

## **A X-FEM Shell model for dynamic fracture of thin structures.**

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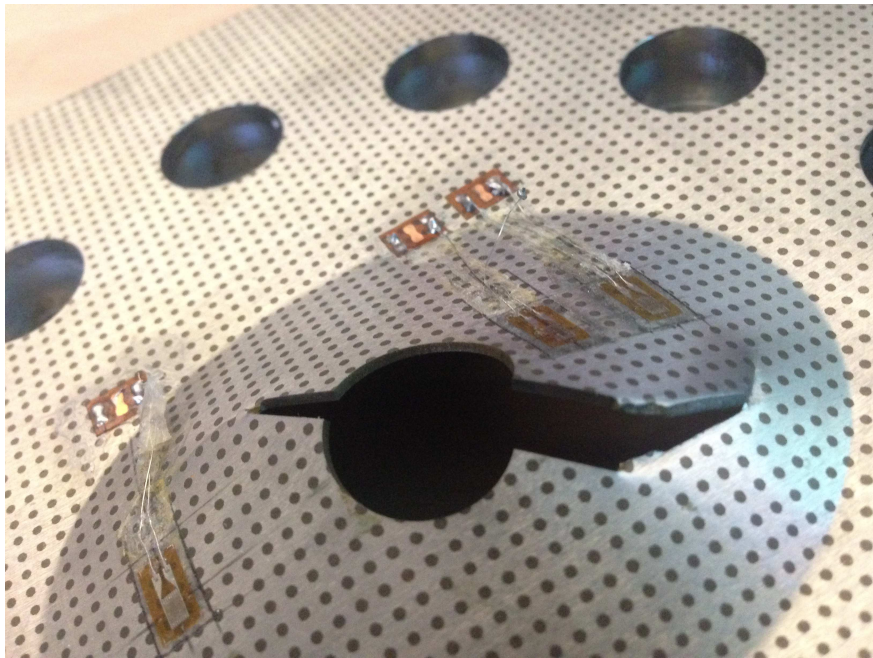
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### **ABSTRACT**

This paper is devoted to the presentation of an X-FEM element for thin shell dynamic crack propagation simulation. The element is based on the  $Q_4\gamma_{24}$  4 nodes shell element. The shell is supposed to be always cut by a through crack. The element is proposed for fast transient loadings. This element is hence enriched only with jump Heavyside functions on all degree of freedom (displacements as well as rotations). The crack is discretized with segments which are more simple to implement and propagate than the level sets especially in case of large shell motions and distortions. The mass matrix is useful for transient analysis. For this element the mass matrix corresponding to all added DOF is simply a copy of the usual continuous DOF diagonal mass matrix. Plasticity as well as stress field used for crack propagation criterion is evaluated in 5 Simpson points across the thickness. The crack propagation criterion is based on a measure of the mean stress in a small cylindrical region ahead of crack tip (only membrane and shear stress state is taken into account to evaluate crack propagation). This is an extension of what has been done previously in 2D [1] and in 3D cases [3]. This mean stress state is then used to decide if the crack propagates, in which direction and at which velocity. The crack propagation criteria used here will be able to decide whether it is tensile or shear crack propagation mode [2]. The element is first compared to existing 2D elements for in plane crack propagations. It is then validated by comparison of response of a fixed cracked panel under bending loading. Finally an example of simulation of crack propagation under combined membrane bending loading is proposed and compared with a SPH shell model of the same problem. A challenging experiment in which one observes a crack propagation in a thin shell combined with fluid structure flow will be presented. In the simulation the real loading shall be simplified and replaced by the measured mean pressure acting on the plate.

### **REFERENCES**

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**Figure 1:** A typical crack propagation path

- [3] Extension de l'approche X-FEM en dynamique rapide pour la propagation tridimensionnelle de fissure dans des matériaux ductiles *PHD thesis* [http : //inis.iaea.org/search/search.aspx?orig<sub>q</sub> = RN : 46012709](http://inis.iaea.org/search/search.aspx?orig_q=RN:46012709) , 2013.