ADVANCED R&D TRAINING

INNOVATIVE STRATEGIES FOR THREE DIMENSIONAL MODELING OF FRACTURE PHENOMENA

4-7 SEPTEMBER 2012

At INSA-Lyon
Campus LyonTech La Doua
Villeurbanne - France

X-FEM

Global and local crack propagation laws

Coupling between numerical simulation and experiments

In collaboration with

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4-7 SEPTEMBER 2011

Location
Campus LyonTech La Doua
INSAVALOR
66, boulevard Niels Bohr
69603 Villeurbanne Cedex, France

Participant Profile
Engineers, teachers, researchers,
masters students, PhD students, post-doc students

Prerequisites
Continuum mechanics, behavior of solid materials,
numerical methods dedicated to structural mechanics,
computational mechanics.

Teaching Staff
● Anthony GRAVOUIL - INSA de Lyon
● Nicolas MOËS - Ecole Centrale de Nantes
● Alain COMBESCURE - INSA de Lyon
● Sylvie POMMIER - Ecole Normale Supérieure de Cachan

Participation fee (lunch included)
1 950 € HT

For more information
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● Fax: 04 72 44 34 24
● E-mail: formation.cast@insa-lyon.fr

TEACHING TEAM

Anthony GRAVOUIL
- Professor at «INSA de Lyon» and member of «Institut Universitaire de France»,
- LaMCOS laboratory, UMR CNRS 5259,
- PhD Thesis at «Ecole Normale Supérieure de Cachan».

Nicolas MOËS
- Professor at «Ecole Centrale de Nantes» and member of «Institut Universitaire de France»,
- GeM Laboratory, UMR CNRS 6183.
- Jean Mandel Price in 2003 and IACM «Young Investigator Award» in 2006.

Alain COMBESCURE
- Professor at «INSA de Lyon»,
- President of « Institut Carnot I@L »,
- Member of scientific advices DEA DEN and ONERA DMSE.
- Elected Fellow of IACM in 2008 and Henri de Parville price of French Academy of Sciences in 2008.

Sylvie POMMIER
- Professor at «Ecole Normale Supérieure de Cachan»,
- PhD Thesis at «Ecole Centrale de Paris»,
- LMT Laboratory, UMR CNRS 8535.

PROGRAM

Learning objectives: to acquire or update knowledge on simulation tools dedicated to fracture phenomena, experimental techniques and modeling of fatigue crack propagation laws.

Tuesday, 4th September 2012

10h00 / 12h00 - Alain Combescure

- Introduction, industrial context, basics of fracture mechanics.

14h00 / 17h00 – Sylvie Pommier

- Fracture mechanics, propagation criteria: local approach, energetic approach, kinetics of fatigue cracking, scaling approach, complex fatigue loading complex and application to fracture, bifurcation criteria: local or energetic ones (2D, 3D), history effects.

Wednesday, 5th September 2012

9h00 / 12h00 - Nicolas Moës

- Extended finite elements (X-FEM), recall on discretization methods, partition of unity, modeling of discontinuities, level set functions, review of applications using X-FEM, modeling of three-dimensional cracks, examples of numerical implementations in a prototype or commercial code.

14h00 / 17h00 - Nicolas Moës

- Numerical aspects: integration, conditioning, evaluation of stress intensity factors by path independent integrals, mixed formulations and numerical treatment of locking, boundary conditions, incompressibility, plates and shells with cracks.

Thursday, 6th September 2012

9h00 / 12h00 - Anthony Gravouil

- Multi-scale approaches dedicated to fracture modeling, 3D fatigue cracks with level sets, coupling between numerical / experimental methods, multi-grid X-FEM, mixed-mode cracks, fracture with complex loads, fatigue crack modeling with confined plasticity, frictional cracks and closure effect.
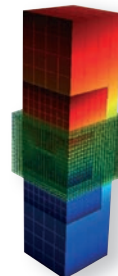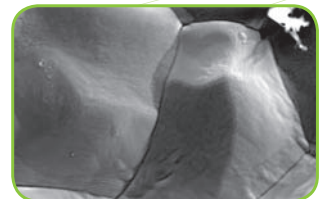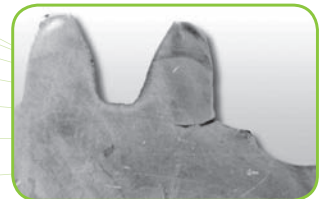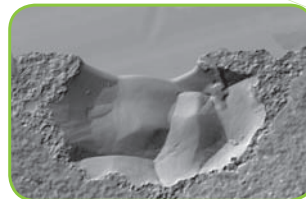
14h00 / 17h00 - Anthony Gravouil

- Use of a prototype software dedicated to the X-FEM simulation of fracture phenomena, two-dimensional and three-dimensional linear elastic fracture modeling, fatigue, confined plasticity, dynamic fracture.

Friday, 7th September 2012

9h00 / 12h00 - Alain Combescure

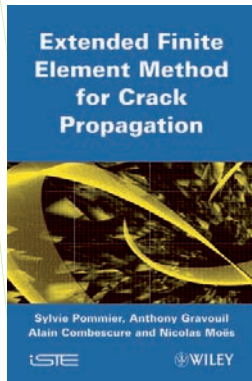- Simulation of brittle crack propagation and ductile tearing, submitted to fatigue or dynamic loads. Open problems.

Extended Finite Element Method for Crack Propagation

Sylvie Pommier, Anthony Gravouil, Nicolas Moes, Alain Combescure (1ère Edition - January 2011 - John Wiley & Sons)

Novel techniques for modeling 3D cracks and their evolution in solids are presented Cracks are modeled in terms of signed distance functions (level sets). Stress, strain and displacement field are determined using the extended finite elements method (X-FEM). Non-linear constitutive behavior for the crack tip region are developed within this framework to account for non-linear effect in crack propagation. Applications for static or dynamics case are provided.

Formation Continue
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