TELKOMNIKA: Indonesian Journal of Electrical Engineering
ISSN: 1693-6930, e-ISSN: 2087-278X
accredited by Directorate General of Higher Education of Indonesia, SK No: 51/Dikti/Kep/2010
http://telkomnika.ee.uad.ac.id
ISSN: 1693-6930

DYNAMIC MODELLING OF A FLEXIBLE LINK MANIPULATOR ROBOT USING AMM

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Abstrak

Paper ini menyajikan pemodelan robot lengan fleksibel menggunakan teknik Lagrangian dan assumed mode method (AMM). Lengan robot dimodelkan sebagai lengan Euler-Bernoulli dengan pembagian massa pada setiap bagian lengan. Pada ujung lengan robot ditambahkan suatu beban, sedangkan hub inertias disertakan pada sambungan aktuator. Pendekatan Lagrangian untuk mendapatkan model stuktur yang dinamis. Pemodelan robot lengan fleksibel pada penlitian ini menggunakan simulasi Matlab/Simulink. Persamaan model yang dilengkapi dengan pengaruh beban yang dan redaman yang terdapat dalam material yang digunakan untuk lengan robot. Persamaan model ini untuk mendapatkan persamaan gerakan yang relevan antara lengan robot biasa dengan lengan robot fleksibel yang akurat.

Kata kunci*: assumed mode method; dynamic model; Lagrangian.*

Abstract

This paper presents modeling of a flexible link manipulator using Lagrangian technique in conjunction with the assumed mode method (AMM). The links are modeled as Euler-Bernoulli beams satisfying proper mass boundary conditions. A payload is added to the tip of the outer link, while hub inertias are included at the actuator joints. The Lagrangian approach is used to derive the dynamic model of the structure. In this research, the dynamic model of a flexible link manipulator verified using Matlab/Simulink simulation. The model formulation proposed in this work is complete in the sense that it considers the effects of payload and damping structural of the link. The emphasis has been set on obtaining accurate equations of motion that display the most relevant aspects of the coupling between rigid and flexible dynamics.

Keywords*: assumed mode method; dynamic model; Lagrangian.*

1. INTRODUCTION

The first step of design procedure is to acknowledge the information of constructing the dynamic model of flexible manipulators using the combination of Euler-Lagrange and Assumed mode method (AMM). In order to have a successful modeling design, prior knowledge of AMM and Euler Lagrange equation are needed by integrating with Simulink. Simulation results are analyzed in both the time and frequency domains to assess the accuracy of the model in representing the actual system.

Partial differential equations (PDE) and boundary equations of a flexible link manipulator system are obtained by matching the shear force and bending moment at the elbow joint, allowing the eigenvalues to be computed without recourse to dynamic formulations [1]. On the other hand, the vibration modes of a generic flexible link manipulator are studied as a function of the link, rotor and tip mass distribution. Necessary and sufficient conditions are developed for all vibration modes to exhibit a node at the manipulator. Various approaches have been developed which can mainly be divided into two categories: the numerical analysis approach and the AMM. The numerical analysis methods that are utilized include finite difference (FD) and finite element (FE) methods. The FD and FE approaches have been used in

obtaining the dynamic characterization of a single-link flexible manipulator system incorporating damping, hub inertia and payload [2,3].

5. CONCLUSSION

A generalized modeling framework has been described to obtain the closed-form finite dimensional dynamic model for a flexible link manipulators by using the Euler-Lagrange approach combined with the AMM. The model formulation proposed in this work is complete in the sense that it considers the effects of payload and damping structural of the link. The emphasis has been set on obtaining accurate equations of motion that display the most relevant aspects of the coupling between rigid and flexible dynamics.

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