Noel Chalmers

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Employment

2018-Present **Instructor**, *Department of Mathematics, Virginia Tech*, Blacksburg, VA.
Instructor of record for Computer Science Foundations for Computational Modeling and Data Analytics. The course covers topics including Linux, C programming, and parallel computing with MPI, OpenMP, and CUDA on remote clusters. I manage a team of three teaching assistants.

2017-Present **Post Doctoral Fellow**, *Department of Mathematics, Virginia Tech*, Blacksburg, VA.
Conducted research to develop GPU-accelerated numerical linear algebra solvers with algebraic multigrid preconditioners. Developed novel numerical algorithms and methods for simulating acoustics, seismic imaging, and solving elliptic potential problems. These projects have involved collaborating with researchers in the Oil & Gas Industry and at the National Labs.

2015-2016 **Post Doctoral Fellow**, *Department of Mechanical Engineering, University of Ottawa*, Ottawa, Ontario, Canada.
Development software implementation of a parallel adaptive discontinuous Galerkin finite element solver for the incompressible Navier-Stokes equations.

2013 **Instructor**, *Department of Mathematics, University of Waterloo*, Waterloo, Ontario, Canada.
Instructor of record for Calculus II for engineering. The class consisted of 150 students. I managed a team of three teaching assistants.

2010–2015 **Teaching Assistant**, *Department of Mathematics, University of Waterloo*, Waterloo, Ontario, Canada.

2009–2010 **Teaching Assistant**, *School of Mathematics and Statistics, Carleton University*, Ottawa, Ontario, Canada.
Served as a teaching assistant for several courses including Calculus, ODEs, PDEs, Numerical Analysis, and Numerical PDEs.

Education

2010–2015 **Ph.D. Applied Mathematics**, *University of Waterloo*, Waterloo, Ontario, Canada, Supervisor: Dr. Lilia Krivodonova.
Thesis: Superconvergence, Superaccuracy, and Stability of the Discontinuous Galerkin Finite Element Method.

2009–2010 **M.Sc. Applied Mathematics**, *Carleton University*, Ottawa, Ontario, Canada, Supervisor: Dr. Emmanuel Lorin.
Thesis: Numerical Approximation of Non-conservative Hyperbolic Systems: A Theoretical Framework.

2006–2009 **B.Math. Pure Mathematics**, *Carleton University*, Ottawa, Ontario, Canada.

Research Interests

- High-order methods for computational fluid dynamics.
- Efficient and scalable GPU-accelerated parallel algorithms.
- Sparse linear system solvers, preconditioners, and multigrid methods.

- Adaptive mesh refinement and local time-stepping.
- Scalable preconditioning strategies for high-order elliptic systems.

Programming skills

Programming:	C/C++, Fortran, Python	OS:	Linux, Windows
HPC:	CUDA, OpenCL, MPI, OpenMP	Scientific:	Matlab, Maple, R

Software Projects

HOLMES, *github.com/tcew/holmes*, Developer.
Developed Holmes, an experimental testbed for multi-level parallel and GPU-accelerated implementations of high-order finite element computations. I created several fully multi-GPU accelerated sparse linear system solvers, including multigrid and algebraic multigrid methods, as well as multi-rate time stepping methods and incompressible flow solvers.

CEED, *github.com/CEED*, Contributer.
The Center for Efficient Exascale Discretizations (CEED) is a collaborative effort of two U.S. Department of Energy organizations developing software, applications, hardware, advanced system engineering, and early testbed platforms, towards the nation's exascale computing imperative. I have contributed several highly GPU-optimized kernels to this source project for a selection of finite-element operators. These kernels are currently used in several large scale flow solvers.

DGAdapt, *bitbucket.org/nchalmers/dgadapt*, Lead Developer.
DGAdapt is an parallel adaptive discontinuous Galerkin finite element code for approximating the incompressible Navier-Stokes equations. I led the majority of code development including the parallelization of the algorithms using MPI and OpenMP and the subsequent deployment of the code to SciNet at the University of Toronto.

DGOpenCL, *bitbucket.org/nchalmers/dgopencl*, Lead Developer.
DGOpenCL is testbed code which investigated the parallel performance and GPU-acceleration of a discontinuous Galerkin finite element method for hyperbolic problems. I implemented the GPU-acceleration of the code using OpenCL as part of my PhD work the source has continued to be developed at the University of Waterloo.

Awards and Distinctions

- Funded by the National Sciences and Engineering Research Council of Canada (NSERC) throughout both M.Sc. and Ph.D.
- Awarded the Ontario Graduate Scholarship (OGS).
- Awarded the President's Graduate Scholarship from the University of Waterloo.
- Awarded Senate Medal for Outstanding Undergraduate Achievement from Carleton University.

Contributed Conferences

- Accelerating discontinuous Galerkin methods, *SIAM CSE*, Atlanta, GA, 2017.
- Parallel implementation of an adaptive discontinuous Galerkin method for the incompressible Navier-Stokes equations, *Nek Users Meeting*, Cambridge, MA, 2016.
- Parallel implementation of an adaptive discontinuous Galerkin method for the incompressible Navier-Stokes equations, *CFDSC*, Kelowna, BC, 2016.
- A characteristic-based CFL number for the discontinuous Galerkin method on triangular meshes, *CFDSC*, Waterloo, ON, 2015.

- Spatial and modal superconvergence of the discontinuous Galerkin method for linear equations. *ICOSAHOM*, Salt Lake City, Utah, 2014.
- Spatial and modal superconvergence of the discontinuous Galerkin method for linear equations. *New York Conference on Applied Mathematics*, Ithaca, NY, 2013.
- Relaxing the CFL number of the discontinuous Galerkin method through flux modifications, *New York Conference on Applied Mathematics*, Troy, NY, 2012.
- Relaxing the CFL number of the discontinuous Galerkin method through flux modifications, *Sharcnet Research Day*, Guelph, ON, 2012.
- Reduction of convergence errors in numerical schemes for non-conservative hyperbolic systems, *ICIAM*, Vancouver, BC, 2011

Publications

A Karakus, N Chalmers, K Świrydowicz, and T Warburton. GPU acceleration of a high-order discontinuous Galerkin incompressible flow solver. *Submitted to International Journal for Numerical Methods in Fluids*, 2018.

K Świrydowicz, N Chalmers, A Karakus, and T Warburton. Acceleration of tensor-product operations for high-order finite element methods. *Submitted to International Journal of High Performance Computing Applications*, 2017.

N Chalmers and T Warburton. Low-order preconditioning of high-order triangular finite elements. *Submitted to SIAM Journal on Scientific Computing*, 2017.

K Świrydowicz, N Chalmers, A Karakus, and T Warburton. GPU accelerated spectral element operators for elliptic problems. *CEED Project Report*, Lawrence Livermore National Lab, Livermore, CA, 2017.

N Chalmers and T Warburton. Development of efficient GPU-accelerated high-order acoustic solvers for seismic imaging. *Project Report*, TOTAL Petrochemicals, Houston, TX, 2017

N Chalmers and L Krivodonova. A characteristic based CFL condition for the discontinuous Galerkin method on triangular meshes. *Submitted to Journal of Computational Physics*, 2017.

N Chalmers and L Krivodonova. Spatial and modal superconvergence of the discontinuous Galerkin method for linear equations. *Journal of Scientific Computing*, 72(1):128–146, 2017.

N Chalmers, R Qin, and L Krivodonova. Relaxing the CFL number of the discontinuous Galerkin method. *SIAM Journal on Scientific Computing*, 36(4):A2047–A2075, 2014.

N Chalmers and E Lorin. On the numerical approximation of one-dimensional non-conservative hyperbolic systems. *Journal of Computational Science*, 4(1):111–124, 2013.

N Chalmers and E Lorin. Approximation of non-conservative hyperbolic systems based on different shock curve definitions. *Canadian Applied Mathematics Quarterly*, 4, 2010.