INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Flexible robotic manipulator systems exhibit many advantages over the conventional robotic systems. However, they have not been favoured in production industries due to their vibration-control issues. This thesis presents theoretical investigation into the dynamic modelling and optimal design through shape optimization of the links. Optimized dynamic behaviour of revolute-jointed single link flexible manipulator, double link rigid-flexible manipulator, and double link flexible manipulator is studied. A constrained flexible robotic manipulator is considered that moves in horizontal plane only. Mathematical models of the systems are developed using finite element method. Distributed systems are converted into discrete systems and equations of motions are derived using Lagrangian approach. Due to their slenderness, robotic links are considered as Euler-Bernoulli beams. Different optimization problems are considered for shape optimization of the robotic links.

Four optimization problems are considered *viz.,* maximization of fundamental beam/system frequency, minimization of static tip deflection, and minimization of dynamic tip deflection for single link flexible manipulator to obtain the optimized shapes. Optimized shapes for a particular objective function are also obtained for various payloads. Effects of system parameters on the dynamics are also studied. Shape optimization is done for a range of payloads, and the results highlight the advantage of shape optimization. Dynamics of double link flexible manipulator is more complex than single link manipulator. Effects of system parameters on its dynamics are studied. Three optimization problems are considered *viz.,* minimization of static tip deflection, maximization of fundamental beam frequency of individual links and maximization of fundamental system frequency of individual links. Improved dynamics of whole system is studied and compared. Dynamics of shape optimized double link flexible manipulator is also investigated under the excitation of energy based robust (EBR) controlled torque and a significant advantage is observed over the non-optimized shape.

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