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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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A NEW APPROACH TO STABILIZATION OF INFLATABLE SPACE STRUCTURES

Abstract

Large space structures are becoming increasingly important to fulfil the ever increasing demand for scientific space research. Large deployable space structures are needed in a variety of fields from satellite antennas and reflectors over solar sails to habitat modules for extra-terrestrial exploration. These structures require strong, rigid and reliable supports to deploy effectively and efficiently. In order to meet the space mission demands, these support structures have to be lightweight and strong enough to bear the load of the space inflatable structure and any external loads that may apply. In this paper we discuss the discretized non-linear equations for the bending, buckling and inflating of inflatable beams to act as the support beams for these inflatable structures. These equations are written with the help of the virtual work principle alongside Timoshenko's Beam Model combined with finite rotation kinematics. From this, we are able to deduce the linearized equations around a pre-stressed reference configuration. Three examples are then investigated, the bending and buckling of the beam and the post inflation of the beam after buckling to stabilize it. The inflatable beam is given an initial internal pressure to rigidise the structure before the preliminary subjected loads. This post inflation will act as a reinforcement technique to stabilize the supportive structure after deformation. Different pressure gradients are considered for the post inflation stage, taking into consideration the material properties and initial pressure inside the beam. These pressure gradients are compared with the final beam configuration from its deformed state. The model was computed in Abaqus using an explicit time integration method. The validity of the numerical results obtained from the beam element is discussed in connection with the published results achieved from the Abaqus model.