Fatigue Crack Propagation Life of Welded Structures Accounting For Welding Induced Residual Stress

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A numerical simulation approach for fatigue crack propagation life assessment of a complicated ship welded structure subjected to welding induced residual stress and cyclic loadings is developed here. Fatigue has been always a highly challenging and complex engineering issue which is faced by the maritime and offshore industry worldwide. In this paper, three-dimensional coupled thermo-mechanical finite element analyses are performed to predict the temperature and residual stress distribution field in a real ship structures with welded joints by using double ellipsoidal heat source model and the element birth and death technique. A new simulation approach based interface element and Paris-Erdogan law is proposed to estimate 3D fatigue crack growth. The interface element is employed to simulate the formation of new crack surface. The influence research of residual stress, crack initiation location, size and multiple site damage on the fatigue crack propagation life of the welded joint is performed.

Keywords: Welding, Fatigue crack growth, Residual stress, Interface element modeling, Fracture mechanics