High Performance Computing (HPC) Computational Weld Modeling With Examples

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ABSTRACT

A state-of-the-art software code is currently available and is used to design and model large welded structures prior to fabrication. The use of this code helps control distortion, minimize residual stresses, control welding microstructure, and pre-determine welding parameters such as weld-sequencing, pre-bending, and thermal-tensioning. Through use of such a digital tool, manufacturing companies <u>avoid</u> costly design changes after fabrication. Additionally, use of this weld modeling tool allows distortion control strategies to be determined in a matter of a few days, not weeks or months as is required when only an iterative, physical approach is

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employed. Weld modeling and analysis methods are used very effectively to determine best practices for weld repair and this methodology has been successfully employed for joining (welding) dissimilar metal applications.

This particular digital tool is a sophisticated, mathematical and physics-based approach that simulates the weld process. The weld process is a highly non-linear and difficult phenomenon to capture which involves (for example) melting, removal and re-depositing of material. Inclusion of micro- mechanical properties of the weld and parent structural materials provides simulation efficacy to the solution process. Engineering Mechanics Corporation of Columbus (Emc^2) staff developed this software code over a number of years in close cooperation with Caterpillar Inc. (CAT) of Peoria, IL, who currently uses this code exclusively for their fabrication and product design and development activities worldwide. Emc^2 successfully adapted the tool to perform efficiently in a high performance computing (HPC) environment independent of commercial software on a platform to permit easy and cost effective access to the code. The adapted HPC version of this tool resides on the AweSim platform at the Ohio Supercomputer Center (OSC) within the Ohio State University (OSU). Key for small- and medium-size enterprises (SMEs), that do not have the financial or technical assets to state-of-the-art weld simulation digital tools, is the access to this sophisticated and proven methodology that is quick, accurate and cost effective and available "on-demand" to address weld-simulation and fabrication problems prior to manufacture.

This presentation discusses the strategy developed for hosting the digital tool on the AweSim system at OSC and details about its use, capabilities and examples of weld fabrication problem solutions for users of this digital technology.

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