NAFEMS UK Regional Conference 2018 - Abstract Submission

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Please identify the event for which your submitting?	NAFEMS UK Conference 2018
Will you be the presenting author?	Yes
Presentation Title	Combined solid modelling and meshing to create a new standard for CAD and CAE
Relevant Themes / Keywords	CAD, CAE, integration, solid modelling, meshing, finite object, system analysis

Abstract (plain text)	3D CAD systems took over from drawing boards and 2D CAD systems in modern engineering companies. These systems promised a high level of integration with downstream tasks being based on a single 3D model including machine tool commands and calculations such as Finite Element Analysis (FEA). However there is now a crisis in engineering design as 3D CAD models are often created without due consideration of analysis. FEA and CFD are relegated far too late in the design process and often get carried out too late to make decisions, and even on a version of the design model that is not current. AIES's new methodology addresses these issues by creating solid models fused with hexahedral calculation mesh for FEA or CFD, and with geometry suitable for robust design studies. Models are created using Finite Objects selected from a library and transforming the Finite Object Assembly into the required shape. The Finite Objects have hex mesh and solid fused together. Thus the current solid model is in step with the current analysis model and, indeed the solid model is capable of being analysed: not something that is always the case in the old CAD-FEA paradigm. The approach has been incorporated in AIES's patented SystemDeveloper software. Part of the modelling process automatically generates geometric parameters, and a distinction is made between internal surfaces (connections) and external surfaces (interfaces). AIES's bearing or other tribology solutions can be attached to the interfaces of models to form assemblies for system analyses, for example engines and gearbox systems. Application of mesh control and boundary conditions is often difficult to maintain, in the current CAD/FEA design process, due to loss of identity of the boundary representation entities regenerated at each geometry change. The new methodology uses Finite Objects and application of boundary conditions to interface surfaces keep the geometry and analysis model changes in step. A feature of the method is that an experienced analyst can set up a model (solid and mesh) with boundary conditions assigned and save it. The designer or analyst can change the model using the geometric parameters and automatically analyse the design. This helps with the shortage of adequately skilled simulation engineers, and enables their skills to be applied efficiently while keeping solid modelling and simulation in step. Capturing a company's design knowledge is important and means SystemDeveloper is used as a Knowledge Based System that assists in maintaining the process. The Object Oriented structure of the program also means that this will evolve to replace current Product Lifecycle and Simulation Lifecycle products. The ability of SystemDeveloper to prepare models for complex system analysis using tribological objects requires efficient use of computer power for simulation to be an integrated part of the design process. The use of hexahedral meshes is important in this situation as it gives accurate results for much less computer power than tetrahedrons. In addition the Finite Objects include attributes such as section properties that enable automatic dimensional reduction to beams and shells where required e.g. for complex system dynamic simulations where calculation time is a major issue. The automatic identification of external surfaces not only allows easy attachment of tribological objects but also facilitates automatic modal condensation to those surfaces. Examples show the way that SystemDeveloper is used and demonstrate its relevance to solving the current CAD/FEA design management crisis. This approach to CAD and CAE means that a new standard method has just been developed which lends itself to automation and eliminates complex file transfer issues.
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