Asymptotic Numerical Algorithm for thin shell instabilities

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Asymptotic Numerical Method (ANM) is an efficient method to solve nonlinear problems with a high accuracy (in particular for instability modeling of thin structures) [1]. It allows to transform a nonlinear problem into a sequence of linear ones to be solved successively. The solution is represented in the form of power series (polynomial approximation) truncated at relatively high orders. In this work, we present different techniques to detect singular points in the branches of nonlinear solutions. Several bifurcation indicators will be presented and tested on different applications concerning the buckling of thin shells. The bifurcation point is detected by evaluating, along the computed solution branch, a scalar function by introducing a fictitious perturbation force [2]. The polynomial approximation can be replaced by rational fractions named Padé approximants in order to improve the radius of convergence [3]. These approximants can also be used as indicators by analyzing their poles. We have also implemented a technique that combines buckling and vibration and allows to use vibration frequencies as an indicator for structural instabilities [4]. The frequencies decrease as the load increases and a critical point (bifurcation point or limit point) is characterized by a zero frequency. Several numerical examples show the efficiency and robustness of the proposed methods.

Keywords: Asymptotic Numerical Method, Instabilities, buckling, bifurcation indicators, thin shells.

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