National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Dynamic Modelling of Multi Degrees-of-freedom Robotic Manipulators in Uncertain Environments
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Venue	: Seminar Room, Department of Mathematics
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Abstract	: The study of the governing differential equation related to the dynamic behaviour of multi-link robotic manipulators is challenging and essential for various real-world applications. Many researchers have investigated the dynamics of robotic manipulators in a crisp environment nevertheless, the introduction of uncertainty in these scenarios enhances the system's realism. This research aims to analyse single and multi-link robotic manipulators in both crisp and uncertain environments, with or without complicating factors. The governing differential equation for a single-link robotic manipulator may not always be analytically solved due to many complicating environmental conditions hence, numerical or semi-analytical methods are more suitable for resolving these difficulties. The differential equation related to a single-link robotic manipulator has been examined through analytical and numerical approaches to ascertain vibration characteristics in both crisp and uncertain scenarios (namely, fuzzy and interval), indicating a forward vibration problem. The inverse problem is crucial, as it seeks to determine the structural parameters based on the given vibrational properties. A model has been developed to forecast unknown parameter values, relevant to both crisp and uncertain situations, utilising known vibration characteristics for the inverse problem. Euler's beam theory, Timoshenko beam theory, and higher-order shear deformation theory have been utilised in the study to define the dynamics of single-link robotic manipulators, applied in both forward and inverse problems of these manipulators. Different types of fuzzy numbers are utilised to analyse the vibration of multi-link manipulators, with the resultant conclusions validated in particular cases, while new results for vibration frequencies are computed. Further investigation has been undertaken on a flexible-link manipulator demonstrating damage and parameter non-homogeneity, encompassing complicated effects in an uncertain environment. The design and experiments of the Flexible Universal Modular Robot (FUMoR) were undertaken for vibration analysis.