PhD Proposal 2017

School: Ecole Centrale de Nantes	
Laboratory: GeM	**Web site:** http://gem.ec-nantes.fr/
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Title: Numerical modeling of strain localization on concrete using second gradient models
Scientific field: Civil Engineering, Mechanics
Key words: Strain localization, higher order medium, microstructure, multiphysics, coupled phenomena, hydro-mechanical calculations, fracture, nuclear wastes disposals

Details for the subject:

Background, Context:

Strain localization appears in solids that have suffered severe loadings, progressively leading to cracks. From a practical point of view, it is important to predict the possible occurrence of such phenomena (location threshold), but also to simulate the behavior beyond this point (post-localization behavior). Possible applications include nuclear wastes disposals but also the vulnerability assessment of nuclear power plants, dams and reinforced concrete structural elements.

To objectively reproduce strain localization and cracks, higher order media with microstructure called "local" second gradient models, have been recently applied to concrete structural elements. It is thus now possible to introduce an internal length scale parameter (corresponding to the localization bandwidth) independent of the finite element mesh size. Furthermore, beyond a certain level of damage, fracture appears in the localization areas. It is therefore crucial to consistently deal with the transition from a continuous description to fracture in such higher order media.

The scope of this PhD is to study localization phenomena in concrete and more specifically the evolution of the localization zone. In order to represent cracks, second gradient interface elements will be developed. At first, the new numerical tools will be adopted for a monophasic medium and then for a biphasic medium (porous solid saturated with a single fluid). In this way, the links between poromechanics and cracks will be studied. The purpose is to propose a novel constitutive formulation to control the evolution of the width of the localization zones. Validation will be provided for real cases (e.g. nuclear waste disposals).

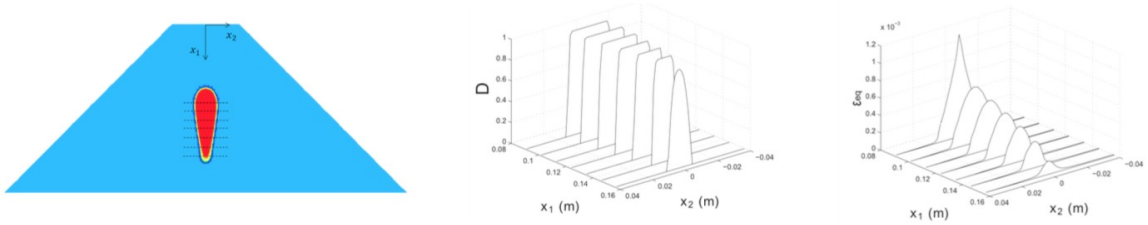

Figure: Notched trapezoidal beam: damage and equivalent strains around the crack. Evolution of the localization zone

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