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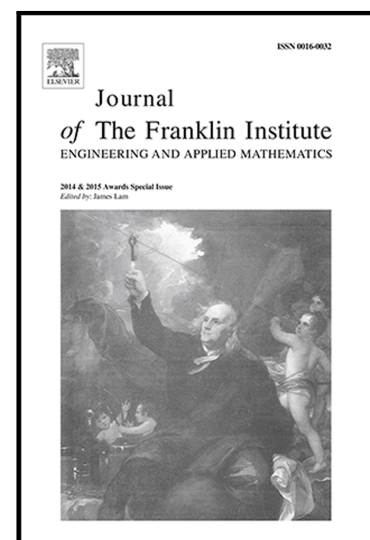
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Discrete Time Sliding Mode Controllers with Relative Degree One and Two Switching Variables

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Abstract

In this paper, a new reaching law based sliding mode control strategy for discrete time systems is introduced. Contrary to most existing approaches, the new strategy uses a sliding variable with relative degree two. It is demonstrated that the new reaching law drives the sliding variable to a narrower quasi-sliding mode band than its relative degree one equivalent, while simultaneously ensuring the desired dynamic properties of the system. Furthermore, it is shown that the smaller quasi-sliding mode band width is reflected in reduced magnitude of all state variables in the sliding mode.

Keywords: Sliding mode control, discrete-time systems, reaching law approach

1. Introduction

Continuous time sliding mode controllers [1–3] are well known to be computationally efficient and robust with respect to matched disturbance and parameter uncertainties [4]. These attractive properties have earned them considerable popularity in the control engineering community [5–8] and led to many further advances in the field. The most significant development in the context of this paper is the introduction of discrete time sliding mode controllers [9, 10]. The fact that such controllers only calculate a new value of the control signal at fixed intervals makes it impossible to attain ideal sliding motion and thus reject matched disturbance completely. However, these strategies still provide remarkable robustness by confining the system representative point to a vicinity of the sliding surface. Various authors have

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