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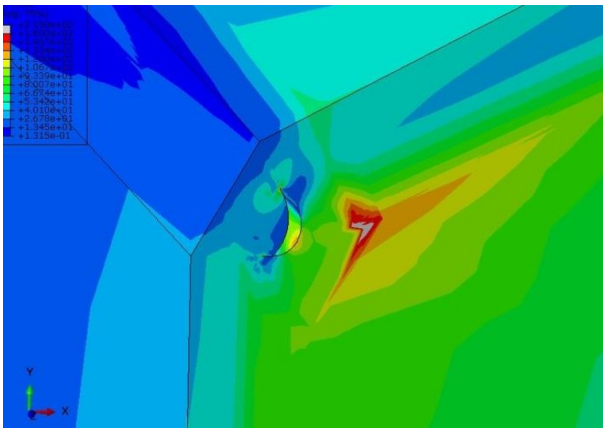
Welding Simulation and Modeling

We are recognized as industry leaders in the field of computational weld mechanics. We have expertise in computational engineering of welding and complex welded structures using both the Abaqus Welding Interface and the VrWeld platform. We are have expertise in quick scripting and subroutine programming to electronically optimize welding procedures, including transient thermal effects, microstructure evolution, mechanical implication, and localized damage analysis, without using expensive human and physical resources.



THE Applus+ SOLUTION

Weld distortion is the most frequent problem in welding applications and many techniques have been developed over time to mitigate distortion or in some case achieve zero distortion. Simple techniques like **tack welding** and **fixturing** can now be optimized using welding models that reliably predict distortion. Furthermore, simulation and modeling enables the designer to optimize complex methods like **pre-offset**, **side heating**, **trail cooling**, or more advanced techniques including **adaptive clamping** and **process control**.

Welding sequence and **intermittent welding** design, which determines the best welding pattern in multi-pass welds, are familiar techniques to control the distortion when dealing with multi-pass welded structures. Finding the best solution for such a design is limited by available resources since a designer needs to pick one out of many patterns i. e. hundreds to thousands patterns, usually based on experience. Optimization of this problem is not feasible through shop trials, so we use computer modeling that automates implementation of several patterns for minimal distortion, residual stress, or other design objectives. Using **our signature technique** based on surrogate modeling we can efficiently select the best pattern out of tens of thousands of pattern or all possible weld sequence configurations.

Residual stress affects the service life and condition of weldment during course of service if it doesn't introduce immediate problems during the manufacturing process. Weld modeling is the most cost effective method to generate a **3D map of all stress components** during and after welding as well as interaction with operation loading condition for **fatigue** and **creep** analysis. This leads to optimal design for enhancing service life and can avoid further cost of rejected parts from service.

Microstructure evolves inevitably through the rapid heating and cooling cycle from welding and this evolution differs from point to point in the weld and Heat Affected Zone (HAZ). Given the **3D transient temperature field** from welding, simulation plays a key role to predict local microstructure changes and our model predicts the evolution of steel' s microstructure based on transformation of **Gamma** to form phase fraction of **Ferrite**, **Pearlite**, **Bainite**, and **Martensite**. The **Vickers hardness** of the alloy can also be computed by using the rules of mixture from volume fraction of phases and cooling rates.

Repair welding is among the most challenging welding engineering since:

- It is usually for high value assets
- Operational down-time is critical
- Generally there is no past experience or similar case
- No risk of mistake is aceptable
- Repair procedures are not directly dictated from standards
- The condition of weldments has changed over time
- Limited available information on older structures and welds

We are capable of modeling weld and welding procedures on existing structures for an optimal **repair process** that will be **validated** through our experimental lab and **mock-up tests** to assure delivery of **high quality and risk-free** repair procedure.

Target customers

Using computational weld mechanics, we can account for all of the complex physical processes involved in welding allowing us to effectively model distortion and residual stresses, weld strength, microstructure and hardness. Applications include automotive, energy production, marine, aerospace, oil and gas and heavy equipment. Simulation may be used to optimize welding sequencies prior to fabrication, or to understand the effects of welding on existing structures.

Weld modeling can also be used in the field of additive manufacturing, to optimize the fabrication of metalic components.

Key customer benefits

- Understand the effects of welding on your valuable infrastructure prior to welding
- Optimize weld sequencing to reduce effects of distortion
- Predict microstructure evolution and resulting mechanical properties
- Obtain realistic thermal models for the dynamic process of welding