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

NEXT GENERATION DIGITAL MOCK-UPS FOR MULTI-PHYSICS SIMULATION

FLAVIEN BOUSSUGE*, CECIL G ARMSTRONG*
AND JEAN-CLAUDE LÉON†

* Queens University Belfast, School of Mechanical and Aerospace Engineering,
Ashby Building BT9 5AH, Northern Ireland
f.boussuge@qub.ac.uk, c.armstrong@qub.ac.uk and URL

† Grenoble University - INRIA
INRIA Rhône-Alpes, 655 av de l'Europe, Montbonnot, 38334 Saint-Ismier, France
jean-claude.leon@grenoble-inp.fr and URL

Key words: Assembly; Digital Mock-Ups, CAD models; FE pre-processing, functional information, simulation intent.

ABSTRACT

ACARE's vision 2050[1] for aerospace requires technological leadership in terms of managing the complexity of multidisciplinary design and development. Computational Simulation is essential to meet these challenges. The Digital Mock Up (DMU), which represents virtually the product being developed, provides full 3D detailed geometric (CAD) models as input for analysis. However, converting large assembly CAD structures into FEA models is extremely time-consuming and requires highly-skilled engineers[2]–[4]. Even though solve time is often used as a key performance indicator, model preparation is typically orders of magnitude larger that the solution time. On top of that, the pre-processing task is distributed across all the simulation departments where analysis models are created over and over again for the same assemblies to correspond to the different physics. This practice keeps the modelling and simulation decisions in silos, and makes it difficult to transfer the decisions between disciplines. Efforts have been made to reduce the complexity of FE models preparation by providing automatic methods and tools [4]–[6] essentially on individual components. Recent contributions [7], [8]have shown how to extract automatically functional knowledges from the DMU. However, relatively few researches[9], [10] exploit the potential of the DMU to simplify the pre-processing process of assembly models. As shown in [2], mechanisms to preserve and transfer data between the different simulation domains are today not existent in the DMU, a significant limitation to the use of DMU for simulation purpose.

In response to the challenges above, the goal of the minisymposium is to bring together researchers from academia and industry in view of sharing contributions related to CAD geometric analysis approaches, DMU enrichment and pre-processing techniques for the generation of FEA/CFD models.

The objectives are:

(1) To define the content of the next generation of digital mock-ups to be used for the unification of geometric models and simulation attributes across the different simulation disciplines.

(2) To share technical pre-processing methods and rules in the transformation of CAD assembly models into FEA/CFD models.

This minisymposium will engage dialogue between the simulation and engineering specialists about the disciplinary differences in the geometric representation of simulation models. Authors will be encouraged to show how the DMU is transformed regarding specific simulation objectives and to highlight how consistent the CAD input models are compared to the level of accuracy needed to generate equivalent FEM/CFD models. Finally, the minisymposium will participate to the unification of models exchange for multi-physics simulation delivering a key differentiator for the European industry.

REFERENCES

[1] "ACARE," Advisory Council for Aviation Research and Innovation in Europe. [Online]. Available: http://www.acare4europe.com/.

[2] F. Boussuge, J.-C. Léon, S. Hahmann, and L. Fine, "An analysis of DMU transformation requirements for structural assembly simulations," in Int. Conf. ECT, 2012.

[3] F. Boussuge, J.-C. Léon, S. Hahmann, and L. Fine, "Idealized models for FEA derived from generative modeling processes based on extrusion primitives," Eng. Comput., vol. 31, no. 3, pp. 513–527, 2015.

[4] D. C. Nolan, C. M. Tierney, C. G. Armstrong, and T. T. Robinson, "Defining simulation intent," Comput. Des., vol. 59, pp. 50–63, 2015.

[5] C. M. Tierney, L. Sun, T. T. Robinson, and C. G. Armstrong, "Using virtual topology operations to generate analysis topology," Comput. Des., vol. 85, pp. 154–167, Apr. 2017.

[6] L. Sun, C. M. Tierney, C. G. Armstrong, and T. T. Robinson, "Automatic decomposition of complex thin walled CAD models for hexahedral dominant meshing," Procedia Eng., vol. 163, pp. 225–237, 2016.

[7] H. Vilmart, J.-C. Léon, and F. Ulliana, "From CAD Assemblies toward Knowledge-based Assemblies using an Intrinsic Knowledge-based Assembly Model," in Proceedings of CAD'17, 2017, pp. 374–378.

[8] A. Shahwan, J.-C. Léon, G. Foucault, M. Trlin, and O. Palombi, "Qualitative behavioral reasoning from components' interfaces to components' functions for DMU adaption to FE analyses," Comput. Des., vol. 45, no. 2, pp. 383–394, 2013.

[9] F. Boussuge, A. Shahwan, J.-C. Léon, S. Hahmann, G. Foucault, and L. Fine, "Template-based geometric transformations of a functionally enriched DMU into FE assembly models," Comput. Aided. Des. Appl., vol. 11, no. 4, pp. 436–449, 2014.

[10] C. M. Tierney, D. C. Nolan, T. T. Robinson, and C. G. Armstrong, "Managing equivalent representations of design and analysis models," Comput. Aided. Des. Appl., vol. 11, no. 2, pp. 193–205, 2014.