SMART simulation of fatigue crack growth

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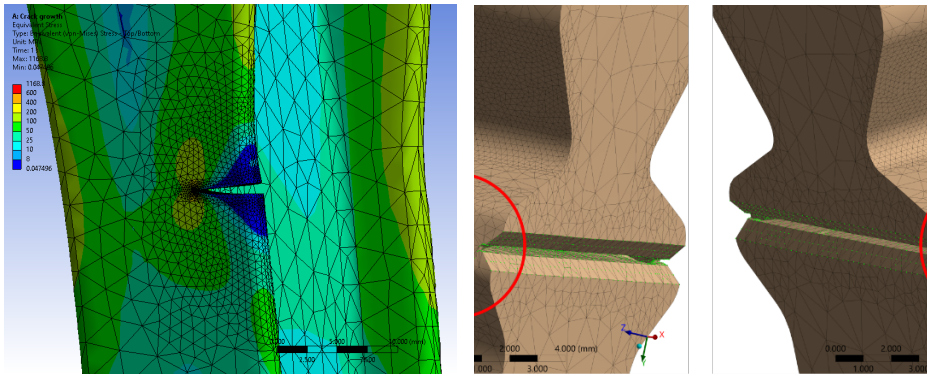
Abstract

In this paper Separating Morphing and Adaptive Remeshing Technology (SMART) was used to simulate fatigue crack growth according to the Paris law and the stress state of a component analysed. In mathematical terms, stress state is treated as an elliptic boundary value problem, solved by the Finite Element Method (FEM) by applying variational principle to get the weak formulation of the governing partial differential equation and then using Galerkin procedure to get approximate solution, introducing basic finite element functions and interpolation thereby. Paris law is treated as an ordinary differential equation, integrated in each crack growth step to provide dependance between crack length and number of cycles. The key feature of SMART), which relies on the Unstructured Mesh Method (UMM) implemented in ANSYS Workbench, is automatic remeshing in each crack growth step, enabling the use of conventional FEM and couple of options to simulate crack initiation, which will be illustrated by 3 case studies of components with complex geometry: High Pressure Turbine (HTP) case, torque link in landing gear assembly (Fig.1a) and turbine blade slot damaged by fretting (Fig. 1b).



(a) (b)

Fig. 1: Fig. 1. Fatigue crack growth simulation: a) torque link, b) turbine blade slot