PhD Dissertation

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On the initiation, the growth, the arrest and the restart of cracks under impact loading.

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Abstract:

The objective is to propose a methodology for assessing dynamic crack propagation laws under mixed-mode loading. Unlike quasi-static cases where the loading and the crack position can be easily established, in dynamic impact cases the loading conditions, the variation of the propagation parameters and the exact position of a crack are difficult to control. Thus, the determination of relevant constitutive crack propagation laws from dynamic crack propagation experiments is a rather challenging operation. Therefore, if one wants to evaluate dynamic crack propagation laws under mixed loading, one must perform numerical simulations and assess the quality of the laws by comparing numerical and experimental results. This process requires that the quality of both the numerical simulations and the experiments be perfectly controlled.

Dynamic crack propagation experiments have been performed and two different techniques for measuring accurate crack tip position histories have been considered: very accurate crack tip localization by optical displacement sensor has been first used for transparent materials; then, an automatic method based on full-field displacement measurement has been developed for crack localization in all brittle materials whatever their opacity.

Those experimental techniques have been carried out to study different cases of dynamic propagation: initiation in mode 1 or in mixed-mode, crack propagation, crack arrest, crack restart, interaction between two cracks, influence of a hole on the crack path, dynamic branching. Those experiments have been then numerically reproduced. A good fit of the experimental and numerical results is observed.

Fulltext in French: http://docinsa.insa-lyon.fr/these/pont.php?id=gregoire