"New Frontiers for Computational Solid Mechanics based on eXtended Level Set representation. Applications to damage mechanics, contact mechanics and stress analysis."

**Final Report Summary - XLS (New Frontiers for Computational Solid Mechanics based on eXtended Level Set representation. Applications to damage mechanics, contact mechanics and stress analysis.)**

Damage mechanics interprets cracking by local material degradation. Fracture mechanics interprets cracking by the movement of a geometrical entities (growing line or surface, ie cracks).

These two theories alone cannot predict complex cracking patterns of cracks. Indeed, damage mechanics
does not take into account material separation when the crack is fully formed and fracture mechanics cannot predict crack birth (or one crack tip leading to two, ie crack branching). The ERC XLS project did demonstrate that damage and fracture mechanics could be reconcile both from a theoretical and computational point of view, thus merging the advantages while limiting their drawbacks. The Thick Level Set model was developed. It places damage in a configurational perspective. A front pulls damage in it's wake. This a generalization of the crack concept. The damage front is located by a level set and the crack inside is located by a another level set which is an offset by a characteristic material length from the damage front. The TLS model is implemented on a computer using two strong assets : the level set technology and the extended finite element method (to introduce displacement jumps along the crack path).

Still surfing on the configurational point of view, another achievement of the ERC XLS was to demonstrate that contact could be handled numerically much more efficiently by considering that the main unknown in the modelling is now the boundary of the contact zone.

Finally, the ERC did target the computation of the influence of small objects which are vital for the safety of structures. This is the case of reinforcement bars inside concrete.

Last update: 24 July 2017
Record number: 201927