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Expertise in Fracture Mechanics

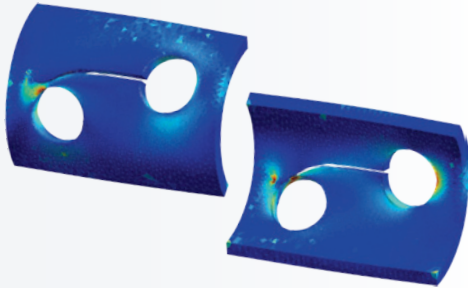
Unique engineering services
for non-planar 3D crack
propagation simulations

Structural integrity analysis

Cenaero offers cost efficient engineering services in the field of damage tolerant approaches and structural integrity assessment for aero-structures and aero-engines.

Cenaero helps you to investigate the critical character of cracks thanks to a thorough numerical analysis using the most advanced features of the Morfeo/crack software and Morfeo/crack plug-in. Hence, Cenaero approach relies on the **eXtended Finite Element Method (XFEM)** and level set solutions in order to offer the most accurate and cost / time - efficient solution (5 times faster than any other competing technique based upon finite elements).

We deliver accurate predictions of stress intensity factors, **3D crack paths**, number of cycles to failure, with influence of mode mixity, in a deterministic manner or accounting for variability in the input parameters. Cenaero services extend far beyond numerical analysis as our fracture mechanics experts can guide you in the whole process of interpretation of fatigue test results and investigation of in-service failure crises.



Automated propagation of a 3D crack in a hollow cylinder submitted to inner cyclic pressure. The crack propagates from the right to the left. It approaches the left hole without effectively touching it on the outer surface of the cylinder (see picture on the left), while it actually crosses the left hole boundary on the inner surface of the cylinder (see picture on the right). This demonstrates the peculiar ability of the method to treat major topological changes without manual intervention.



Three dimensional crack analysis in a stator blade submitted to a thermal load and an alternating pressure.

Starting from standard structural analysis or CAD models, **crack severity and crack propagation** analyses are as easy as any standard stress analysis. The models do not need to be simplified, almost all boundary conditions being accepted. Multi-physics computations are also possible: thermal, mechanical, forced response, residual stress and other types of body forces. No cumbersome crack meshing operations are needed and crack propagation is naturally handled by our numerical tool. Common and custom-tailored crack propagation law can be interfaced.

Highly skilled engineers and state-of-the-art tools guarantee you the most accurate, reliable and cost efficient service of structural integrity analysis. Quality and discretion also make Cenaero a trustworthy partner for typical in-service failure investigations that require a high level of confidentiality.

- > Expertise in fracture mechanics and damage tolerant analyses
- > Efficient implementation of the eXtended Finite Element Method (XFEM)
- > Prediction of 3D crack paths with major topology changes
- > Time-efficient crack simulations on real and complex industrial cases
- > Simultaneous handling of multiple cracks
- > Computation of stress intensity factors and prediction of fracture
- > Prediction of the number of cycles to failure for parts with propagating cracks
- > Cost-effective solution, very low lead time

Cenaero knowledge and know-how is captured in **Morfeo/crack**, a module from the commercial Morfeo software available for Windows and Linux operating systems.

