

# Thomas Menouillard

Date of Birth: June 14th 1980

Country of citizenship: France

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## EDUCATION

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- Ph.D. Applied Mechanics

*INSA Lyon, France, 2007*

Thesis entitled: "*Numerical methods for crack propagation by XFEM and damage computation in explicit dynamics*"

Research developments within a French Atomic Commission Scholarship.

- M.S. Engineering Mechanics

*INSA Lyon, France, 2004*

Representative courses: Finite Element Method for solids, gears transmission, fluid mechanics, aerodynamic mechanics, continuum mechanics.

- "Agrégation de mécanique"

*ENS Cachan, France, 2003*

National exam to enter the teaching profession at secondary and higher degree in France (national ranked 8th).

- B.S. Mechanical and Civil Engineering

*ENS Cachan and Paris 6 University, France, 2002*

Representative courses: Continuum solid mechanics, fluid mechanics (compressible and incompressible flows), thermodynamic, thermal mechanics, civil engineering, mechanical technology, planning process, automatic and robotic systems.

## RESEARCH EXPERIENCE

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- Post-doctoral research

*Northwestern University, Evanston, U.S.A., 2007-present*

Adviser: **Prof. Ted Belytschko**

1. Implementation of a 3 nodes shell element (DKT18) for plastic fracture simulation mixed with XFEM for crack propagation in shell structures, (*book chapter in press*)
2. Development of an efficient local level set method to deal with dynamic crack propagation for 3D, (*article in press*)
3. Time dependent tip enrichment in XFEM formulation for enhancing the behavior near the crack tip vicinity, (*article in press*)
4. Development of a method to deal with the smoothy release of the crack tip element with XFEM using only a discontinuous enrichment for dynamic crack propagation, (*two articles in press*)
5. Implementation of the meshfree method in the explicit dynamic code coupled with XFEM, in order to emphasize the crack vicinity, and first to improve the stress intensity factors computation, and second to catch the crack branching, (*article submitted*)
6. Theoretical development to compute stress intensity factors for structure under thermal and mechanical loading in static: the particular effect of the temperature field in the stress intensity factors and the energy release rate is underlined and quantified, (*article submitted*)
7. Simulation of dynamic crack propagation under thermal loading; comparison with the experiments performed by Prof. Dov Sherman (Technion Israel), (*article in preparation*)
8. Computational analysis of an experiment of a crack in a heated strip, (*article in preparation*)
9. Coupling spectral element method with the extended finite element method (XFEM) for dynamic crack propagation, (*article in preparation*)

- **Ph.D. Research**

*CEA Saclay - INSA Lyon, France, 2004–2007*

Adviser: **Prof. Alain Combescure**

- Development and implementation of XFEM coupled with Level Set functions to track the crack in the semi commercial explicit code Europlexus (at CEA Saclay, French Atomic Commission) for dynamic crack simulation,
- Theoretical developments and analytical determination of critical time step for enriched element with X-FEM, and mass lumping techniques to increase the critical time step from XFEM,
- Development and implementation in a commercial code of damage composite models for aerospace structure with SNECMA Industry and ONERA Research Center: application to blade impact for modeling bird strike for SNECMA aircraft reactors.

- **Graduate Research**

*INSA Lyon, France, 2003–2004*

Adviser: **Prof. Alain Combescure**

- Determination of asymptotic fields near crack tip for graded materials whose properties depend on the space: application to steel tank in nuclear power plant,
- Theoretical development and implementation to compute stress intensity factors for graded materials under mechanical loading in static.

- **Graduate Research**

*University of British Columbia, Vancouver, Canada, 2002*

Adviser: **Prof. Reza Vaziri**

- Development of a damage meso-model in Matlab for laminate composites, co-supervised by Prof. Olivier Allix, LMT Cachan: matrix and fibers damages model in layers of the composite.

- **Undergraduate Research**

*ENS Cachan, France, 2001*

Adviser: **Prof. Marc François**

- Conception of a system to allow non axial tensile test for anitropic specimens for civil engineering research: use of structural links through the material to avoid friction. Dimensioning, drawing were effected, and even building was begun.

## TEACHING EXPERIENCE

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- **Participated in the multimedia internet network for mathematical tests**

*INSA Lyon, France, 2007*

The project was to design an online evaluation so that the students can take the tests from home. Their results were kept in the data base of the school and could later be recalled if necessary. My job was to create and prepare the tests and to implement them in a particular online software related to Maple.

- **Teaching Assistant, Mathematics, Algebra (during 192 hours)**

*INSA Lyon, France, 2004–2007*

Taught 3 straight years of a class that consisted of students who were half Asian and half French. This class took place in the first semester in the undergraduate program: exercises, evaluation tests and main semester tests, corrections were prepared by myself.

- **Teaching Assistant, Mechanics (during 20 hours)**

*INSA Lyon, France, Spring 2004*

Taught practical work to undergraduate and graduate students on different experiments to test material specimens; tensile, torsion, and bending tests were performed by the students. They had to make the comparison between experimental results and theoretical analysis. They also made the link with their theoretical class, thanks to this practical work on deformation solids. The purpose was to apply what they were taught in continuum mechanics class.

- **Teaching Assistant, Mathematics, Analysis (during 40 hours)**

*INSA Lyon, France, Spring 2004*

Taught a semester of a class that consisted of students who were half South American and half French.

- **Teacher formation**

*ENS Cachan, France, 2002–2003*

This year was to pass the national exam to enter the teaching profession at High school and University level. This formation consisted of how to prepare a 1-2 hour class, and how to organize the whole semester. Mechanics and technology classes were involved: 1D bar analysis in high school level to general continuum mechanics in graduate school.

## LANGUAGES

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- French: Native,
- English: Fluent, studied in class from 1993 until 2003
- German: Intermediate level, studied in class from 1991 until 2000, and in 2009
- Spanish: Beginner, studied in 2008
- Korean: Beginner, studied in 2009

## OTHER PROFESSIONAL SERVICES

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- Organizer of a Minisymposium at the 4th European Conference on Computational Mechanics 2010 (ECCOMAS): "Recent developments in computational fracture analysis".
- Reviewer for "International Journal for Numerical Methods in Engineering" since 2009
- Member of the administrative council of the Laboratory at Lyon, 2005-2006  
Acted as one of three graduate student representatives at faculty meetings and the committee meetings that concerned any decision pertaining to the laboratory.
- Co-author of the electronic version of the "Applied Fluid Mechanics" 2001  
(Mécanique des fluides appliqués, by Jean-Paul Chabard, Pascal Esposito, Dominique Laurence, Pierre-Louis Viollet)  
Electronic version for the ENPC Civil Engineering School at Paris. MathCad was the software used for this electronic publication.

## OTHER TECHNICAL SKILLS

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- Integration of the XFEM method and an orthotropic damage model material in the semi commercial explicit code EUROPLEXUS developed at the French Atomic Commission, co-supervised by Hariddh Bung (2004–2007): XFEM discretization, Level-set procedures and crack propagation criteria were implemented and linked together to the original commercial code; 2D and 3D.
- Softwares, and Programming Skills:
  - Extensive experience with LS-DYNA, Catia V5, Europlexus, Gmsh, Cast3M, Solid Works.
  - Proficient in programming: C, C++, Fortran, Pascal, Gibiane.
  - Proficient in the use of both Matlab, Maple and Mathcad.
  - Working knowledge of HTML.
  - Extensive experience with  $\LaTeX$ : Ph.D. thesis, articles, presentations (with *Beamer*).
  - Experience working in Windows and Linux environments.
- Development of a code for solids mechanics computation in explicit dynamic.  
2D triangular and quadrilateral elements, 3D tetrahedral and cubic elements, and 3D shell 3 nodes and 4 nodes elements mixed with the XFEM method for crack propagation.
- Development of a personal code for fluid mechanics computation:  
Incompressible and steady case so far. A goal is first to code the dynamic case and then couple with the solid code in order to deal with fluid-structure interaction. Second, it gives me a tool for future research developments in both solids and fluids computations and methods developments, and also a tool for teaching, such as the Finite Element Method course.

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## JOURNAL PUBLICATIONS

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14. **T. Menouillard** and T. Belytschko,  
"Computational analysis of the stability and instability of a crack in a heated strip",  
*Nuclear Engineering and Design* in preparation.
13. Z. Liu, **T. Menouillard** and T. Belytschko,  
"XFEM coupled with spectral element for dynamic crack propagation",  
*International Journal for Numerical Methods in Engineering* in preparation.
12. O. Barkai, **T. Menouillard**, J.-H. Song, D. Sherman, and T. Belytschko,  
"Slow and Fast Crack Propagation in Brittle Specimens: Experiments by a Novel Method and Computations",  
*International Journal of Fracture*, in preparation.
11. J.-H. Song., **T. Menouillard**,  
"Explicit Dynamic Finite Element Method for Fractures with Stable Fracture Energy Dissipations",  
*Nuclear Engineering and Design*, in preparation.
10. **T. Menouillard** and A. Combescure,  
"Mixed-Mode Stress Intensity Factors for graded mechanical properties and thermal fields",  
*Theoretical and Applied Fracture Mechanics*, under review.
9. L. Marcin, **T. Menouillard**, L. Idoux, J.-F. Maire,  
"Composites damage and failure model: application to blade impact",  
*European Journal of Mechanics*, under review.
8. **T. Menouillard** and T. Belytschko,  
"Dynamic Fracture with Meshfree Enriched XFEM",  
*ACTA Mechanica*, (2009), in press.
7. **T. Menouillard** and T. Belytschko,  
"Improvement with smoothy discontinuous enrichment in XFEM for dynamic crack propagation",  
*International Journal for Numerical Methods in Engineering*, (2009), in press.
6. **T. Menouillard** and T. Belytschko,  
"Correction Force for releasing crack tip element with XFEM and only Discontinuous enrichment",  
*European Journal of Computational Mechanics*, (2009), 18(5/6):465–483.
5. **T. Menouillard**, J.-H. Song, Q. Duan, T. Belytschko,  
"Time Dependent Crack Tip Enrichment for Dynamic Crack Propagation",  
*International Journal of Fracture*, (2009), in press.
4. Q. Duan, J.-H. Song, **T. Menouillard**, T. Belytschko,  
"Element-local level set methods for three-dimensional dynamic crack growth",  
*International Journal for Numerical Methods in Engineering*, (2009), in press.
3. **T. Menouillard**, J. Réthoré, N. Moës, A. Combescure and H. Bung,  
"Mass lumping strategies for X-FEM explicit dynamics: application to crack propagation",  
*International Journal for Numerical Methods in Engineering* (2008), 74(3):447–474.
2. **T. Menouillard**, J. Réthoré, A. Combescure and H. Bung,  
"Efficient explicit time stepping for the eXtended Finite Element Method (X-FEM)",  
*International Journal for Numerical Methods in Engineering* (2006), 68:911-939.
1. **T. Menouillard**, T. Elguedj and A. Combescure,  
"Mixed-mode stress intensity factors for graded materials",  
*International Journal of Solids and Structures* (2006), 43:1946-1959.

## BOOK CHAPTERS

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3. J.-H. Song and **T. Menouillard**,  
"Explicit Dynamic Finite Element Method for Fracture of Shells",  
Computational Mechanics Research Trends, Nova Science Publishers (2009), in press.
2. **T. Menouillard**, J. Réthoré, H. Bung and A. Suffis,  
"Composite blade damaging under impact",  
EDP Sciences, Les Ulis, Journal of Physics IV (2006), 134:409-415.
1. **T. Menouillard**, N. Moës and A. Combescure,  
"An optimal explicit time stepping scheme for cracks modeled with X-FEM",  
Springer, IUTAM Symposium on Discretization Methods for Evolving Discontinuities (2006), 267-281.

## CONFERENCE PUBLICATIONS

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- International conferences:

7. **T. Menouillard**, J.-H. Song, T. Belytschko,  
"Improved crack tip enrichment in the eXtended Finite Element Method for Explicit Dynamics",  
USNCCM X, US National Congress on Computational Mechanics, Columbus OH (U.S.A.), July 16-19 2009.
6. **T. Menouillard**, A. Combescure, T. Belytschko,  
"Explicit dynamics for the eXtended Finite Element Method",  
WCCM VIII, 8th World Congress on Computational Mechanics, Venice (Italy), July 1-4 2008.
5. A. Combescure, J. Réthoré, **T. Menouillard**, B. Prabel,  
"Some recent results on simulation of dynamic crack propagation",  
Compdyn. Papadrakakis Ecommas Rethymno (Greece), June 13-16 2007.
4. **T. Menouillard**, A. Combescure and H. Bung,  
"Explicit dynamic crack propagation with two different meshes: X-FEM and Level-set",  
International Conference on Computational Fracture of Structures, Nantes (France), June 11-13 2007.
3. **T. Menouillard**, J. Réthoré, H. Bung and A. Suffis,  
"Composite blade damaging under impact",  
8th International Conference on Mechanical and Physical Behavior of Materials under Dynamic Loading, Dijon (France), September 11-15 2006.
2. **T. Menouillard**, J. Réthoré, A. Combescure,  
"Explicit time stepping for the eXtended Finite Element Method",  
WCCM VII, 7th World Congress on Computational Mechanics, Los Angeles CA (U.S.A.), July 16-22 2006.
1. A. Combescure, J. Réthoré, A. Gravouil, **T. Menouillard**,  
"Quality of the simulation of dynamic crack propagation: FEM versus (T) X-FEM",  
Cachan (France), May 10-12 2006.

- National conferences (France):

3. **T. Menouillard**, N. Moës, A. Combescure,  
"X-FEM en dynamique explicite : obtention d'un pas de temps critique optimal par une diagonalisation appropriée de la matrice des masses",  
8<sup>o</sup> Colloque National en Calcul des Structures, Giens (France), May 21-25 2007, Vol.2. p.19-24.
2. A. Combescure, A. Gravouil, J. Réthoré, **T. Menouillard**,  
"La conservation de l'énergie une clé pour la conception d'algorithmes de qualité en dynamique transitoire",  
8<sup>o</sup> Colloque National en Calcul des Structures, Giens (France), May 21-25 2007, Vol.1. p.417-422.
1. **T. Menouillard**, T. Elguedj, A. Combescure,  
"Méthode de calcul des facteurs d'intensité des contraintes en mode mixte pour des matériaux à gradient de propriétés mécaniques",  
7<sup>o</sup> Colloque National en Calcul des Structures, Giens (France), May 17-20 2005, Vol.2. p.439-444.