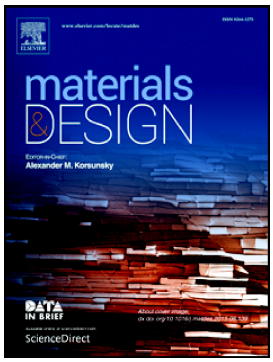

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Prediction of residual stress within linear friction welds using a computationally efficient modelling approach

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Abstract

Modelling the mechanical mixing occurring at the interface of a linear friction weld (LFW) is complex, making it difficult to study the development of residual stresses within real engineering workpieces. To address this, a sequentially-coupled numerical model of a Ti-6Al-4V LFW was developed, bypassing the modelling of the oscillations by applying the heat at the weld interface and sequentially removing rows of elements to account for the burn-off. Increasing the rubbing velocity was found to numerically increase the peak of residual stress while narrowing the distribution. Only small changes arose from increasing the applied pressure or changing the oscillation direction. Predictions suggested a strong correlation between the phase 3 temperature profile and the residual stress field subsequently created. Validation against neutron diffraction and contour method are also presented. This approach provides a computationally efficient technique to study the residual stress development within large 3D structures.

Keywords: Linear friction welding, Titanium, Residual stress, Modelling, Experiments