Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **9 (2002)** 1-11

CONTROL OF A PUMA LIKE MANIPULATOR BY USING SUCCESSIVELY TWO INVERSE DYNAMICS TRANSFORMATIONS

Y. Yavin[1] and C. Frangos[2]

[1] Department of Electrical, Electronic and Computer Engineering
University of Pretoria, Pretoria 0002, South Africa.
[2] Department of Mathematics and Statistics, The Rand Afrikaans University
P O Box 524, Auckland Park 2006, Johannesburg, South Arica.

Abstract. This work deals with the control of a Puma like manipulator. A control problem concerning the motion of its end-effector is posed, and the problem is solved by using successively two inverse dynamics transformations.

Keywords. Puma like manipulator, inverse dynamics transformations.
AMS (MOS) subject classifications : 93B05, 70E15, 70Q05, 93C15

1 Introduction

This work deals with the control of a Puma like manipulator (see Fig.1). It is assumed here that the motion of the manipulator is driven by three motors. The first motor is located at the base of the first link, at the point **O**, the second motor is located at the joint between the first and second links, and the third motor is located at the joint between the second and third links. Let $\mathbf{r}_{EF}$ denote the location of the manipulator's end-effector. Let $\mathbf{r}_A$ and $\mathbf{r}_B$ denote the location of two given points within the reach of $\mathbf{r}_{EF}$, $\mathbf{r}_A \neq \mathbf{r}_B$, and such that $\mathbf{r}_{EF}(0) = \mathbf{r}_A$. Also, let $t_f > 0$ be a given number. Thus the following control problem is considered here: Find control laws for the torques applied on the links [1] such that: (i) $\mathbf{r}_{EF}(t_f)$ will be in a small neighbourhood of $\mathbf{r}_B$. (ii) the system will come almost to rest at $t = t_f$, and (iii) during the time interval $[0\,,\,t_f]$ the system's motion will be subjected to three constraints that will be introduced later.
The problem posed here is dealt with by using successively two inverse dynamics transformations. By doing so we obtain complete separation of the kinematics of the system from its dynamics. This enables us to solve the problem posed here by dealing directly with the kinematics of the system. Inverse dynamics is discussed, for example in [1], whereas the solution of con-

[1] These torques are generated by the motors. However, the inclusion of the motors' dynamics in the dynamical model of the system and the computation of the corresponding control laws for the inputs to the motors will be dealt with elsewhere.