

Marc T. Henry de Frahan

US citizen, Applied Mathematics/Mechanical engineer

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Education

Ph.D. in Mechanical Engineering 2011-2016

University of Michigan, Ann Arbor, MI

Thesis: *Numerical simulations of shock and rarefaction waves interacting with interfaces in compressible multiphase flows*

Advisor: E. Johnsen, Assistant Professor of Mechanical Engineering

M.S. in Applied Mathematics Engineering 2009-2011

Université Catholique de Louvain, Belgium

Thesis: *Implementation of a Discontinuous Galerkin Method for hyperbolic PDEs on GPUs*

Advisors: Prof. J-F Remacle, Prof. P. Chatelain, Prof. V. Legat.

B.S. in Applied Mathematics Engineering 2007-2009

Université Catholique de Louvain, Belgium

Research Interests

Fluid mechanics - multiphase flows, hydrodynamic instabilities, turbulence

Energy - turbomachinery, combustion, wind farms

High order numerical methods for computational fluid dynamics

High performance computing with graphics processing units

Research Experience

Post-doctoral Researcher, National Renewable Energy Laboratory 2016-present

Next-generation simulations of wind farms and combustion processes

NextProf Engineering Future Faculty Workshop, University of Michigan Fall 2015

Invited to participate in a workshop to prepare for faculty positions

International High Performance Computing Summer School, Hungary Summer 2014

Invited to attend NSF workshop to learn new paradigms in scientific computing

Lawrence Livermore National Laboratory, Livermore, CA Summer 2012

Student intern

Comparing Beryllium strength models with experimental data

Supervisors: Dr. B. Remington and Dr. R. Cavallo

Computational Methods in High Energy Density Plasmas, UCLA, CA Spring 2012

Invited to attend a 6 week long workshop by the Institute for Pure and Applied Mathematics at the University of California - Los Angeles

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| Lawrence Livermore National Laboratory, Livermore, CA Student intern Studied hydrodynamic instabilities in inertial confinement fusion targets Characterized growth factors during capsule compression Supervisors: Dr. L. J. Suter and Dr. D. S. Clark | Summer 2010 |
| Lawrence Livermore National Laboratory, Livermore, CA Student intern Studied hot electron signatures and capsule preheat in the context of inertial confinement fusion as developed at the National Ignition Facility Supervisors: Dr. L. J. Suter and Dr. C. A. Thomas | Summer 2009 |
| Lawrence Livermore National Laboratory, Livermore, CA Student intern Studied and optimized National Ignition Facility inertial confinement fusion target geometries using view factor calculations Supervisors: Dr. L. J. Suter and Dr. C. A. Thomas | Summer 2008 |

Leadership Experience

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| Sweetland Center for Writing, University of Michigan Dissertation Writing Group Leader Lead a group of PhD students in weekly dissertation writing and feedback sessions | Spring 2016 |
| Mechanical Engineering Graduate Council, University of Michigan - STEM Communication Chair Communicate graduate student research to lay audiences - President Promote social, academic and professional development for ME graduate students - Graduate Seminar Chair Organize monthly seminars to showcase graduate student research | 2013-2016 |
| Graduate Student Advisory Committee, University of Michigan Representative for Department of Mechanical Engineering Identify and plan activities to promote community among engineering graduate students | 2014-2015 |

Mentorship and Teaching Experience

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| Jalil Alidoost, University of Michigan Mentored senior undergraduate for a project on diffusive and kinetic properties of chair motion in the Shapiro Library | 2015-2016 |
| Colby Hanley, University of Michigan Mentored freshman undergraduate for a project on multi-GPU profiling for high-performance computing | 2015-2016 |
| Graduate Student Instructor for ME 523: Computational Fluid Dynamics University of Michigan, Ann Arbor, MI | Fall 2013 |

Fellowships and Awards

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| AIAA CFD Best Student Paper Award (3^d place) American Institute of Aeronautics and Astronautics | 2015 |
| Rackham Predoctoral Fellowship University of Michigan | 2015 |
| Rackham Centennial Fellowship University of Michigan | 2013 |
| NIF Poster Winner Lawrence Livermore National Laboratory 2012 Summer Poster Session | 2012 |
| High Distinction M.S. in Applied Mathematics Engineering at the Université Catholique de Louvain | 2011 |

Volunteer Service and Outreach

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| DAPCEP Instructor Organized and taught a 6-week long engineering discovery course for Detroit-area middle school students | Spring 2015 |
| Volunteer Instructor, Adams Academy Engineering Club Instructed fun basic science and engineering projects at a local primary school | 2014-2016 |
| Graduate Student Recruiter, University of Michigan Organized and participated in recruitment events graduate students visiting the Mechanical Engineering department | 2012-2016 |

Publications

- M. T. Henry de Frahan, J. L. Belof, R. M. Cavallo, V. A. Raevsky, O. N. Ignatova, A. Lebedev, D. S. Ancheta, B. S. El-dasher, J. N. Florando, G. F. Gallegos, E. Johnsen and M. M. LeBlanc, **Experimental and Numerical Investigations of Beryllium Strength Models Using the Rayleigh-Taylor Instability**, *featured article in J. Appl. Phys.*, 117(22):225901, 2015
- M. T. Henry de Frahan, S. Varadan, and E. Johnsen, **A new limiting procedure for discontinuous Galerkin methods applied to compressible multiphase flows with shocks and interfaces**, *J. Comput. Phys.*, 280(0):489 – 509, 2015
- M. T. Henry de Frahan, P. Movahed, and E. Johnsen, **Numerical simulations of a shock interacting with successive interfaces using the Discontinuous Galerkin method: the multilayered Richtmyer-Meshkov and Rayleigh-Taylor instabilities**, *Shock Waves*, 25(4):329–345, 2015
- C. A. Di Stefano, G. Malamud, M. T. Henry de Frahan, C. C. Kuranz, A. Shimony, S. R. Klein, R. P. Drake, E. Johnsen, D. Shvarts, V. A. Smalyuk, and D. Martinez, **Observation and modeling of mixing-layer development in high-energy-density, blast-wave-driven shear flow**, *Phys. Plasmas*, 21(5):056306, 2014
- M. T. Henry de Frahan and E. Johnsen, **Mixing in blast-driven hydrodynamic instabilities**, *In preparation for J. Fluid Mech.*, 2016

Conference Proceedings

- M. T. Henry de Frahan, L. Khieu, and E. Johnsen, **High-order Discontinuous Galerkin Methods**

Applied to Multiphase Flows, 22^d *AIAA Computational Fluid Dynamics Conference*. American Institute of Aeronautics and Astronautics, doi: 10.2514/6.2015-3045, 2015, AIAA CFD Best Student Paper Award (3^d place)

M. T. Henry de Frahan and E. Johnsen, **Discontinuous Galerkin method for multifluid Euler equations**, In *21st AIAA Computational Fluid Dynamics Conference*. American Institute of Aeronautics and Astronautics, doi: 10.2514/6.2013-2595, 2013

M. T. Henry de Frahan, P. Movahed, and E. Johnsen, **Investigating the multilayered Richtmyer-Meshkov instability with high-order accurate numerical methods**, In *29th International Symposium on Shock Waves 2*, Springer International Publishing, 2015

Conference Presentations

M. T. Henry de Frahan, S. Beig, B. Aboulhasanzadeh, H. Ganesh, S. L. Ceccio, and E. Johnsen, **A new mixture model for compressible multiphase flows**, 9th *International Conference on Multiphase Flow*, May 2016, Firenze, Italy

M. T. Henry de Frahan, H. Ganesh, S. L. Ceccio, and E. Johnsen, **Numerical simulations of high-void-fraction bubbly flow over a wedge**, 9th *International Symposium on Cavitation*, Dec. 2015, Lausanne, Switzerland

M. T. Henry de Frahan, E. Johnsen, **Interactions of Blast Waves with Perturbed Interfaces**, *APS 68th Meeting of the Division of Fluid Dynamics*, Nov. 2015, Boston, MA

M. T. Henry de Frahan, L. Khieu, and E. Johnsen, **High-order Discontinuous Galerkin Methods Applied to Multiphase Flows**, 23^d *AIAA Computational Fluid Dynamics Conference*, Jun. 2015, Dallas, Tx

M. T. Henry de Frahan, E. Johnsen, **Numerical simulations of hydrodynamic instabilities with GPUs**, *IPAM Computational Methods in High Energy Density Plasmas Reunion Conference*, Dec. 2014, Lake Arrowhead, CA

M. T. Henry de Frahan, E. Johnsen, **Hydrodynamic instabilities in blast-driven systems**, *APS 67th Meeting of the Division of Fluid Dynamics*, Nov. 2014, San Francisco, CA

M. T. Henry de Frahan, R. P. Drake, E. Johnsen, **Hydrodynamic instabilities of finite width layers**, *APS 56th Meeting of the Division of Plasma Physics*, Oct. 2014, New Orleans, LA

E. Johnsen, M. T. Henry de Frahan, S. A. Beig, **Numerical simulations of gas-liquid interfaces in compressible flows**, *AIAA Aviation Forum*, Jun. 2014, Atlanta, GA

M. T. Henry de Frahan, E. Johnsen, **Blast-driven hydrodynamic instability**, *APS 66th Meeting of the Division of Fluid Dynamics*, Nov. 2013, Pittsburgh, PA

M. T. Henry de Frahan, J. L. Belof, R. M. Cavallo, O. Ignatova, E. Johnsen, B. A. Remington, V. Raevsky, **Analysis of recent Beryllium Rayleigh-Taylor experiments**, *Fundamentals of Pu Workshop XIII*, Sep. 2013, Sarov, Russia

M. T. Henry de Frahan, P. Movahed, E. Johnsen, **Investigating the multi-layered Richtmyer-Meshkov instability with high-order accurate numerical methods**, 29th *International Sympos-*

sium on Shock Waves, Jul. 2013, Madison, WI

M. T. Henry de Frahan, E. Johnsen, **Discontinuous Galerkin method for multifluid Euler equations**, 21st *AIAA Computational Fluid Dynamics Conference*, Jun. 2013, San Diego, CA

M. T. Henry de Frahan, J. L. Belof, R. M. Cavallo, O. Ignatova, E. Johnsen, B. A. Remington, V. Raevsky, **Beryllium strength under extreme dynamic loading conditions**, *APS 54th Meeting of the Division of Plasma Physics*, Oct. 2012, Providence, RI

Skills

Scientific programming

C/C++, Python, Git, Bash, R, C for CUDA, MPI, OpenMP, L^AT_EX, VisIt, Gmsh, Matlab, Hydra, Ares, Yorick, ITS Monte-Carlo Codes

Operating systems

GNU/Linux, Windows

Languages

English, French

Memberships

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| American Physical Society | 2012-2016 |
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| American Institute of Aeronautics and Astronautics | 2012-2016 |
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