A NOVEL CO-SIMULATION ALGORITHM FOR HANDLING FIELD-SIGNAL INTERACTION

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ABSTRACT

Co-simulation is becoming an increasingly integral and indispensible technique for solving today's challenging engineering problems. By means of this code coupling technique, the engineering problem is decomposed as an assembly of different subsystems exchanging solution information at run time. The inherent advantage of co-simulation in contrast to the monolithic approach is that it allows the (re-)use of well-established and specialized simulation software to be combined with minor alterations. Furthermore, co-simulation allows different fidelity models to be combined at all stages of the design process. Unfortunately, this partitioned treatment of the individual system poses stability and accuracy challenges.

We present a novel co-simulation algorithm, referred to as the Interface Jacobian-based Co-Simulation Algorithm (IJCSA), which has been developed as a collaboratively effort between Daussault Systems and Technische Universität München. The algorithm handles the co-simulation involving an arbitrary number of fields and signals. Due to the fact that the IJCSA is based on the residual form it handles algebraic loops in a natural manner. Furthermore, the individual simulators can run in parallel without flow dependency reducing the wall-clock time of the simulation, since the subsystems do not have to be executed using the classical Gauss-Seidel pattern. A thorough stability analysis of the IJCSA is presented.

The IJCSE has been implemented as part of the SIMULIA Co-Simulation Services (CSS), an open technology for coupling logical and physical systems. The openness of the platform allows partners and customers to develop specialized coupling algorithms addressing their specific numerical challenges for their particular multiphysics problem without having to embed specific code in their solvers.

We conclude the presentation with several examples demonstrating the IJCSA, including a fully coupled industrial example of a fluid-structure-signal interaction with closed-loop control.

Performing a co-simulation requires expertise in different engineering disciplines. To complement the above capabilities Dassault System is introducing the 3DEXPERIENCE platform, a collaborative product suite to

simulate products virtually through realistic multiphysics simulations. We envision that this platform will allow the ability to easily add/subtract physics phenomena, seamlessly move across different fidelity models, and provide robust coupling of simulation domains. Designers, analysts and domain experts can collaborate and work jointly on the same models, revolutionizing the way products will be designed in the future.