6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

ON THE COUPLING OF LOCAL 3D PARAMETRIC SOLUTIONS AND GLOBAL 2D SHELL THEORY IN STRUCTURAL MECHANICS

Giacomo Quaranta[1], Fatima Daim[2] , Mustapha Ziane[2] , Emmanuelle Abisset-Chavanne[1] , Jean-Louis Duval[2] and Francisco Chinesta[3]

[1] ESI Group Chair, ICI Institute at Ecole Centrale de Nantes, Nantes, France.
Giacomo.Quaranta@ec-nantes.fr, emmanuelle.abisset-chavanne@ec-nantes.fr
[2] ESI Group, Rungis, France. Fatima.Daim@esi-group.com,
Mustapha.Ziane@esi-group.com, Jean-Louis.Duval@esi-group.com.
[3] ESI Group Chair, PIMM Institute at ENSAM ParisTech, Paris, France.
Francisco.CHINESTA@ensam.eu

Most of mechanical systems and complex structures exhibit mainly plate parts, with few complex zones. Therefore, 2D simulation, based on plate and shell theory, appears as an appealing choice to simulate the entire structure for design [1] as it allows reduced computation times.

Nevertheless, this 2D framework prevent from capturing the richness of the mechanical fields in the complex zones, such as the joining parts (welding points, riveting), and then from predicting the damage initiation and propagation. To tackle this issue, authors proposed a shell separated representation [2] allowing to capture the richness of the mechanical fields for a 2D computation time price. However, this rich representation is not needed in the whole structure, and then, we propose to couple the two approaches only in the weak parts as the joining ones.

We then propose to create local 3D parametric solutions of the complex zones by taking advantages of the Proper Generalized Decomposition PGD [3], not necessary for the 2D-1D decomposition but for the parameters introduction. These "vademecums" describe finely the complex geometries, integrate all the rich physics (damage, plasticity) while taking as inputs any external internal loadings and the generalized displacements imposed on the boundaries. These patches are then coupled with the 2D simulations to performed enriched simulations able to predict the structure degradation and failure at low computation times.

This project is part of the Marie Skodowska-Curie ITN-ETN AdMoRe funded by the European Union Horizon 2020 research and innovation program with grant number 675919.

REFERENCES

[1] Oñate,E. Structural Analysis with the Finite Element Method. Linear Statics. Volume 2. Beams, Plates and Shells. Springer, Barcelona (2013).

[2] Bognet, B. and Leygue, A. and Chinesta, F. and Poitou, A. and Bordeu, F. Advanced simulation of models defined in plate geometries: 3D solutions with 2D computational complexity. *Computer Methods in Applied Mechanics and Engineering* (2012) **201**, pp. 1–12.

[3] Chinesta, F. and Leygue, A. and Bordeu, F. and Aguado, J.V. and Cueto, E. and Gonzalez, D. and Alfaro, I. and Ammar, A. and Huerta, A. Parametric PGD based computational vademecum for efficient design, optimization and control. *Archives of Computational Methods in Engineering* (2013) **20/1**, pp. 31–59.