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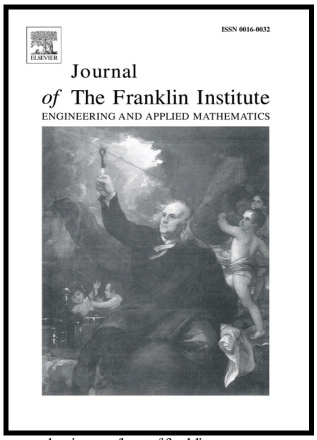

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Passivity Analysis of Discrete-Time Inverse Optimal Control for Trajectory Tracking

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Abstract

This paper presents passivity properties analysis of discrete-time inverse optimal control for trajectory tracking of nonlinear systems; it extends previous results for stabilization. It is assumed that the nonlinear system can be transformed to the so called Nonlinear Block Controllable (NBC) form. The analysis is done by means of a storage function and a supply rate, in order to determine that the closed-loop of the nonlinear system and the inverse optimal controller is passive. An example, based on induction motors, is included to illustrate the applicability of the obtained results.

Keywords: Optimal Control, Inverse Optimal control, Trajectory Tracking, Passivity.

1. Introduction

The energy concept is very useful for the analysis of physical systems. Many systems can be studied from their sources and losses of energy. Considering gain and loss of energy, intuitively, a dissipative system can not store all provided energy. A dissipative system dissipates energy and does not produce it; any increase of stored energy is only due to external sources. This definition implies the existence of three energy functions: the storage function (representing the energy stored by the system), the supply function (the energy injected to the system from an external source, which restricts the manner in which the system absorbs energy) and the dissipation function. The supply function is interpreted as the input power, denomination inherited from circuit theory [1], [2]. Depending upon the form of the supply function, different kinds of dissipativity are obtained; passivity is the one which has attracted more attention. There are works which have analyzed the properties of passive systems in continous time [1], [2], [3], [4]. For the discrete-time case, there are publications about passivity [5], [6], [7], [8], [9], but none considers discrete-time inverse optimal control trajectory tracking based on Control Lyapunov Function (CLF). This paper is focused on passive properties of the inverse optimal control based on the CLF proposed in [10] , where a stabilizing feedback control law is synthesized, which is optimal with respect to a cost functional. In this approach, a candidate CLF is used to construct an optimal control law directly without solving the associated Hamilton-Jacobi-Bellman (HJB) equation [11]. Motivated by this kind of controller, the passive properties of the inverse optimal control for