**Abstract**

This paper presents a new and general technique for solving the inverse dynamics of flexible robots. The proposed method finds the joint torques that must be applied by the actuators to obtain a specified end-effector trajectory. Moreover, since the inverse dynamic problem for flexible robots is closely coupled to the inverse kinematic problem, the solution of the inverse dynamics also renders the elastic deformations of the arms and the rotations at the joints. There are no restrictions on the configuration of the flexible robots that can be analyzed with the new technique. Elastic characteristics of the robotic arms are modeled using Euler-Bernoulli beam theory. Lagrange's equations, combined with the finite element method to discretize space variables, are used to establish the global dynamic equations of the robot. Kinematic constraints are introduced in the dynamic equations by means of a penalty formulation. Given a tip trajectory, the solution to the posed numerical problem is carried out through a finite differences discretization for the time variable and a collocation procedure that provides the stable, non-causal solution. In contrast with methods previously proposed, this new technique is a non-recursive and non-iterative approach carried out in the time domain. In order to show the performance and accuracy of the proposed method, the paper presents simulation analysis for different robots and several trajectories. When available, the results are compared with those published in previous literature.

**Key words:**

Actuators; Constraint theory; Elastic moduli; End effectors; Finite element method; Inverse kinematics; Inverse problems; Lagrange multipliers; Mathematical models; Motion control; Problem solving; Torque; Euler Bernoulli beam theory; Flexible robots; Global dynamic equations; Inverse dynamics; Multibody systems; Penalty formulation; Robotics.