

Jordan University of Science and Technology

FEM and Simscape modelling and LQG control of a two-link rigid-flexible manipulator

Authors: Tariq T. Darabseh

Abstract: This study models a two-link rigid-flexible manipulator using two methods: mathematical modelling with Lagrange's equations and the finite elements method (FE model) and constructing the model with MATLAB's Simscape multibody tool (Simscape Model). The FE model is validated by comparing it to a linearised version of the physical Simscape model, taking into account structural damping, hub inertias, and payload at the flexible link's endpoint. The resonance frequencies of the first three modes are analysed in the frequency domain using both models. The open-loop responses of both models are also compared in the time domain. A linear quadratic Gaussian (LQG) controller with a Kalman filter and integral action is developed and implemented using the Simscape Model. The simulation results using MATLAB show that the proposed method is efficient and practical for joint angle trajectory tracking and flexible link vibration control of the rigid-flexible manipulator. The LQG controller is shown to be more effective in reducing vibrations and enhancing performance of flexible link manipulators when compared to a proportional-derivative (PD) controller.