Optimal input filters for iterative learning control systems with additive noises, random delays and data dropouts in both channels

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Abstract

In wireless networked iterative learning control systems, the controller is separated from the plant, and additive noises, random delays and data dropouts arise in both sensor-to-controller and controller-to-actuator channels. In order to guarantee the convergence performance of such systems with the effect of these uncertainties, an input filter is designed based on a proportional iterative learning controller, so that updated inputs can be filtered at the actuator side. Specifically, two data transmission processes are first developed to describe the mix of those uncertainties in both channels by Bernoulli and Gaussian distributed variables with known distributions. Based on state augmentation, the two data transmission processes are further combined with the iterative learning process of controllers to build a unified filtering model. According to this unified model, an optimal filter is designed via the projection theory and implemented at the actuator side to filter the updated inputs in iteration domain. Moreover, the convergence performance of the filtering error covariance matrix is proved theoretically. Finally, some numerical results are given to illustrate the effectiveness of the proposed method.

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