Abstract

The focus of this paper is first on understanding the difficulties involved in constructing reduced order models of structures that exhibit a strong nonlinearity, e.g., snap-through, buckling (local or global), mode switching, symmetry breaking, but also on modifying/extending the current Reduced Order Modeling (ROM) methodology, basis selection and/or identification methodology, to obtain reliable reduced order models of these structures. Aiming at this goal, the attribution of this paper is in three parts: i) basis optimization, ii) stiffness coefficients reidentification, iii) detection of events through nonlinear reduced order modeling (NLROM). For i), an approach was proposed by proper orthogonal decomposition on the projection from a series of nonlinear displacement on a group of linear modes which could make the shape of the new transverse mode more similar to the shape of actual deformation, in other word, more ‘dominant’ in representing the actual deformation. It doesn’t expand the modal space but make the transverse modes more efficient, the identification of stiffness coefficients more reliable and the selection of dual modes more compact which also benefit the identification of stiffness coefficients. For ii), two tuning approaches on the stiffness coefficients were proposed here. Both approaches could bring a significant improvement on the static prediction for the clamped-clamped curved beam model. The first tuning approach is based on the matching of modal force that is not so stable for the moment. The second one is much more stable tested under different type of loading showing good match with Nastran counterpart. For iii), the main contribution is building connection between eigenvalue of tangent stiffness matrix and the occurrence of some ‘events’. The occurrence of ‘events’ are usually accompanied with sharp change on the eigenvalue of tangent stiffness. A detection strategy is proposed utilizing this relation which predict the symmetry breaking of curved panel and snap-through of curved beam successfully.