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Efficient handling of stability problems in shell optimization by asymmetric 'worst-case' shape imperfection. (English) Zbl 1159.74028

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Summary: The paper presents an approach to shape optimization of proportionally loaded elastic shell structures under stability constraints. To reduce the stability-related problems, a special technique is utilized, by which the response analysis is always terminated before the first critical point is reached. In this way, the optimization is always related to a precritical structural state. The necessary load-carrying capability of the optimal structure is assured by extending the usual formulation of the optimization problem by a constraint on an estimated critical load factor. Since limit points are easier to handle, the possible presence of bifurcation points is avoided by introducing imperfection parameters. They are related to an asymmetric shape perturbation of the structure. During the optimization, the imperfection parameters are updated to get automatically the 'worst-case' pattern and amplitude of the imperfection. Both the imperfection parameters and the design variables are related to the structural shape via the design element technique. A gradient-based optimizer is employed to solve the optimization problem. Three examples illustrate the proposed approach.

MSC:

74P10 Optimization of other properties in solid mechanics
74K25 Shells
74G60 Bifurcation and buckling

Keywords:

critical load factor; imperfection parameters; gradient-based optimizer

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