Mark J. Olah
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Areas of Expertise

- High-performance parallel numerical algorithms
- Nonlinear numerical optimization
- C/C++; Python; Matlab
- OpenMP, MPI, and CUDA programming models
- CMake C++/Fortran build system design
- High-dimensional data visualization
- Bayesian network inference using particle filters
- Particle localization and tracking in video applications
- Markov-chain Monte Carlo simulation and inference
- Multispectral imaging hardware and data processing
- Partial differential equation modeling using 2D/3D nonlinear meshing
- Parallel data processing on HPC and Cloud resources

Education

- **University of New Mexico** Albuquerque, NM

  Ph.D., Computer Science [with distinction], 2012
  Advisor: Prof. Darko Stefanovic
  Dissertation: *Multivalent random walkers: A computational model of superdiffusive transport at the nanoscale.*
  Awards: Best computational dissertation award, UNM School of Engineering. [2013]

- **Carnegie Mellon University** Pittsburgh, PA

  B.S., Mathematics, 2004
  B.S., Computer Science, 2004

Professional and Research Experience

- **Software Engineer** **May 2019 – Present**
  Joint Center for Satellite Data Assimilation
  University Corporation for Atmospheric Research Boulder, CO
  - HPC performance analysis and optimization for MPI and OpenMP weather data assimilation.
  - Design of parallel data processing workflows and software for automated continuous delivery of weather data products on supercomputer and cloud resources.
  - Development of portable CMake build systems for MPI/OpenMP global weather models, supporting mixed C++/Fortran packages under multiple compiler and HPC environments.

- **Postdoctoral Researcher** **2013 – 2017**
  Department of Computer Science and Department of Physics and Astronomy
  University of New Mexico Albuquerque, NM
  - Research: Developed high-performance parallel simulation and analysis software for localizing and tracking single molecules in microscopy image and video data.
  - Developed machine learning techniques for change-point detection in particle trajectories.
  - Worked in an interdisciplinary environment developing efficient, mathematically principled analysis methods to help solve scientific problems for colleagues in the biological and physical sciences.
  - Advisor: Prof. Darko Stefanovic, Department of Computer Science
  - Advisor: Prof. Keith Lidke, Department of Physics and Astronomy

- **Graduate Research Assistant** **2005 – 2012**
  Department of Computer Science, University of New Mexico Albuquerque, NM
  - Research: Stochastic models of chemical kinetics and molecular motors; Programming language semantics for object-relational mapping; Pattern recognition for chemical sensor arrays.
  - Advisor: Prof. Darko Stefanovic, Department of Computer Science
- **Research Associate** **2003 – 2005**
  Computer Science Department, Carnegie Mellon University Pittsburgh, PA
  - Research: Microscopic blood flow simulation. Developed high-performance C++/Ruby framework for solving Navier-Stokes partial differential equations using a Lagrangian (moving) mesh framework with nonlinear elements and explicit boundary tracking.
  - Advisor: Prof. Gary Miller, Computer Science Department

Teaching Experience

- **Lecturer** **2014**
  Department of Physics and Astronomy, University of New Mexico Albuquerque, NM
  - Course: UNM PHYSC 551 - Introduction to Matlab for Scientists and Engineers
- **Adjunct Professor** **2013**
  Department of Computer Science, University of New Mexico Albuquerque, NM
  - Course: UNM CS 341 Spring 2013 — Introduction to Computer Systems
- **Graduate Teaching Assistant** **2012**
  Department of Computer Science, University of New Mexico Albuquerque, NM
  - Course: UNM CS 341 Fall 2012 — Introduction to Computer Systems

Leadership Experience

- Albuquerque Mountain Rescue. Rescue Technician: 2008–2017
  - Executive Board [Secretary]: 2012–2016

Selected Open-source Projects — github.com/MarkJOlah

- MAPPEL – Maximum likelihood inference for single particle localization in super-resolution microscopy data. Implements state of the art trust-region and modified-Cholesky variants of Newton's method for fast robust multidimensional optimization. Built on an object-oriented parallel C++/OpenMP library with Python and Matlab bindings.
- MexIFace – C++ library and CMake cross-platform build system that provides a low-overhead object-based Matlab to C++ interface for high-performance applications.
- RPT – Robust Particle Tracker. A Matlab / C++ framework that builds on MAPPEL and other custom C++ components to localize and track particles in super-resolution florescence microscopy data. Designed with a GUI front-end that enables 3D visualization of data.

Grants

- "Programmable Nanowalkers: Models and Simulations." NSF: Division of Computer and Communication Foundations [#1422840]. 2014–2017.

Selected Talks

- "Design of a Generic Workflow Generator for the JEDI Data Assimilation System." ECMWF: Reproducible Workflows Workshop. Reading, UK. 2019.

- "Inferring chemical kinetic rates from single particle trajectories using dynamic Bayesian networks." UNM Department of Computer Science Colloquium. Albuquerque, NM. 2016.
- "Markov-chain Monte Carlo methods for localization of point emitters in line-scanning fluorescence microscopy." Quantitative BioImaging. Paris, France. 2015.
- "Computational aspects of single particle tracking in fluorescence microscopy." UNM Department of Computer Science Colloquium. Albuquerque, NM. 2015.
- "Representing uniqueness constraints in object-relational mapping: The Natural Entity framework." 50th International Conference on Objects, Models, Components, Patterns [TOOLS Europe]. Prague, Czech Republic. 2012.
- "Multivalent Random Walkers — A model for deoxyribozyme walkers." DNA Computing and Molecular Programming (17th International) [DNA 17]. Prague, Czech Republic. 2011.

Selected Publications

- Samantha L. Schwartz , Cedric Cleyrat , **Mark J. Olah**, *et. al.* "Differential mast cell outcomes are sensitive to FcϵRI-Syk binding kinetics." Molecular Biology of the Cell, 28(23). (2017)
- Peter K. Relich, **Mark J. Olah**, Patrick J. Cutler, and Keith A. Lidke. "Estimation of the diffusion constant from intermittent trajectories with variable position uncertainties." Physical Review E, 93. (2016) 042401.
- **Mark J. Olah** and Darko Stefanovic. "Superdiffusive transport by multivalent molecular walkers moving under load." *Physical Review E*, 87. (2013) 062713. [arXiv:1211.3482].
- Oleg Semenov, **Mark J. Olah**, and Darko Stefanovic. "Cooperative linear cargo transport with molecular spiders." *Natural Computing*, 12(2). (2013) 259–276.
- **Mark J. Olah**, David Mohr, and Darko Stefanovic. "Representing uniqueness constraints in object-relational mapping: The Natural Entity framework." In *Objects, Models, Components, Patterns*, vol. 7304 of *Lecture Notes in Computer Science*. Springer Berlin. (2012) 236–251.
- **Mark J. Olah** and Darko Stefanovic. "Multivalent random walkers: A model for deoxyribozyme walkers." In *DNA Computing and Molecular Programming*, Vol. 6937 of *Lecture Notes in Computer Science*. Springer Berlin / Heidelberg. (2011) 160–174.
- Oleg Semenov, **Mark J. Olah**, and Darko Stefanovic. "Multiple molecular spiders with a single localized source—the one-dimensional case." In *DNA Computing and Molecular Programming*, Vol. 6937 of *Lecture Notes in Computer Science*. Springer Berlin / Heidelberg. (2011) 204–216.
- Oleg Semenov, **Mark J. Olah**, and Darko Stefanovic. "Mechanism of diffusive transport in molecular spider models." *Physical Review E*, 83. (2011) 021117.
- Renjun Pei, Aihua Shen, **Mark J. Olah**, Darko Stefanovic, Tilla Worgall and Milan N. Stojanovic. "High-resolution cross reactive array for alkaloids." *Chemical Communications*, 22. (2009) 3193–3195.
- Eric Green, **Mark J. Olah**, Tatiana Abramova, Lance R. Williams, Darko Stefanovic, Tilla Worgall, and Milan N. Stojanovic. "A rational approach to minimal high-resolution cross-reactive arrays." *Journal of the American Chemical Society*, 128(47). (2006) 15278–15282.
- David E. Cardoze, Gary L. Miller, **Mark Olah**, Todd Phillips. "A Bezier-based moving mesh framework for simulation with elastic membranes." *Proceedings of the 13th International Meshing Roundtable*. (2004) 71–79.