method [5]. Linear models obtained at different surroundings are weighted to obtain the approximation of the process that approach real behaviors. There are also some problems unresolved in the foundation of model set and the selection of model weighting and switching rules. Due to its ability to approach general nonlinear function,