Improved Hybrid Displacement Function (IHDF) element method for solving edge effect problem of plate/shell structure

***†Yan Shang[1]**

[1]College of Aeropace Engineering, Nanjign University of Aeronautics and Astroautics, China

*Presenting and †Corresponding author: shangyan@nuaa.edu.cn

Abstract

For plates subjected to transverse loadings, the distributions of the rotations and some resultant forces may vary very sharply within a narrow district near certain boundaries. This phenomenon, called edge effect, is a great challenge for finite element analysis. Due to the inherent theoretical limitations, when the usual FEM is employed to solve such problem, only poor results can be obtained even when very refined meshes are used.

In this article, a novel and effective FEM solution scheme, named as the improved hybrid displacement function (IHDF) element method, is introduced. Its main idea is to employ analytical solutions of the edge effect to develop special plate/shell elements for specially modeling the boundary layers near free and soft simply-supported (SS1) boundaries. Besides, these elements are based on a modified complementary energy functional containing the Lagrangian multipliers. Therefore, the constraints of related zero-value resultant boundary conditions at free/SS1 edges can be considered. By using this method, the edge effect problem can be efficiently and exactly solved without the use of adaptive mesh refinement technique.

Keywords: high-performance finite element method; Mindlin-Reissner plate; edge effect;