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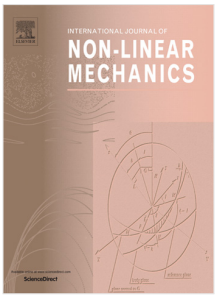

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Chaos analysis in attitude dynamics of a satellite with two flexible panels

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Abstract

We investigate chaos in attitude dynamics of a satellite consisting of a rigid body and two flexible panels. We use the assumed mode method for the vibration of the panels and attempt to find an appropriate methodology to define the internal perturbation due to the flexibility of the panels, followed by the derivation of the Hamiltonian of the system. A canonical transformation on the entire flexible satellite is then applied, reducing the dimensionality of the system by two. The new Hamiltonian will have $2N+1$ degrees of freedom with only two main variables. These two variables are preserved, while the rest of the variables are approximated by explicit functions of time due to the rotation of the main body. This will lead to the proof of the existence of a chaotic behavior using the Melnikov–Wiggins' method, which in turn produces an analytical relation for the width of chaotic layers. This relation provides a means to make a proper comparison of the analytical and numerical results. The results obtained indicate that this approach is useful in the analysis of the effect of the parameters on the chaotic motion of the satellite. The results also show that one or at most two mode shapes suffice to reveal the vibration behavior of the panels and the effect of the panels on the chaotic behavior of the satellite.

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