

## Axel MODAVE

CNRS research scientist  
ENSTA ParisTech – Team POEMS

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### Professional positions

- Since Oct 2016    **CNRS research scientist** (*chargé de recherche*)  
**ENSTA Paristech** (Palaiseau, France) – Unité de Mathématique Appliquée  
Équipe POEMS (UMR 7231, CNRS-ENSTA-INRIA)
- Oct 2015  
→ Sept 2016    **Postdoctoral Associate** at **Virginia Tech** (Blacksburg, VA, USA)  
Department of Mathematics  
*Mentor: Prof. Tim Warburton*
- Oct 2014  
→ Sept 2015    **Postdoctoral Research Associate** at **Rice University** (Houston, TX, USA)  
Department of Computational and Applied Mathematics  
*Mentor: Prof. Tim Warburton*
- Feb 2014  
→ June 2014    **Postdoctoral Researcher** at **Université catholique de Louvain** (Belgium)  
Division “Applied Mathematics and Mechanics”  
*Mentor: Prof. Jean-Francois Remacle*
- Sept 2008  
→ Janv 2014    **Research and Teaching Assistant** at **Université de Liège** (Belgium)  
Research unit “Mathematical Modeling and Methods” (Sept 2008 → May 2010)  
Research unit “Applied and Computational Electromagnetics” (June 2010 → Jan 2014)  
*Advisors: Prof. Christophe Geuzaine and Prof. Éric Delhez*

### Education

- Sept 2008  
→ Oct 2013    **Doctor of Engineering Sciences**  
Université de Liège (Belgium)
- Sept 2003  
→ June 2008    **Physics Engineer with *summa cum laude***  
Université de Liège (Belgium)

### Awards and Scholarships

- *F.R.S.-FNRS Postdoctoral Researcher* Grant (3-years post-doctoral grant - Call 2014)
- WBI Excellence Grant for 2-years research stay in the USA – 2014/2016
- BAEF Honorary Fellowship – 2014/2015
- NSF-funded Early Career Travel Award to attend *SIAM Conference on Mathematical and Computational Issues in the Geosciences* – June 2015
- SMAI Travel Grant “Jeunes chercheurs” to attend *Congrès d’Analyse Numérique* – May 2012
- Pisart Grant for Pedagogic Support – 2006/2007

## Teaching

- At *ENSTA-ParisTech* (France)
  - The Finite Element Method - MSc - Fall 2017 (T.A. 12h)
  - High Performance Scientific Computing - MSc - Spring 2017 (Coordinator, Lecturer 8h, T.A. 24h)
  - Parallel Scientific Computing - MSc - Fall 2016 (T.A. 7h), Fall 2017 (T.A. 16h)
  - Mathematical Models and Discretisation in Electromag. - MSc - Spring 2017 (Lecturer 7h)
- At *Rice University* (USA)
  - Numerical Analysis 1 - Undergraduate - Fall 2014 (Guest lecturer 2h)
- At the *Université catholique de Louvain* (Belgium)
  - Project of Structure - BSc - Spring 2014 (T.A. 8h)
- At the *Université de Liège* (Belgium)
  - Modeling and Design of Electromagnetic Systems - MSc - Fall 2013 (Guest lecturer 4h)
  - Multiphysic Scientific Computational Projects - MSc - Spring 2011, 2012, 2013 (T.A. for projets)
  - High Performance Scientific Computing - MSc - Fall 2010, 2011 (T.A. for projets)
  - Rational Mechanics - BSc - Fall 2009 (T.A. 30h)
  - Algebra - BSc - Fall 2009 (T.A. 20h)
  - Numerical Analysis - BSc - Fall 2007 (T.A. 20h)
  - Continuum Mechanics - BSc - Spring 2007, 2008 (T.A. for projets)

## Mentoring

### Master Student

- May-July 2017 – Ningyuan HU, M1 Student at ENSTA-ParisTech – Research projet on “*Absorbing Boundary Conditions for the Wave Equation (Finite Differences, Corners, Stability)*”

## Services

- Reviewer for
  - Advanced Electromagnetics (1)
  - Computers and Mathematics with Applications (1)
  - Geophysical Journal International (4)
  - International Journal of Numerical Modelling: Electronic Networks, Devices and Fields (1)
  - Journal of Computational and Applied Mathematics (1)
  - Journal of Computational Physics (2)
  - SIAM journal on numerical analysis (1)
  - SIAM journal on scientific computing (1)
- Reviewer for *MATh.en.JEANS*, a french initiative to promote mathematics for high school students
- Co-organizer of a *Young Researchers’ Days* on “*Large-Scale Wave Propagation Solvers*” (November 2017 – 2 days – 20 participants)
- Co-organizer of the 2nd Gmsh Workshop (May 2013 – 2 days – 50 participants)
- Involvement in academic bodies of the University of Liège (Oct 2005 → Sept 2013) (faculty council, department council and bachelor/master councils)

## Software

- **Developer** of testing codes to evaluate implementation strategies for accelerated wave propagation on GPU/CPU with discontinuous finite element schemes, C++ code with OCCA (CUDA, OpenCL and OpenMP)
- **Co-developer** (2014-2015, leader) of an industrial software (*RiDG*) for accelerated seismic imaging on GPU/CPU clusters, discontinuous finite element schemes, C++ code with OCCA (CUDA, OpenCL and OpenMP) and MPI
- **Co-developer** (2010-2014) of an academic software (*Gmsh/dg*) for time-domain wave propagation on CPU clusters, discontinuous finite element schemes, C++ code with MPI
- **Advanced user** (since 2010) of the open-source softwares Gmsh (*mesh generator with pre- and post-processing facilities*), GetDP (*finite element solver*) and Onelab (*user-friendly interface*).

## List of publications and communications

### Papers in international journals

- [1] A. M., A. Atle, J. Chan, T. Warburton (2017). High-order absorbing boundary conditions with corner/edge compatibility for GPU-accelerated discontinuous Galerkin wave simulations. To appear in *International Journal of Numerical Methods in Engineering*
- [2] A. M., J. Lambrechts, C. Geuzaine (2017). Perfectly Matched Layers for Convex Truncated Domains with Discontinuous Galerkin Finite Element Simulations. *Computers and Mathematics with Applications*, 73 (4), 684-700, 17 pages
- [3] J. Chan, Z. Wang, A. M., J.-F. Remacle, T. Warburton (2016). GPU-accelerated discontinuous Galerkin methods on hybrid meshes. *Journal of Computational Physics*, 318, 142-168, 27 pages
- [4] A. M., A. St-Cyr, T. Warburton (2016). GPU performance analysis of a nodal discontinuous Galerkin method for acoustic and elastic models. *Computers & Geosciences*, 91, 64-76, 13 pages
- [5] A. M., A. St-Cyr, W. A. Mulder, T. Warburton (2015). A nodal discontinuous Galerkin simulations for reverse-time migration on GPU clusters. *Geophysical Journal International*, 203 (2), 1419-1435, 17 pages
- [6] A. M., E. Delhez, C. Geuzaine (2014). Optimizing Perfectly Matched Layers in Discrete Contexts. *International Journal of Numerical Methods in Engineering*, 99 (6), 410-437, 28 pages
- [7] M. Boubekur, A. Kameni, L. Pichon, A. M., C. Geuzaine (2014). Analysis of transient scattering problems using a discontinuous Galerkin method: application to the shielding effectiveness of enclosures with heterogeneous walls. *International Journal of Numerical Modelling: Electronic Networks, Devices and Fields*, 27 (3), 626-635, 10 pages
- [8] M. Boubekur, A. Kameni, L. Bernard, A. M., L. Pichon (2014). 3-D Modeling of Thin Sheets in the Discontinuous Galerkin Method for Transient Scattering Analysis. *IEEE Transactions on Magnetics*, 50 (2), 4 pages
- [9] M. Boubekur, A. Kameni, A. M., L. Bernard, L. Pichon (2013). Modeling of Weakly Conducting Thin Sheets in the Discontinuous Galerkin Method for Shielding Effectiveness Evaluation. *ACES Journal*, 28 (10), 7 pages
- [10] A. M., A. Kameni, J. Lambrechts, E. Delhez, L. Pichon, C. Geuzaine (2013). An optimum PML for scattering problems in the time domain. *The European Physical Journal - Applied Physics*, 64 (2), 6 pages
- [11] A. Kameni, A. M., M. Boubekur, V. Preault, L. Pichon, C. Geuzaine (2013). Evaluation of shielding effectiveness of composite wall with a Time Domain Discontinuous Galerkin Method. *The European Physical Journal - Applied Physics*, 64 (2), 4 pages
- [12] A. M., E. Deleersnijder, E. Delhez (2010). On the parameters of absorbing layers for shallow water models. *Ocean Dynamics*, 60 (1), 65-79, 15 pages

## Theses

- [1] “*Absorbing Layers for Wave-Like Time-Dependent Problems – Design, Discretization and Optimization*”  
PhD thesis, Université de Liège, Belgique, Octobre 2013  
Advisors: Prof. Christophe Geuzaine and Prof. Éric Delhez
- [2] “*Étude de modèles de frontière ouverte pour des problèmes de propagation d’ondes*” (in french)  
Master thesis, Université de Liège, Belgique, Juin 2008  
Advisor: Prof. Éric Delhez

## International conferences

- [1] A. M., V. Mattessi, C. Geuzaine. High-order absorbing boundary conditions with edge and corner compatibility for the Helmholtz equation. **Talk in a minisymposium** at the *7th International Conference on Advanced Computational Methods in Engineering (ACOMEN 2017)* – Ghent (Belgium) – Septembre 18-22, 2017 – 2-pages paper
- [2] A. M., A. Atle, J. Chan, T. Warburton. A nodal discontinuous Galerkin method with high-order absorbing boundary conditions and corner/edge compatibility. Talk at the *13th International Conference on Mathematical and Numerical Aspects of Waves Propagation (WAVES 2017)* – Minneapolis (USA) – May 15-19, 2017 – 2-pages paper
- [3] A. M., A. Atle, J. Chan, R. Hewett, T. Warburton. High-Order Absorbing Boundary Conditions for Time-Domain Wave Propagation with DG Methods. **Talk in a minisymposium** at the *SIAM Conference on Computational Science and Engineering (CSE17)* – Atlanta (Georgia, USA) – February 27-March 3, 2017
- [4] A. M., J. Chan, T. Warburton. GPU Performance Analysis of Discontinuous Galerkin Implementations for Time-Domain Seismic Wave Propagation. **Talk in a HPC dedicated session** at the *78th EAGE Conference & Exhibition* – Vienna (Austria) – May 30-June 2, 2016
- [5] A. M., J. Chan, T. Warburton. GPU Performance Analysis of Discontinuous Galerkin Implementations for Time-Domain Seismic Wave Propagation. **Talk in a HPC dedicated session** at the *78th EAGE Conference & Exhibition* – Vienna (Austria) – May 30-June 2, 2016
- [6] A. M., J. Chan, T. Warburton. GPU Performance Analysis of Discontinuous Galerkin Implementations for Time-Domain Wave Simulations. Talk at the *17th SIAM Conference on Parallel Processing for Scientific Computing (PP16)* – Paris (France) – April 12-15, 2016
- [7] A. M., A. St-Cyr, T. Warburton. Performance of DGTD Finite Element Methods for the RTM Procedure on GPU Clusters. Talk at the *2016 Oil & Gas HPC Conference* – Houston (Texas, USA) – March 2-3, 2016
- [8] A. M., A. St-Cyr, T. Warburton, W. A. Mulder. Accelerated Discontinuous Galerkin Time-Domain Simulations for Seismic Imaging. **Talk in a minisymposium** at the *SIAM Conference on Mathematical & Computational Issues in the Geosciences (GS15)* – Stanford (California, USA) – June 29-July 2, 2015
- [9] A. M., A. St-Cyr, T. Warburton, W. A. Mulder. Accelerated Discontinuous Galerkin Time-Domain Simulations for Seismic Wave Propagation. **Talk in a HPC dedicated session** at the *77th EAGE Conference & Exhibition* – Madrid (Spain) – June 1-4, 2015
- [10] A. M., D. Medina, A. St-Cyr, T. Warburton. RiDG: A Portable High-Performance Simulation Tool for Seismic Imaging. Talk at the *2015 Oil & Gas HPC Workshop* – Houston (Texas, USA) – March 4-5, 2015
- [11] M. Boubekour, A. Kameni, L. Bernard, A. M., L. Pichon (2013). 3D Modeling of Thin Resistive Sheets in the Discontinuous Galerkin Method for Transient Scattering Analysis. Poster at the *19th Conference on the Computation of Electromagnetic Fields (COMPUMAG 2013)* – Budapest (Hungary) – 30 June-4 July, 2013 – 2-pages paper
- [12] A. M., J. Lambrechts, E. Delhez, C. Geuzaine. A PML for convex truncated domains in time-dependent acoustics with a DG-FE discretization. Talk at the *11th International Conference on Mathematical and Numerical Aspects of Waves Propagation (WAVES 2013)* – Gammarth (Tunisia) – June 3-7, 2013 – 2-pages paper
- [13] A. M., C. Geuzaine, M. Boubekour, L. Pichon, A. Kameni. Evaluation of Shielding Effectiveness in the

Time Domain using a DG Method with an Efficient PML. Poster at the *9th International Symposium on Electric and Magnetic Fields (EMF 2013)* – Bruges (Belgium) – April 23-25, 2013

- [14] A. M., E. Delhez, A. Kameni, L. Pichon, C. Geuzaine. An optimum PML for scattering problems in the time domain. Talk at the *7e Conférence Européenne sur les Méthodes Numériques en Electromagnétisme (NUMELEC 2012)* – Marseilles (France) – July 3-5, 2012 – 2-pages paper
- [15] A. Kameni, A. M., M. Boubekour, C. Geuzaine, L. Pichon. Évaluation de l'efficacité de blindage de parois hétérogènes par une méthode de Galerkin discontinue en domaine temporel. Poster at the *7th European Conference on Numerical Methods in Electromagnetism (NUMELEC 2012)* – Marseilles (France) – July 3-5, 2012 – 2-pages paper
- [16] A. M., E. Delhez, C. Geuzaine. On the Parameters of the Perfectly Matched Layer in Discrete Contexts. Talk at the *10th International Conference on Mathematical and Numerical Aspects of Waves Propagation (WAVES 2011)* – Vancouver (Canada) – July 25-29, 2011 – 4-pages paper
- [17] A. M., E. Delhez, C. Geuzaine. Optimization of the PML in the Discrete Context for Wave-Like Problems. Talk at the *7th International Congress on Industrial and Applied Mathematics (ICIAM 2011)* – Vancouver (Canada) – July 18-22, 2011
- [18] A. M., E. Deleersnijder, E. Delhez. Absorbing layers for shallow water models. Talk at the *15th Biennial Workshop of the Joint Numerical Sea Modelling Group (JONSMOD 2010)* – Delft (The Netherlands) – May 12-10, 2010

### National conferences

- [1] A. M., E. Delhez, C. Geuzaine. Optimisation des PML dans des contextes discrets. Talk at the *41e Congrès National d'Analyse Numérique (CANUM 2012)* – Superbesse (France) – May 21-25, 2012
- [2] A. M. Optimizing the PML in the discrete context. **Invited talk** at the *Journées de Metz 2012 "Recent Advances in Modeling, Analysis and Simulation of Wave Propagation"* – Metz (France) – March 29-31, 2012

### Seminars and others talks

- [1] Seminar at IRMAR, Numerical analysis – Rennes (France) – June 15, 2017
- [2] Colloquium at VirginiaTech, department of mathematics – Blacksburg (Virginia, USA) – March 25, 2016
- [3] Industrial seminar at TOTAL E&P – Houston (Texas, USA) – January 21, 2016
- [4] Seminar at team MAGIQUE-3D (INRIA) – Pau (France) – January 5, 2016
- [5] Seminar at team POEMS (INRIA-CNRS-ENSTA) – Palaiseau (France) – December 17, 2015
- [6] Seminar at UPMC, Laboratoire Jacques-Louis Lions, Numerical methods – Paris (France) – December 14, 2015
- [7] Seminar at VirginiaTech, SIAM Student Chapter – Blacksburg (Virginia, USA) – November 19, 2015
- [8] Industrial seminar at Shell Technology Center – Rijswijk (The Netherlands) – June 9, 2015
- [9] Seminar at SMU, Graduate students in mathematics – Dallas (Texas, USA) – April 14, 2015
- [10] Seminar at University of A Corua, SINUMAR – A Corua (Spain) – July 17, 2014
- [11] Seminar at team NACHOS (INRIA) – Sophia-Antipolis (France) – June 3, 2014
- [12] Seminar at Universit catholique de Louvain Louvain-la-Neuve (Belgium) – February 10, 2014
- [13] Talk at 1st Gmsh Workshop – Braives (Belgium) – September 15-16, 2011
- [14] Talk at ANR MicroWave – Nancy (France) – December 2-3, 2010