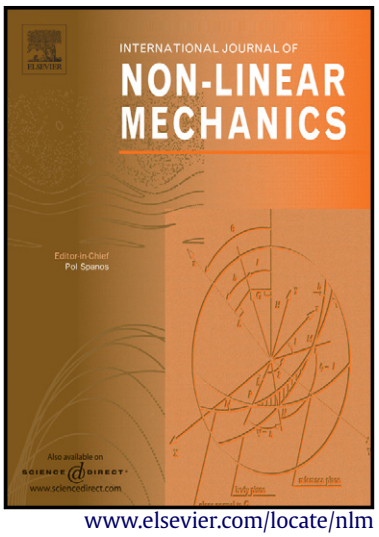

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Grey-box Identification of a Nonlinear Solar Array Structure using Cubic Splines

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Abstract

Most identification methods in nonlinear structural dynamics assume in advance a mathematical model of the nonlinearities. This is however possible in specific situations only, since nonlinear effects may be caused by numerous phenomena and a priori knowledge is generally limited. The present paper investigates the usefulness of piecewise third-order polynomials, termed cubic splines, to identify the complex nonlinear dynamics of solar arrays in their stowed configuration. The estimation of the model parameters is achieved using the frequency-domain nonlinear subspace identification (FNSI) method. A distinct advantage of the FNSI approach is its capability to calculate accurately a large number of parameters, while maintaining an acceptable computational burden. This makes tractable the use of cubic splines to represent nonlinearity in real-life mechanical systems, as the dimensionality of the inverse problem is known to increase dramatically in this case. The experimental structure of interest consists of two parallel aluminium plates assembled with bolted connections. This application is challenging because of the existence of impacts between the two plates at high excitation amplitude, and of the activation of complicated stiffness and damping mechanisms within the bolted connections.

Keywords: Nonlinear system identification; cubic splines; frequency-domain subspace method; solar array structure; unilateral impacts; bolted connections.