

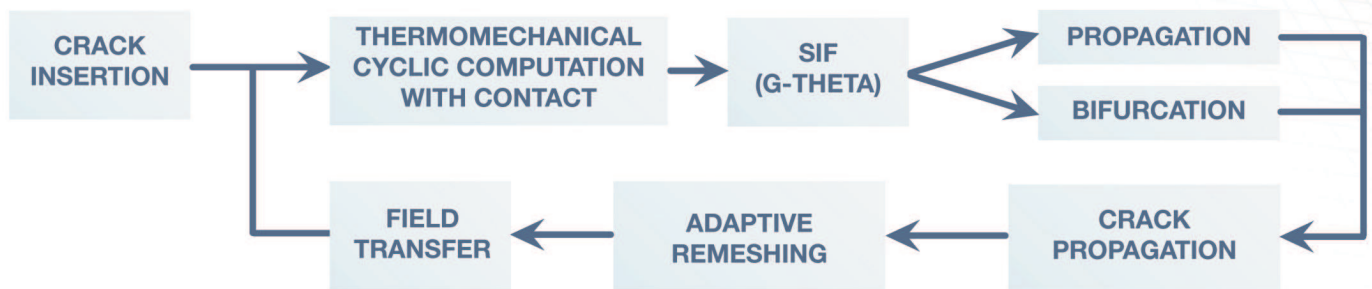


- 3D fracture mechanics simulation
- Adaptive remeshing techniques
- Crack initiation and propagation

Z-cracks is a software for realistic 3D fracture mechanics simulation. Z-cracks fracture modeling technology relies on adaptive remeshing approaches to **accurately predict the crack path and propagation kinetics**. The software is interfaced with the major FEA codes.

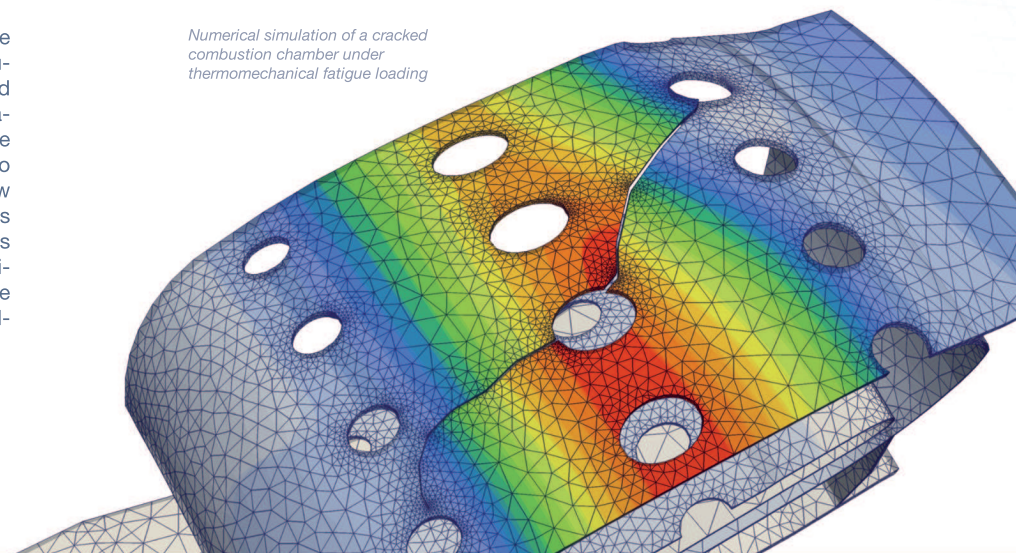
Z-cracks provides a generic and efficient framework for 3D crack analysis including both static crack stress intensity factor (SIF) computation and mixed-mode propagation simulations. Z-cracks allows to significantly reduce the number of man-hours required to analyze different crack initiation

Starting from the uncracked mesh of the studied component, Z-cracks allows on-the-fly insertion and discretization of the arbitrary crack geometries using specific mesh cutting algorithm and adaptive remeshing techniques, so that the updated mesh conforms discontinuities. The remeshing algorithm can be applied globally for the whole model or locally for the zone of interest. This approach is robust, entirely automatic and allows an accurate evaluation of the local mechanical fields near the crack front.



As a post-processing step after the Finite Element Analysis, Z-cracks can provide an evaluation of the energy release rates or SIF and allows Paris law or more complex crack propagation models to be applied in order to calculate crack advance. This information is then used to actualize the initial input file to account for a new crack position, modify contact zones and groups of nodes/elements used for boundary conditions definition. Thus, mixed-mode thermo-mechanical fatigue propagation simulations can be addressed, giving access to component life evaluation under complex loadings.

Numerical simulation of a cracked combustion chamber under thermomechanical fatigue loading

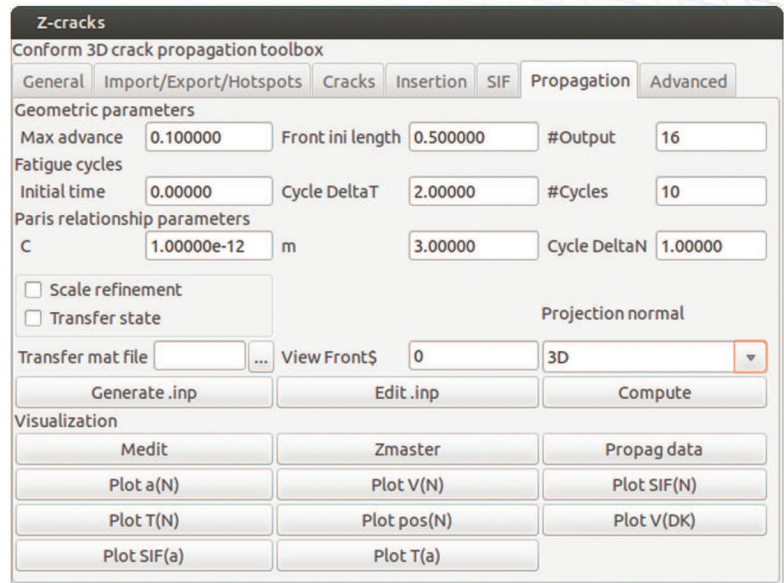


Z-cracks graphical user interface

A special graphical user interface (GUI) was designed to help users move through specific steps of the fracture simulation workflow:

- ▶ uncracked mesh import/export features, crack surface description and multiple cracks insertion
- ▶ static crack calculation with SIF and energy release rate outputs
- ▶ propagation calculation with various fatigue propagation laws : from Paris law to more complex creep-fatigue or user defined laws
- ▶ advanced aspects: elasto-visco-plastic models, complex multiple coalescing cracks, contact, 2D problems, cohesive zone insertion, etc.

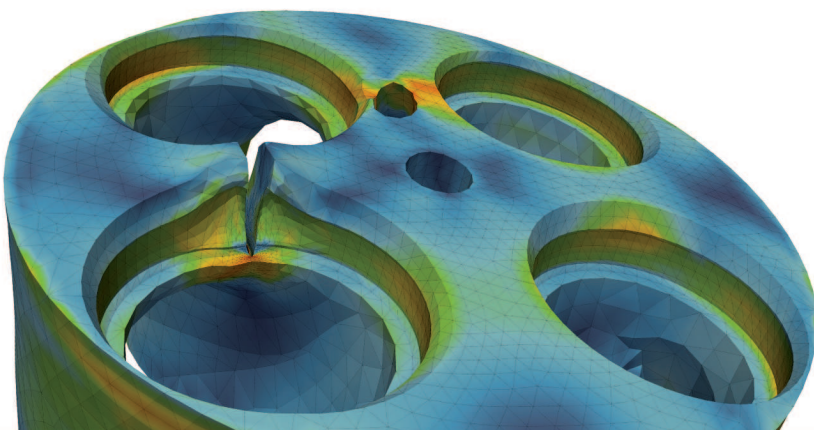
Many default settings are already established in the Z-cracks interface that makes simulation setup process easy and straightforward. The current state of the simulation setup is stored in the history file so that the simulation can be regenerated.



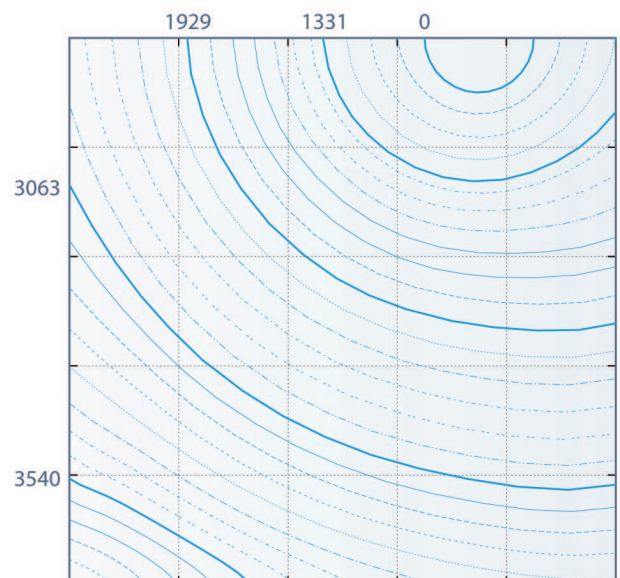
Visualization and output

Z-cracks GUI provides large capabilities for control and review of the simulation setup process, and for visualization and analysis of results:

- ▶ visualization of the crack surface mesh and associated crack fronts
- ▶ visualization of the initial cracked remeshed domain and associated crack fronts
- ▶ review of crack growth profiles associated to fatigue cycle number
- ▶ plot of energy release values or Stress Intensity Factors along the specified crack fronts
- ▶ Display of 3D curve plot of the specified crack front during crack propagation simulation



Front positions for different mission number



Simulation of crack propagation and its possible arrest in presence of thermomechanical cyclic loading

Courtesy of Renault