USE OF SUPERELEMENT/SUBSTRUCTURES TO INTEGRATE COMPONENTS OF DIFFERENCT SCALES IN FINITE ELEMENT ANALYSIS

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KEYWORDS

Superelement, substructure, FEA plug and play, integrated system analysis, democratization, automation, Simulation Apps, FEA, finite element, cae, cad, Simulation Automation, CAD CAE Integration, Non-Experts Accessing Simulation, meta-code

ABSTRACT

Often, it is desired to include a detailed model of a small scale into a larger context of an integrated system model. Integration of these models of different scale can become complex and sometimes undoable. Even the machine numerical storage precision can become an issue. Further, each of the components at different scales of this integrated analysis can be extremely large and complex in and of themselves. Use of superelements a.k.a substructures is an elegant mathematical approach to solve the integration of multi-scale integrated systems such as small components on motherboards in computers or actuators to aerospace structures or jet engines to airframes. Further, the standardization inherent in superelements/substructures makes them useful for plug and play FEA approaches.

In this presentation, we will look at examples from the experience of structural transient and static modelling of integrated motherboard systems illustrating the ability to integrate small scale detailed soldercrack models into large scale integrated models. This can also apply to microscale integrated to larger-scaled models in a general sense. We will also look at the underlying theory and typical implementation of superelements/substructures.

We will also look at Meta-code technology which envelopes and controls the various necessary software from various manufacturers to enable large scale system modelling. This metacode approach is able to adapt to significant

changes in component location and geometry while maintaining the original intent of the specialist; especially in the area of boundary conditions, interconnects, and force functions. This enables optimization and doe parameter studies, by not just the specialists, but also by non-specialists allowing “democratization of this high-end structural analysis.

Superelement/substructure technology is abstract and complex. Thus, even for trained engineers, acceptance and implementation takes some commitment. However, the ability to reduce the size of very large models without loss of accuracy and to intermix models of difference scales creates a strong argument to add superelement/substructures to one’s engineering toolbox. Superelements/substructures become most useful once implemented within modern automation techniques(democratization) which removes the human error and fatigue element from the equation showing that this approach is very reasonable once implemented.