



Structural design analysis - Fatigue

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Multiscale Material Modeling – Cenaero

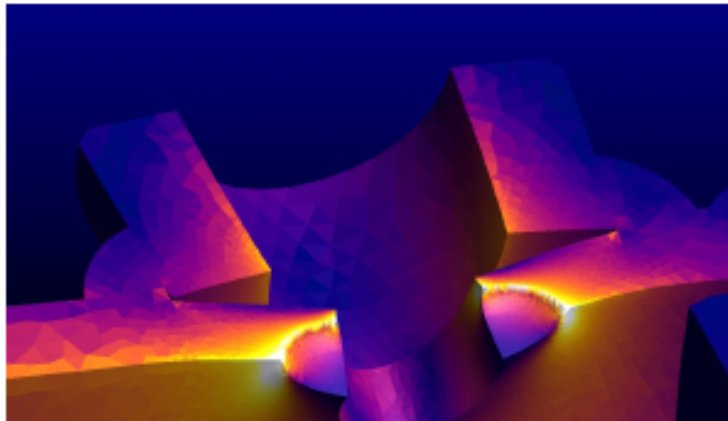
XFEM Crack propagation

Crack propagation with XFEM

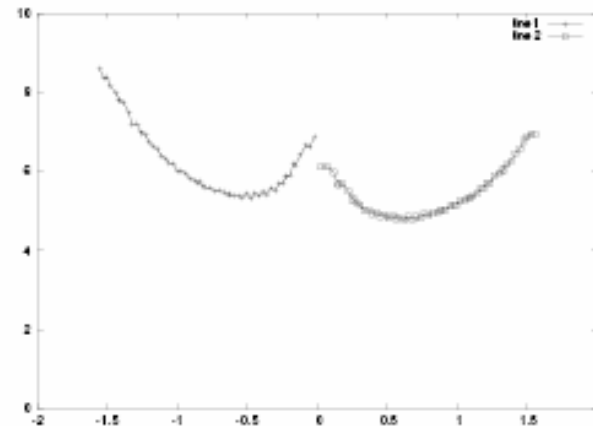
The XFEM uses the same mesh for each step of the propagation. So, no human intervention needed and easy to make a simulation with a large number of steps.

Moreover, easy to do multi-crack problems

See movie



Von Mises stress

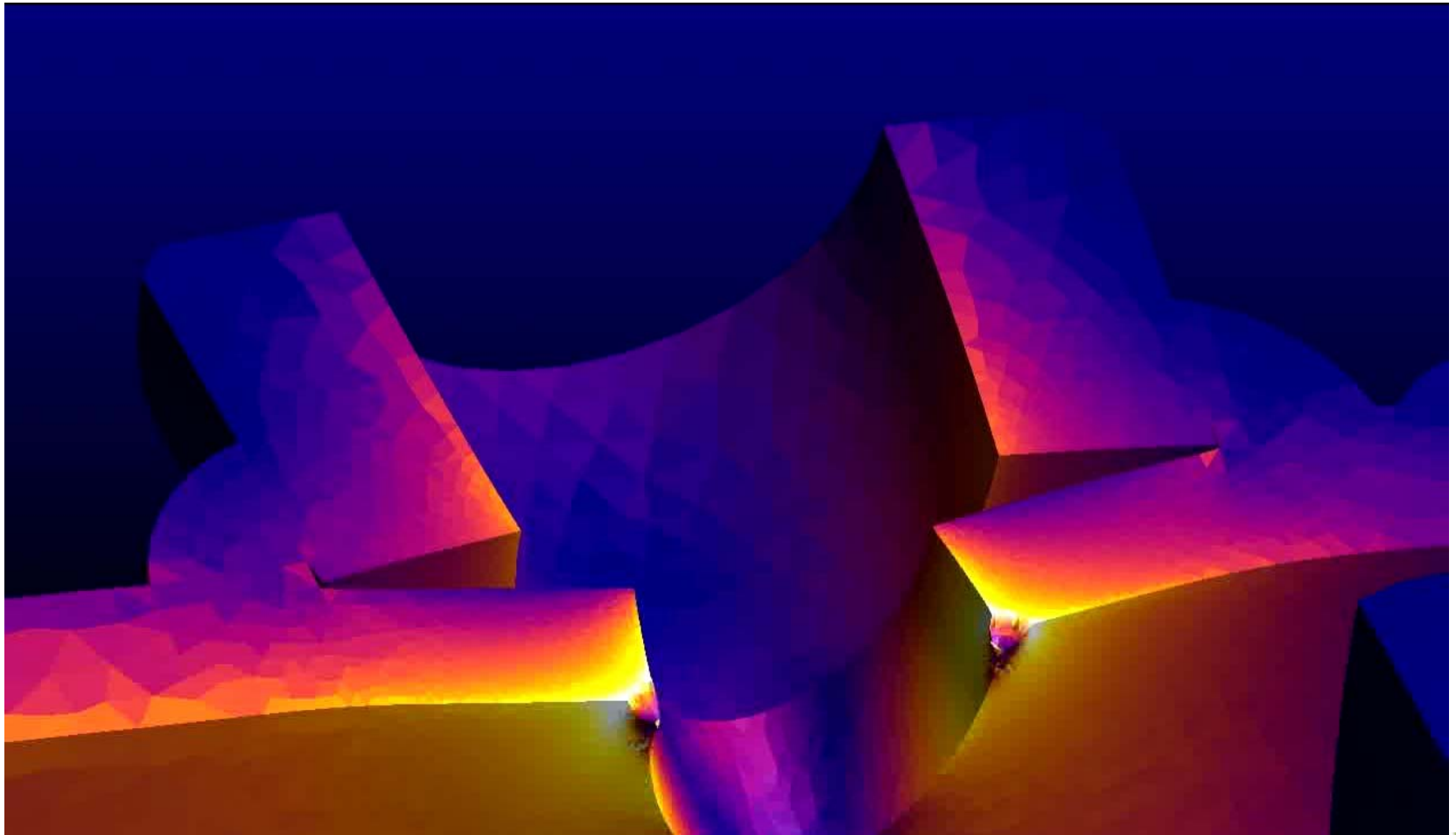


Stress intensity factor

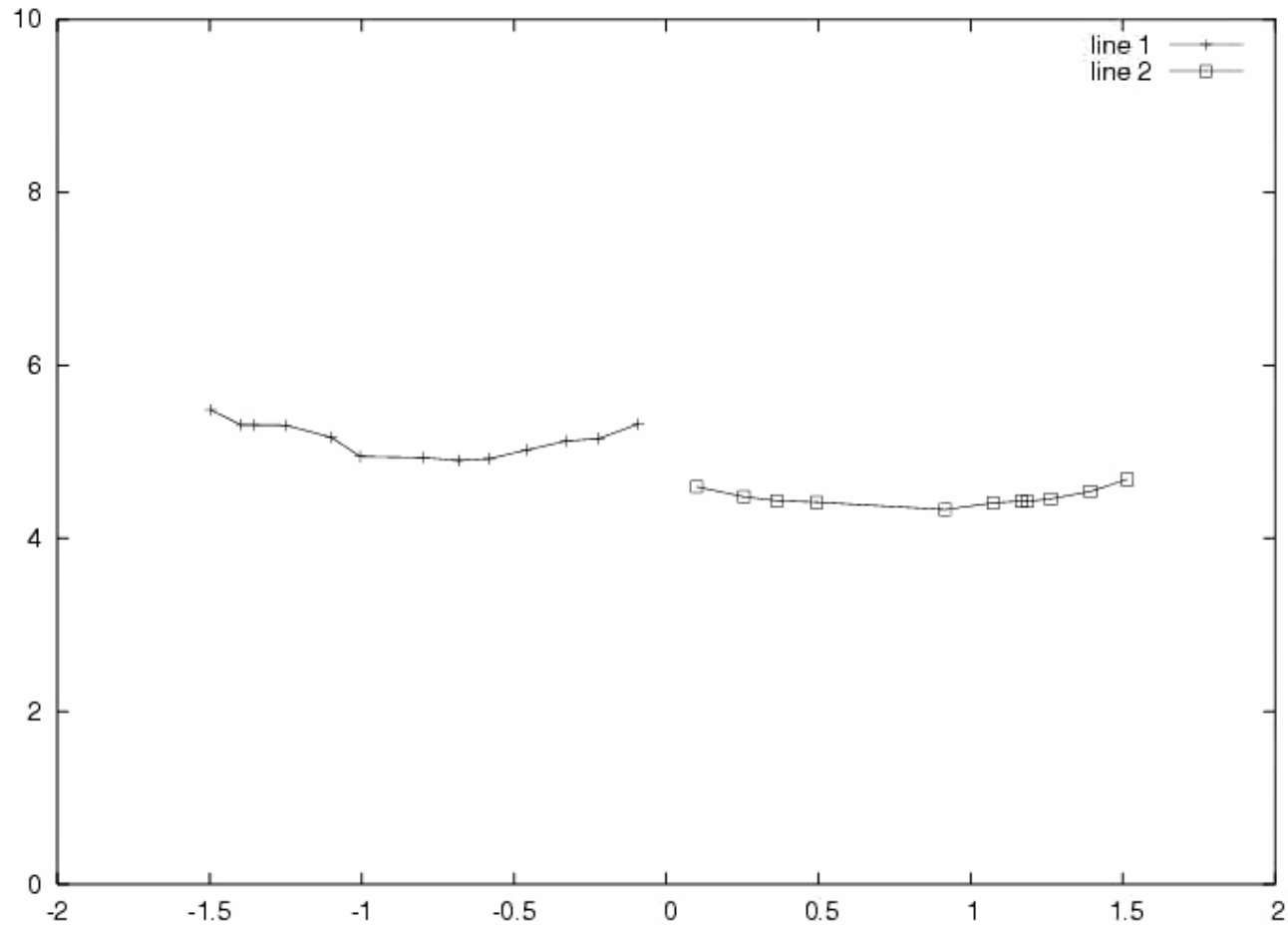
XFEM Crack propagation



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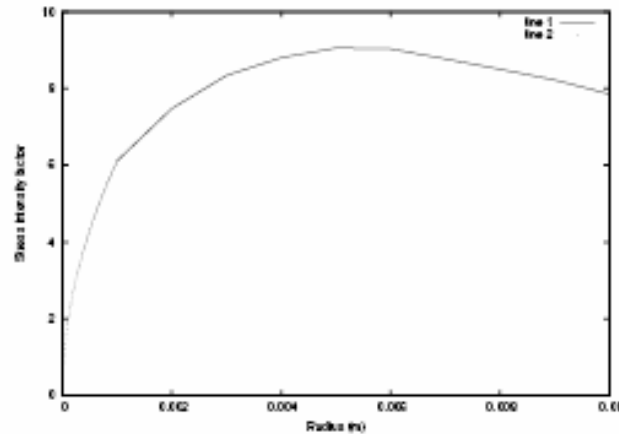


XFEM Crack propagation



XFEM Crack propagation

Crack propagation — Discussion

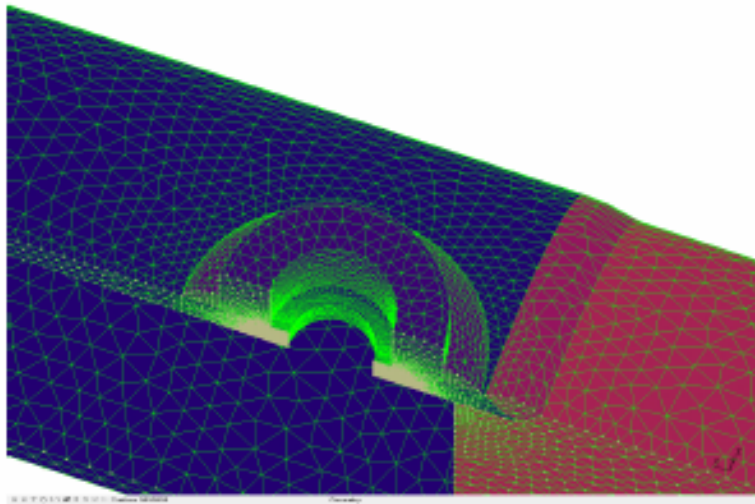


The same conclusions as with the FEM analysis holds.
When the crack reaches the welding, a part of the hoop stress is sustained by the welding and the oil port.
Are we sure of the free displacement condition between the oil port and the main cylinder?

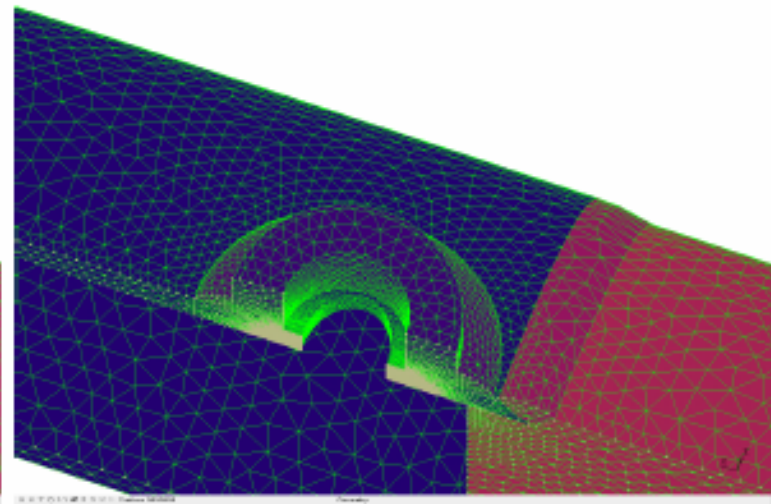
XFEM Crack propagation

Elliptical hole

In our theoretical analysis last year, we demonstrate that the inner pressure create hoop stress in the cylinder and that there is stress concentration at the hole.



Circular hole

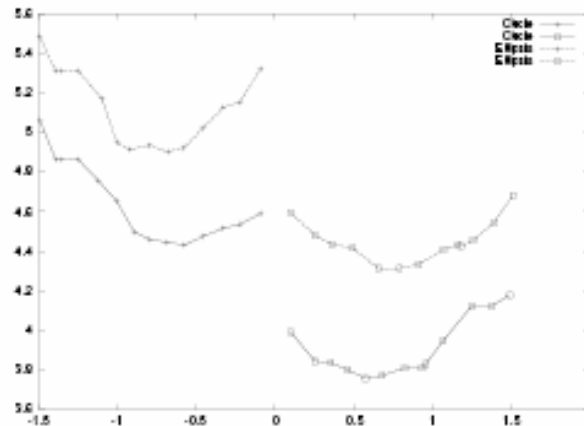


Elliptical hole

XFEM Crack propagation

SIF for the suggested elliptical hole

Results for the numerical simulation for a crack with radius 1 mm



As expected, SIF is 10% lower. For the optimal ellipsis, probably less.

Depending on the material (Paris exponent), we can expect a large increase in the cylinder lifetime. → Experiment?