An Efficient Rotation-free Triangle and its Application

†*Y.X. Zhou[1, 2] and K.Y. Sze[3]

[1]School of Aerospace Engineering and Applied Mechanics, Tongji University, China.
[2]Faculty of Civil Engineering and Mechanics, Jiangsu University, China.
[3]Department of Mechanical Engineering, the University of Hong Kong, Hong Kong, China.

*Presenting author: 1000004464@ujs.edu.cn
†Corresponding author: 1000004464@ujs.edu.cn

Abstract

The deformation of the thin plate/shell usually involves large displacement and large rotation. Numerical simulations for these geometric nonlinear problems are challenge and one of main reasons is related to the rotational degree of freedom used in the traditional plate/shell element. The rotation-free method is a promising approach to deal with this problem. In this presentation, an efficient rotation-free triangular element will be presented. The bending energy of this element is developed based on a six-node quadratic interpolation using an overlapping concept and is extended to the geometric nonlinear formulation by using a coroational frame. This triangle is particularly efficient since the tangential bending stiffness matrix is a constant matrix which does not need to be updated during the nonlinear iterations. On the other hand, the membrane energy can be considered by using the CST or six-node membrane elements. The triangle has been successfully applied to the static and dynamic drape problems. In this presentation, the rotation-free triangle will be extended to consider the nonlinear materials and laminated structures. More examples in flexible electronics and aerospace engineering will be presented.

Keywords: rotation-free, nonlinear, plate and shell elements, drape simulation,

References

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