Solution Left: The Story of Virtual Heat Treatment Simulation at General Motors

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Solution Left

Virtual heat treatment simulation tools have been employed at General Motors over the last decade. Solution left is the concept of leveraging these tools to better understand and make decisions about product and heat treatment manufacturing processes further left in the development life cycle with the objective of reducing program costs and time to launch. Other advantages of a virtual approach are reduced parts and trials in physical recipe development, improved quality for our customers, scrap reduction, earlier consideration of heat treatment manufacturing effects in product design, and an environment to prove-out new technologies.

Virtual Toolchain

The virtual heat treatment simulation toolchain consists of:

- Empirical and CALPHAD based material characterization
- Computational-fluid-dynamics (CFD) simulation to predict fluid flow and heat transfer
- Finite-element-analysis (FEA) to predict part-level distortion, metallurgical, and residual stress outcomes
- Python programming to automate pre- and post- processing
- Machine-learning (ML) applied to both physical and virtual data, for example virtual heat treatment recipe development

Applications

Applications will be presented across a range of heat treatment processes including induction hardening, laser hardening, and low-pressure carburized and high-pressure gas quenched gears with an emphasis on high business value work at General Motors.

Biography

Justin A. Persinger joined General Motors in July 2022 as a Senior Manufacturing Engineer in Global Propulsion Systems Manufacturing Engineering. He has close to 20 years of experience in structural stress analysis, fatigue testing, virtual manufacturing process simulation, and new product development in the power generation and automotive industries. He completed Master's degrees in Mechanical Engineering and Welding Engineering with The Ohio State University, co-authored 3 publications, and is the co-inventor of 12 patents and trade secrets.