# DYNAMIC MODELLING OF A FLEXIBLE LINK MANIPULATOR ROBOT USING AMM

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***Abstrak***

*Paper ini menyajikan pemodelan dari sebuah manipulator link fleksibel menggunakan teknik Lagrangian dalam hubungannya dengan metode modus diasumsikan (AMM). Link-link dimodelkan sebagai Euler-Bernoulli beams yang memenuhi kondisi batas massa. Sebuah beban yang terhubung (payload) ditambahkan ke ujung luar link, sedangkan hub inertias disertakan pada aktuator sendi. Pendekatan Lagrangian digunakan untuk mendapatkan model dinamis dari struktur. Model dinamis dari sebuah manipulator link fleksibel pada penlitian ini diverifikasi menggunakan simulasi Matlab/Simulink. Perumusan model yang diusulkan telah lengkap dengan turut mempertimbankan pengaruh beban yang terhubung (payload) dan redaman yang berada dalam kerangka kopling (structural link). Penekanan dari perumusan model ini telah di diatur untuk mendapatkan persamaan gerakan yang akurat yang menunjukkan aspek-aspek yang paling berpengaruh dalam kopling, khususnya untuk kasus kopling untuk tenaga gerak yang kaku (rigid) maupun yang selalu berubah serta lentur.*

***Kata kunci****: assumed 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 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