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Author: Dr. Ahmed Badawy
Military Technical College, Egyptian Armed Forces, Egypt

ON THE THREE DIMENSIONAL DYNAMICS OF A FLEXIBLE BEAM MOVING IN LOW EARTH ORBIT

Abstract

Abstract Elastic properties of a manoeuvring object orbiting earth are discussed herein. Deflections in an elastic beam produced as a result of its motion and external forces are determined using Kane's dynamical equations. Inertia, internal, control, and gravity forces are included to develop modes shapes of vibrations. Deflections at end points are then determined, consequently mass centre position along with beam orientation is amended to have precise positions of end point where docking with other objects are attained.

INTRODUCTION A growing concern has been rosin during the last decade in assembling large structures on orbit. These structures are ranging from mirrors to reflect the sun light on solar arrays [1], antennae [2,3,4], manipulators, [5], up to the ISS [6]. It is essentially to use light, consequently flexible, structure elements. Due to this flexibility, significant deflection and vibration assist. Accurate rendezvous and docking operations requires a complete knowledge about positions and velocities of connection points, normally end points [7]. Motion planning of a manoeuvring object usually considers the translation of mass centre and rotation about it. These manoeuvres are generated due to the requirements of reaching goal positions and orientation in the mean time avoiding obstacles which are in fact others manoeuvring objects. Goal configuration are determine through constructing the layout of the assembled structures based on all elements remain straight, which of course not the case [8]. A general dynamics of the beam are modelled by using Lagrangian approach. Position and velocity of end points relative to a body reference frame centred at the manoeuvring object mass centre is presented in this paper using Kanne's dynamical equations. Equations governing motions of the manoeuvring object is obtained by utilizing generalized speeds related to vibration modes [9,10].