Mark J. Olah
8634 Carr Loop
Arvada, CO 80005

412-849-0649
markolah@gmail.com
markolah.pecos.us

Areas of Expertise

- High-performance parallel numerical algorithms
- Markov-chain Monte Carlo simulation/inference.
- Non-linear numerical optimization algorithms
- C/C++; CUDA; Python; Matlab; CMake
- Linux/Win64 cross-compilation for OpenMP Python and Matlab modules
- GUI development and 2D/3D data visualization
- Maximum-likelihood and Bayesian statistical parameter estimation and model inference
- Numerical partial differential equations solvers; linear and non-linear meshing and data interpolation
- Particle tracking in video applications
- SVM techniques for classification and regression
- Multispectral scientific imaging hardware and data processing. [SCMOS/CCD/EMCCD]
- Relational databases and object–relational mapping
- Doxygen, LaTeX, and mathematical documentation
- Continuous-integration systems; Docker; github

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: UNM School of Engineering: Best computational dissertation award. [2013]

- **Carnegie Mellon University** Pittsburgh, PA

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

Research Experience

- **Independent Research Consultant** 2017 – Present
  - Research: Development of high-performance software for super-resolution fluorescence microscopy applications. Our software aims to define the state-of-the-art performance in point-emitter localization accuracy, robustness, and computational speed.
  - Design of robust constrained numerical optimization algorithms for maximum-likelihood parameter estimation in statistical models, and Markov-chain Monte Carlo simulations for Bayesian inference.
  - Collaborators/coauthors: Dr. Peter Relich, Department of Physiology, University of Pennsylvania; Dr. Samantha Schwartz, Department of Pharmacology, University of Colorado, Denver

- **Postdoctoral Researcher** 2013 – 2017
  Department of Computer Science and Department of Physics and Astronomy
  University of New Mexico Albuquerque, NM
  - Developed algorithms for localizing and tracking molecules in with C++/CUDA numerical core components, combined into high-level object-oriented GUI processing and visualization toolchains.
  - Implemented Bayesian and maximum-likelihood based techniques to robustly estimate physical parameters from noisy, intermittent particle trajectories.
  - My toolsets improved data processing and analysis throughput by an order of magnitude, which together with GUI tools enabled scientists to interactively manage the data analysis processes with immediate feedback and powerful visualizations.
  - 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 simulations of chemical kinetics and molecular motors in Python
  - Developed object-relational-database software for persistent storage of very large Python objects in SQL databases and HDF5 files, providing concurrent remote access for distributed simulation and analysis workloads.
  - Functioned as Linux sysadmin for research group's heterogeneous workstation cluster from 2005–2017. Managed installation of development toolchains, numerical software, subversion repository, databases, and network file systems and services.
  - Advisor: Prof. Darko Stefanovic, Department of Computer Science
- **Research Associate** 2003 – 2005
  Computer Science Department, Carnegie Mellon University Pittsburgh, PA
  - Research: Fully Lagrangian finite element method simulation of incompressible Navier-Stokes PDEs, using non-linear elements and explicit boundary (phase) tracking with a moving mesh approach.
  - Designed and implemented an objected-oriented C++ Lagrangian meshing package with bindings to PETSc sparse matrix solver, and Ruby/Qt for visualization.
  - Advisor: Prof. Gary Miller, Computer Science Department

Teaching Experience

- **Lecturer** 2014
  Department of Physics and Astronomy, University of New Mexico Albuquerque, NM
  - Course: UNM Physics 551 - Introduction to Matlab for Scientists and Engineers
  - Developed the custom curriculum specifically for professional scientists and postdocs to teach object-oriented organization and awareness of low-level memory and processing considerations.
- **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 – Bayesian and 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 using novel Hessian computations. Built on an object-oriented parallel C++/OpenMP library with bindings for Python and Matlab and GUI visualization tools.
- MexIFace – C++ library and CMake cross-platform build system that provides a low-overhead object-based Matlab/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 Awarded

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

Journal Peer-Reviewing

- Physical Review E [2013–Present]

Selected Talks

- "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, Pattern. 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.

Publications

- **Mark J. Olah**, Peter K. Relich, Darko Stefanovic, and Keith Lidke. "Bayesian point emitter localization algorithms for improved error estimation in super-resolution fluorescence microscopy." [*in prep.*] (2019)
- Samantha L. Schwartz , Cedric Cleyrat , **Mark J. Olah**, Peter K. Relich, *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*, volume 7304 of *Lecture Notes in Computer Science*. Springer Berlin / Heidelberg. (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.