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OBSERVER-BASED ITERATIVE LEARNING CONTROL WITH EVOLUTIONARY PROGRAMMING ALGORITHM FOR MIMO NONLINEAR SYSTEMS

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Abstract. *In this paper, the observer-based iterative learning control with/without evolutionary programming algorithm is proposed for MIMO nonlinear systems. While the learning gain involves some unmeasurable states, this paper proposes the observer-based iterative learning control (ILC) for nonlinear systems and guarantees the tracking error convergences to zero via continual learning. Moreover, a sufficient condition has been presented to alleviate the traditional constraint, i.e., identical initial state, in the convergence analysis. Then, an idea of feasible reference based on polynomial approximation is proposed to overcome the limitation of ILC – initial state error. To speed up the convergence of the iterative learning control, evolutionary programming is applied to search for the optimal and feasible learning gain to reduce the training time. In addition, two improved issues of ILC, an appropriate selection of the initial control input and the improved learning rule for the system whose product matrix of output matrix C and input matrix B is not full rank, are presented in this paper. Three multi-input multi-output (MIMO) illustrative examples are presented to demonstrate the effectiveness of the proposed methodology.*

Keywords: Iterative learning control, D-type ILC, Observer-based ILC, Evolutionary programming

1. **Introduction.** For repeated tracking control tasks, iterative learning control (ILC) which improves the performance of a system via continual learning is one of the efficient control algorithms [1]. Furthermore, the controller can exhibit the perfect control performance according to a less priori knowledge of the system. Due to its advantages, higher efficiency and more convenience, many researchers ardently discussed the subjects of ILC and usually applied the ILC-based controllers in several physical systems, such as industrial robot, computer numerical control (CNC) machine and antilock braking system, etc [1].