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Structuring Assemblies for Physical Simulations

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There are increasing needs in processing assemblies for numerical simulations due to the higher demand in modelling complex phenomena. Consequently, processing assembly models becomes a strong requirement. An appropriate assembly structure seems a significant enabler to speed up the generation of simulation models from a digital mock-up (DMU).

The tree structure of a DMU is not readily available in commercial simulation softwares and assembly tree structures are usually not meaningful. The proposed approach consists in setting up an intrinsic assembly model [1] where the boundary of each solid defining a component of the assembly is described using hypergraphs. This way, the boundary of each solid becomes independent of its modelling process and of the modeller topological constraints. In addition to this boundary description, a symmetry analysis enables the characterization of the shape of each solid as well as the definition of an intrinsic reference frame. This reference frame and the intrinsic boundary of each solid enable the extraction of sets of occurrences, i.e., solids sharing the same shape but a different spatial location. Similarly, when solids are not identical but share the same shape, they are extracted as sets of solids forming families. Also, the geometric domain common between solids, whether surface or volume or line, define their common interfaces and generates a graph reflecting the intrinsic structure of an assembly. Altogether this defines an intrinsic structure of an assembly model.

From a complementary standpoint, occurrences, families and geometric interfaces form the starting point of a knowledge-based approach enabling the enrichment of the previously obtained assembly model with functional information. To this end, an ontology has been defined and combined with inference rules to extract the functional designation of components or sets of components.

The resulting assembly structure exhibit interest when performing shape simplifications or grouping of components as needed for mesh generation purposes and specification of boundary conditions.

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