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

MULTI-SCALE CO-SIMULATION: APPLICATION TO NON-LINEAR STATICS

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Keywords: *non-intrusivity, multi-scale, non-linear statics, co-simulation*

In the last decades, multiple industries have been embracing digitalization in engineering with the employment of numerical simulations for design and certification of structures and products. A multi-scale and multi-physics strategy is inevitable to cover all applications, making use of a growing number of specialized software. This is especially the case in aeronautics, with extremely large and complicated structures.

For the design and certification of aircrafts, a wide range of simulations is performed under non-linear static conditions encompassing different scales. The ability to bridge global coarse models created for conceptual design and global testing to local refined models can become useful to improve the overall design process. In case of non-linear behavior, a concurrent coupling across scales is preferable to 1-way sub-modeling. In today's commercial software, co-simulation tools are available for this purpose. Non-intrusive coupling algorithms are preferable in order to keep untouched assembly level global models and to enable to use most of well established software features.

In this work, we propose the implementation of the non-intrusive coupling scheme presented in [1] and [2] making use of co-simulation for bridging two finite elements analyses performed in Abaqus. The coupling is based on the iterative exchange of displacements from global to local surfaces applied as boundary conditions and of reaction forces in the opposite direction applied as external load and corrected by the global complementary contribution. The convergence of such coupling scheme is not guaranteed. A relaxation scheme has been studied to ensure robustness.

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