Springer
Acta Mechanica Sinica
The Chinese Society of Theoretical and Applied Mechanics (CSTAM)

Acta Mechanica Sinica » 2011, Vol. 27 » Issue (6) :938-949 DOI: 10.1007/s10409-011-0520-2

Geometric and material nonlinear analysis of tensegrity structures

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Abstract A numerical method is presented for the large deflection in elastic analysis of tensegrity structures including both geometric and material onlinearities. The geometric nonlinearity is considered based on both total Lagrangian and updated Lagrangian formulations, while the material nonlinearity is treated through elastoplastic stress – strain relationship. The nonlinear equilibrium equations are solved using an incremental-iterative scheme in conjunction with the modified Newton – Raphson method. A computer program is developed to predict the mechanical responses of tensegrity systems under tensile, compressive and flexural loadings. Numerical results obtained are compared with those reported in the literature to demonstrate the accuracy and efficiency of the proposed program. The flexural behavior of the double layer quadruplex tensegrity grid is sufficiently good for lightweight large-span structural applications. On the other hand, its bending strength capacity is not sensitive to the self-stress level.

Keywords: Nonlinear analysis Tensegrity structures Geometric nonlinearity Material nonlinearity Large displacements

Received 2011-03-17; published 2011-07-13

Cite this article:

Hoang Chi Tran, Jaehong Lee.Geometric and material nonlinear analysis of tensegrity structures[J] Acta Mechanica Sinica, 2011,V27(6): 938-949

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