Non-linear design and control optimization of composite laminated doubly curved shell

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Abstract

Multiobjective design and control optimization of composite laminated non-linear doubly curved shell with various boundary conditions is presented to minimize the dynamic response. The control objective aims at dissipating the elastic energy of the composite laminated shell with the minimum possible expenditure of control energy using a closed-loop distributed force. The layer thicknesses and fiber orientations are taken as design variables. The objectives of the optimization problem are formulated based on a shear deformation theory including the von-Karman non-linear effect for various cases of boundary conditions. The non-linear control problem is solved iteratively until an appropriate convergence criterion is satisfied based on Liapunov-Bellman theory. Liapunov function is taken as a sum of positive definite functions with different degrees. Comparative examples for three-layer symmetric and four-layer antisymmetric cylindrical laminated shell are given for various cases of edges conditions. Graphical study is carried out to assess the accuracy of results obtained due to the successive iterations. The influences of the boundary conditions, orthotropy ratio, shear deformation on the cylindrical laminated shell optimal design are elucidated. (c) 2008 Elsevier Ltd. All rights reserved.

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References:

  Recent advances in active control of civil engineering structures
  Active vibration control of large civil structures
- [3] N.S. Khot
  Structure/control optimization to improve the dynamic response of space structures
  Structural and control optimization of space structures
  Comput Struct, 31 (1989), pp. 139–150
  Game theory approach for the integrated design of structures and controls
o Optimization of fiber reinforced composites
o [7]
o A. Muc, Z. Krawiec
o Design of composite plates under cyclic loading
o Compos Struct, 48 (1-3) (2000), pp. 139–144
o [8]
o P.E. O’Donoghue, S.N. Atluri
o Control of dynamic response of a continuum model of a large space structure
o [9]
o J.M. Sloss, I.S. Sadek, J.C. Bruch Jr., S. Adali
o Optimal vibration control of laminated cross-ply cylindrical panels
o Math Eng Ind, 2 (3) (1989), pp. 169–188
o [10]
o Integrated design and control of laminated hybrid plates with dynamic response and buckling objectives
o J Sound Vib, 163 (1) (1993), pp. 57–66
o [11]
o M.A. Langthjem, Y. Sugiyama
o Optimum design of cantilevered columns under the combined of conservative and non-conservative loads Part II: the damped case
o Comput Struct, 74 (2000), pp. 399–408
o [12]
o Distributed control of layered orthotropic plates with damping
o Optimal Control Appl Methods, 9 (1988), pp. 1–17
o [13]
o I.S. Sadek, J.M. Sloss, J.C. Bruch Jr., S. Adali
o Structural control to minimize the dynamic response of Mindlin–Timoshenko plates
o J Franklin Inst, 324 (1987), pp. 97–112
o [14]
o J.C. Bruch, S. Adali, J.M. Sloss, I.S. Sadek
o Optimal design and control of cross-ply laminate for maximum frequency and minimum dynamic response
o Comput Struct, 37 (1990), pp. 87–94
o [15]
o Passive optimal control of an antisymmetric angle-ply laminate
o J Optim Theory Appl, 66 (2) (1990), pp. 227–242
o [16]
o C.W. Kim, W. Hwang, H.C. Park, K.S. Han
o Stacking sequence optimization of laminated plates
o Compos Struct, 39 (2003), pp. 267–278
o [17]
o Y.G. Youssif, M.N.M. Allam, A.E. Alamir
Optimal stabilization of a compressed elastic shallow shell
J Egypt Math Soc, 6 (2) (1998), pp. 233–244

Y.G. Youssi
The influence of the in-plane compression on the stability of a vibrating cylindrical shell
J Egypt Math Soc, 7 (2) (1999), pp. 279–290

M.E. Fares, Y.G. Youssif, A.E. Alamir
Optimal design and control of composite laminated plates with various boundary conditions using various plate theories
Compos Struct, 56 (2002), pp. 1–12

M.E. Fares, Y.G. Youssif, A.E. Alamir
Minimization of the dynamic response of composite laminated doubly curved shells using design and control optimization
Compos Struct, 59 (2003), pp. 369–383

M.E. Fares, Y.G. Youssif, A.E. Alamir
Design and control optimization of composite laminated truncated conical shells for minimum dynamic response including transverse shear deformation
Compos Struct, 64 (2004), pp. 139–150

C.A. Conceição António
Optimisation of geometrically non-linear composite structures based on load–displacement control
Compos Struct, 46 (1999), pp. 345–356

Y.G. Youssif, M.E. Fares, M.A. Hafiz
Optimal control of the dynamic response of anisotropic plate with various boundary conditions

Integrated design and control of laminated hybrid plates with dynamic response and buckling objectives

J.N. Reddy
On the generalization of displacement based laminate theories

J.N. Reddy

M.E. Fares, Y.G. Youssif
A refined equivalent single layer model of geometrically non-linear doubly curved layered shells using mixed variational approach
- [28] M.S. Gabrlyan, N.N. Krasoviskii
  About stabilization of mechanical system problem
  PMM, 28 (1964)
- [29] M.S. Gabrlyan
  About stabilization of mechanical systems under continuous forces
  YGU, Yervan, 2 (1975), pp. 47–56
  Analytical design of controllers
  Aftamateka Telemchanika, 21 (4–6) (1960) 1961;22(4)
- [31] H. Benaroya
  Mechanical vibration analysis, uncertainties and control
Non-linear design and control optimization of composite laminated plates with buckling and postbuckling objectives

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Abstract
Multiobjective design and control optimization of composite laminated plates is presented to minimize the postbuckling dynamic response and maximize the buckling load. The control objective aims at dissipating the postbuckling elastic energy of the laminate with the minimum possible expenditure of control energy using a closed-loop distributed force. The layer thicknesses and fiber orientations are taken as design variables. The objectives of the optimization problem are formulated based on a shear deformation theory including the von-Karman non-linear effect for various cases of boundary conditions. The non-linear control problem is solved iteratively until an appropriate convergence criterion is satisfied based on Liapunov-Bellman theory. Liapunov function is taken as a sum of positive definite functions with different degrees. Comparative examples for three-layer symmetric and four-layer antisymmetric laminates are given for various cases of edges conditions. Graphical study is carried out to assess the accuracy of results obtained due to the successive iterations. The influences of the boundary conditions, orthotropy ratio, shear deformation, aspect ratio on the laminate optimal design are elucidated. (C) 2006 Elsevier Ltd. All rights reserved.

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References:

  Optimal vibration control of laminated cross-ply cylindrical panels
  Recent advances in active control of civil engineering structures
  Passive optimal control of an antisymmetric angle-ply laminate
  Active vibration control of large civil structures
  Optimal design of thick laminated composite plates for maximum thermal buckling load