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Enriching digital mock-ups with fluid domains

F. Boussuge[1], C. M. Tierney[2], T.T. Robinson and C.G. Armstrong[3]

[1] School of Mechanical and Aerospace Engineering, Queen's University Belfast, BT9 5AH, UK,
f.boussuge@qub.ac.uk, christopher.tierney@qub.ac.uk, t.robinson@qub.ac.uk,
c.armstrong@qub.ac.uk

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The Digital Mock Up (DMU), which represents virtually the product being developed, provides full 3D detailed geometric (CAD) models as input for analysis. In practice, however, the information in a DMU is limited to a set of CAD components positioned in 3D space with respect to a global reference frame. Simulation requires much more information than individual component geometries. Physical domains, and their interfaces with adjacent components, are required for FE analysis[1]. For CFD analysis or FE acoustics, the fluid surrounding the structure should be defined and discretized. The fluid is not described in current DMUs.

The proposed approach considers an enriched DMU as not just a collection of structural volumes, but a partitioning of the space in which the structure and fluid resides, annotated with a description of analysis attributes describing any given simulation[2], [3]. From a CAD assembly, a cellular model is generated, i.e. the full 3D space where the CAD components resided is subdivided into volumes of simulation significance (structures, gas paths, internal and external airflows, etc.). Voids within the cellular model represent fluid portions of the design space.

The resulting Digital Mock Ups are enriched with new B-Rep solids fluid domains directly available for an FE or CFD analysis. The analyst can interrogate the cellular model to extract the geometric cells (structure cells or fluid cells) as well as their interfaces (e.g. fluid/structure interface) having an influence on the user simulation intent. The expected gain is a better interoperability of geometric models available in DMU; allowing analysts to focus on capturing high level modelling and idealisation decisions in order to create an efficient and fit-for-purpose analysis.

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