LIFT LIGHTWEIGHT INNOVATIONS

Technology Project Abstract:

Joining-3: Robust Distortion Control Methods and Implementation for Construction of Lightweight Metallic Structures

Lead Industry Partner: Huntington Ingalls Industries

Lead Research Partner: University of Michigan

Technology Pillar: Joining

Project Summary

The project will develop integrated computational materials engineering (ICME) tools that will accurately predict the distortion associated with the production of representative structural forms, such as complex welded structures, stiffened panels or other structures that are of interest to industrial participants.

Technology Gap / Need

Distortion control for complex structural assemblies in production environments remains largely empirical and experience-based due to:

(1) Effective distortion modeling techniques for complex structures must focus on key parameters that contribute to distortion on a structural level in order to achieve computational efficiency and robustness for practical applications.

(2) Detailed material constitutive behaviors, including microstructure change during welding, only contribute to local through-wall, self-equilibrating stress states and have little effect on structural distortions that by definition are global phenomena at structural levels.

(3) Without effectively separating local versus global effects, current distortion modeling methods become too complex to implement for structural distortion.

Proposed Technology

The project is developing distortion prediction models and validating distortion mitigation strategies for increasing the final quality of lightweight steel fabrication processes. Year 1 will focus on developing ICME models and correlating them with actual production distortion. Year 2 will focus on validating and refining distortion control methodologies and developing and verifying distortion prevention strategies for each stage of production. The project includes a detailed cost analysis of the distortion control methods studied.

Project Benefits

Implementing better distortion control predictions and processes will result in significantly improved first-time quality, less rework and increased productivity in construction of lightweight structural components. The benefits expected include improved shop-floor operating procedures, simple distortion estimation equations that engineers can use to optimize designs for production, and finite element-based distortion analysis procedures for further engineering design and manufacturing analyses.

Education & Workforce Impact

Work force training sessions will be performed during the second year at corporate analysts', design and production engineers', and shop-floor workers' levels. Educational impact will involve undergraduate and graduate level students throughout the projects and will be expected to become potential workforce candidates for the industrial sections involved in the project.

Project Duration

Start: December 2015
End: December 2017

Funding

Total Project Value: $3.75M

Participants

Industry Partners	Research Partners
Huntington Ingalls Industries	University of Michigan
Comau	EWI
ESI NA	MIT
	The Ohio State University