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Discrete-time model reference sliding mode control using an exponential reaching law

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Abstract: Discrete time reaching law based sliding mode control is well known to ensure good robustness of the controlled system with respect to any bounded uncertainties. In principle, reaching law methodology involves a priori specifying the desired evolution of the system representative point and obtaining a control signal which ensures this evolution. However, since the plant is subject to uncertainties at each time instant, the desired state trajectory specified by the reaching law can get gradually distorted during the control process. This in turn can negatively alter the length of the reaching phase or increase quasi-sliding mode band width. Motivated by this problem, in this paper we describe a novel model reference approach to discrete-time sliding mode controller design. In this approach, a reaching law based control strategy is first applied to a reference model of the plant with the aim of obtaining a desirable state trajectory. Then, a secondary controller is applied to the original plant to drive its state alongside that of the model, thus eliminating the residual effect of disturbance on quasi-sliding motion of the system. In particular, in this paper a non-switching reaching law using an exponential function of the sliding variable has been applied to the model with the aim of obtaining favorable properties of its quasi-sliding motion. It has been demonstrated that, with the use of the proposed model reference approach, these properties are then carried over to the original plant even in the continued presence of uncertainties.

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