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# Evaluation of Cyclic Thermo-Mechanical Responses of an Industrial Gas Turbine Rotor

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**Abstract :** This paper describes an elasto-visco-plastic computational modelling method which can be used to assess the cyclic plasticity responses of high temperature structures operating under thermo-mechanical loadings. The material constitutive equation used is an improved unified multi-axial Chaboche-Lemaitre model, which takes into account non-linear kinematic and isotropic hardening. The computational methodology is a three-dimensional framework following an implicit formulation and based on a radial return mapping algorithm. The associated user material (UMAT) code is developed and calibrated across isothermal hold-time low cycle fatigue tests for a typical turbine rotor steel for use in finite element (FE) implementation. The model is applied to a realistic industrial gas turbine rotor, where the study focuses its attention on the deformation heterogeneities and critical high stress areas within the rotor structure. The potential improvements of such FE visco-plastic approach are discussed. An integrated life assessment procedure based on R5 and visco-plasticity modelling, is also briefly addressed.

**Keywords :** unified visco-plasticity, thermo-mechanical, turbine rotor, finite element modelling
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