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# Thermomechanically coupled simulation of cracks in turbine and compressor blades

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In the Collaborative Research Center(CRC) 871 "Regeneration of complex capital goods" new repair procedures are investigated and further developed. Among other things the compressor and turbine blades are taken as a subject of research. In addition to the real repair procedures numerical simulations are carried out in order to estimate the quality of the repair. Another goal of the project is to investigate worn blades during the usage in order to predict component behavior and operational life span.

In turbine blades of aero-engines typical defects are cracks in the range of several centimeters down to 40-70 microns. In addition to the high centrifugal forces, the temperature near the surface can reach up to 1000C. To accurately simulate 3D crack propagation in an inelastically and thermo-mechanically behaving material leads to an extensive numerical effort. Therefore, the extended finite element method (XFEM)[2] is widely used for simulations of fracture mechanics problems considering cracks directly at the element level. Discontinuities in the displacement and temperature[3] field are allowed and simultaneously the crack opening displacement and crack tip stress field are reproduced accurately with the XFEM. Since crack closing and non-physical penetration of the crack surfaces may occur at element level under certain load conditions, it becomes necessary to enforce the non-penetration condition (for crack surfaces) like in multi body systems with contact[1]. Additionally, pressure depended heat transfer across crack surfaces should be taken into account for thermo-mechanically coupled problems which are investigated in this work.

## REFERENCES

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