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When X-FEM ideas join the gap between experiments measures and numerical simulations: 3D fatigue crack propagation

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This presentation will be devoted to the presentation of the main results of the Propavanfis research program. This research was devoted to the study of full 3D fatigue crack propagation in metals. The idea was to perform 3D fatigue crack propagation experiments using tomography which allow to follow crack propagation within a specimen without destroying the specimen and to compare with 3D X-FEM simulation. A nodular graphite cast iron was used.
The results are the following:

1) It is very efficient to use X-FEM technology to process 3D tomographic images in order to know where is the crack front (X-DIC) and what are the experimental crack stress intensities along the front (using the interaction integral computed with the X-FEM code himself)
2) The experimental crack front history as well as the crack surface are far from being even end simple
3) The comparison of experimental and numerical stress intensity factors along the front lead to a new way to impose experimental boundary conditions: the standard usual way to represent the applied loading leading to inaccurate results.
4) The experimental stress intensity factors are best evaluated using HAX-FEM (Heavy side Analytical eXtended Finite Element Method) which should conversely be used for LEFM fatigue crack propagation simulation

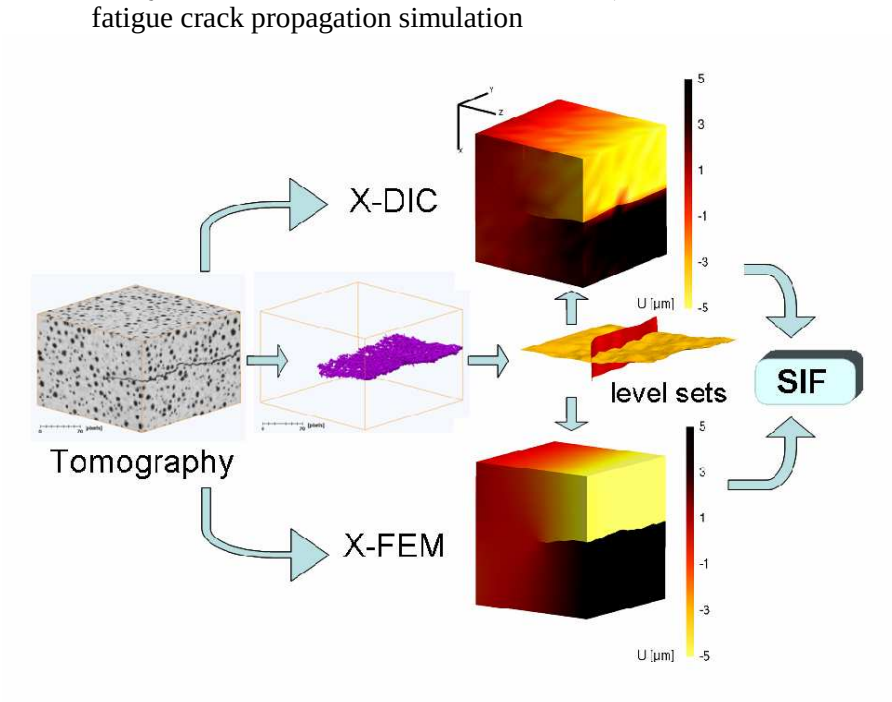

Figure 1: schematic view of the Propavanfis program and results

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