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Dynamic Modelling, Simulation A Two-Link Flexible Manipulators

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Abstract- **This paper presents theoretical on the dynamic modeling and characteristics of a two-link flexible manipulator. A Dynamics model of the two-link flexible manipulator is developed based on finite element methods. A comprehensive dynamic model for the manipulator is derived with the finite element approach and the Lagrangian formulation. The final model derived for flexible manipulator is extremely nonlinear and complex. It reflects the variation in the effective inertia of the system as the manipulator configuration changes as well as the interaction between the rigid body dynamics and vibration modes of the links. In this paper using number of element 1.**

Keywords- modeling, flexible manipulator, finite element.

I. INTRODUCTION

Dynamic models are mostly formulated on the basis of considering forward and inverse dynamics. In this manner, consideration is given to computational efficiency, simplicity and accuracy of the model. Here, a means of predicting changes in the dynamics of the manipulator resulting from changing configurations and loading is proposed, where predictions of changes in mode shapes and frequencies can be made without the need to solve the full determinant equation of the system.

In modeling, firstly the dynamic modeling of a single-link flexible manipulator has to be obtained. The same method is then used to model a two-link flexible manipulator. It presents a finite element method and Lagrangian approach for the mathematical modelling of a single-link flexible manipulator. The link is treated as an assemblage of a finite number of elements for each of which kinetic and potential energies are derived [1]. These elemental kinetic and potential energies are then suitably combined to derive the dynamic model for the system.

product of two functions; one dependent on the distance along the length of the manipulator and the other, a generalized co-ordinate, dependent on time. The Lagrange's formulation is preferable as its matrix structure readily allows the dynamic model to be reformulated in state-space form [2]. This form is particularly convenient for control purposes. Applied the (4 x 4) transformation matrix and the Lagrangian approach to model manipulators with elastic elements [3].

II. BASIC THEORY

The flexible manipulator system used in this study consists of two motors and two flexible links as depicted in Figure 1. The first link, which attached to the first motor, carries at its end the second motor, which operates the second flexible link. $\tau_1(t)$ and $\tau_2(t)$ represent respectively, the input torques applied at the hub and the joint by the drive motor. The angular displacement and the flexural displacement represents the outputs of the system.

The manipulator comprises links 1 and 2 (Usoro, 1986). Link 1 is divided into elements '11', '12', . . . , '1j', . . . '1n_1' of equal length l_1, and link 2 is divided into elements '21', '22', . . . , '2j', . . . '2n_2' of equal length l_2, (refer to Figure 1).

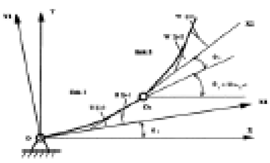

Figure 1. Two-link flexible manipulator.

The modelling used in this work consists of a flexible