
High Cycle Life Fatigue Analysis of Spot Welds with High-Fidelity Modeling

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Abstract

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Industrial context:

Resistance spot welding is a widely used joining process for assembling two or three sheets, particularly valued in the automobile industry. It allows for cost-efficient high-quality assemblies and to automate a big part of the assembly chain. Despite its use in the automobile industry for over 100 years, the modeling of spot welds remains a challenge, especially for durability simulations, as fatigue is the primary failure mode of spot welds. In fact, the models currently used are not precise enough and the need to have a full 3D spot weld accuracy is rising (3,4). However, given the large number of spotwelds on a car's body, reduced models of those "high-fidelity" models are commonly used for the simulation of structures with several spotwelds (4).

Content:

In this work, we focus on the high cycle fatigue modeling of a spotweld using a "high-fidelity" model. In this model, a spot weld is represented by a 3D fine mesh in the high cycle simulation performed in **Abaqus/Standard** using the **cycle jump** method (2). Two approaches are investigated to model the fatigue failure of spotwelds.

The first one is based on element deletion coupled with the continuum damage mechanics (2). A damage variable is assigned to each element and elements are deactivated when

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their damage value exceeds a threshold of 1.

The second method is based on eXtended Finite Element Method (XFEM) combined with linear elastic fracture mechanics (LEFM). Crack growth is estimated using LEFM.

We evaluate these two methods by modeling U-shaped fatigue samples with a single spot weld submitted to shear and tension loading. The results are then compared in term of crack profiles, stiffness evolution and mesh objectivity.

References

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