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GLOBAL-LOCAL TECHNIQUES FOR MACROSCALE ANALYSIS AND KEY PERFORMANCE INDICATOR EVALUATION OF COMPOSITE STRUCTURES

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The current work deals with the stress analysis of complex composite structures using a combination of refined beam models and global-local techniques. The refined beam models are obtained within the framework of the Carrera Unified Formulation (CUF), where expansion functions are used across the cross-section to enrich the kinematics of the finite elements, resulting in 3D-like accuracy of the solution at a fraction of the computational cost associated with a full 3D FEA [1]. Global-local techniques are used to focus the analysis on a specific region of the structure where highly accurate stress fields are required, for instance in the neighbourhood of a stress concentrator. The extent of the local region is determined using failure indices which are calculated based on criteria such as LaRC05.

In the current work, the global structure is modelled in a commercial software (ABAQUS) and the local analysis is performed in CUF, thus demonstrating the capability of interfacing the academic and commercial codes. The displacements obtained from the global analysis are used as boundary conditions for the local analysis. Such a global-local methodology can be of advantage while performing a refined analysis of an existing model, since remeshing of a complex structure can be avoided. The results obtained using the global-local technique are in good agreement with reference 3D FEM solutions, as can be seen in Figure 1 for the case of a plate with a hole, with a significant reduction in the number of degrees of freedom.

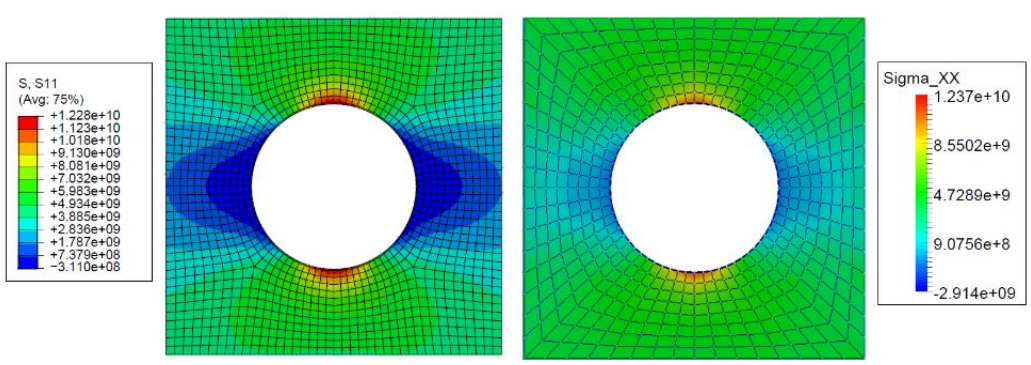

Figure 1: Contour plot of the axial stress near a hole (left) 3D FEA, and (right) analysis of the local region in CUF

References

[1] Carrera E, Cinefra M, Petrolo M, and Zappino E, 2014, Finite Element Analysis of Structures through Unified Formulation, John Wiley & Sons