An Integrated Computational Weld Mechanics Framework for Exploring Design Space in Industrial Scale Weld Optimization

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Abstract:

Development of a computational weld mechanics (CWM) framework that automates multiple setups and evaluations is proposed and implemented to practically explore a design space by given design of experiment (DOE) matrices. Saving an expert-user's time to prepare several analyses and allocating CPUs to be utilized efficiently make this framework cost effective and time effective to manage industrial-scale designer-driven optimization and control application of CWM. A validation analysis is conducted to identify the CWM control vector that minimizes the difference between the computed and experimental data. Actual CWM problems with continuous and discontinuous parametric design spaces including regression modeling, surrogate modeling, sensitivity analysis, and control problem are solved in this framework to minimize weld distortion using derivative-free optimization algorithms that become attractive in this framework. The study can fit in a design space exploration of welding process for many structures such as aircraft, ship, automotive and heavy machinery.