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## Fatigue damage evolution and lifetime prediction of welded joints with the consideration of residual stresses and porosity

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### Abstract

This work investigates the fatigue damage evolution of butt welded joints under cyclic loading through a continuum damage mechanics approach. A coupled thermal-mechanical analysis is conducted to evaluate the residual stresses induced by welding processes, which are used as the initial state in the fatigue damage analysis. An elasto-plastic fatigue damage model that takes into account the porosity-induced stress concentration in the weld zones of joints is developed to study their damage evolution. The fatigue lifetimes of these joints with different pore conditions are predicted and show consistency with the experimental results. The residual stress level is found to decrease due to the combined effects of the plastic deformation and fatigue damage.

**Keywords:** Fatigue damage evolution; lifetime prediction; welded joints; residual stresses; porosity

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