Matthew **McGurn**

Engineer · Developer · Volunteer

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About

Matthew has focused his career upon the development of complex simulation frameworks and required interfaces to allow these powerful tools to be used by a wide variety of people. Holding his PhD in Mechanical Engineering (2013) from the University at Buffalo, he is well versed in the mathematics, physics, and software programming methods associated with CFD and FE based formulations. He is experienced in developing models using a wide variety of frameworks and languages including full web stack, modern software methods, and developing new computational methods/tools.

Work Experience

University at Buffalo - Center for Hybrid Rocket Exascale Simulation Technology

Buffalo, NY

Software Framework Architect — *2020 - Present*

Leading development and integration efforts of the Center's shared computational framework ABLATE - Ablative Boundary Layers At The Exascale - https://ablate.dev

- additional responsibilities include
  - serving as the Technical Contact for the PSAAP Computer Resource Team
  - helping to mentor undergraduate and graduate students
  - organizing annual reports for the center

Ansys

Park City, Utah

Research & Developer Engineer II — *2019 - 2020*

Tasked with developing an application and supporting frameworks in-order to expose multiple physics based solvers to Ansys customers for Additive Manufacturing modeling.

- contributed to the development and design of solver controller framework
  - engineered reactive graph framework to link execution and setup of multiple independent solvers
  - exposed framework through multiple clients: CLI, desktop application, GRPC server, etc.
- built and maintained developer operations for the project including: automated regression testing & build/publish pipelines
- participated in the maintenance and enhancement of existing web based application for the setup and execution of Additive Manufacturing simulations on distributed platforms

Reaction Engineering International

Salt Lake City, Utah

Senior Research Engineer — *2013 - 2019*

Took on the role as lead high performance computing research engineer tasked with the development of new frameworks and extension of existing frameworks to HPC applications along with the user interfaces to access the software.

- served as principal investigator on multiple successful Phase I and Phase II SBIR projects
- developed and architected multiple HPC frameworks for in-house simulation and modeling
- worked in and extended multiple closed and open source numerical and simulation frameworks including Uintah (uintah.utah.edu), PETSc (mcs.anl.gov/petsc/), Trilinos github.com/trilinos, LS-DYNA (lstc.com), SIMIT (http://cet-lab.org), etc
- developed multiple consumer facing user interfaces and support frameworks for interfacing with simulation software
- pioneered the company's transition from desktop to web based SaaS applications
- worked closely with customers on consulting projects to develop user interfaces for REI's three-dimensional reacting framework

Computational Energy Transport Laboratory, University at Buffalo

Buffalo, New York

Research Assistant — *2008 – 2013*

Dissertation research involved the computational investigation of flame spread over charring materials. Numerical solution approaches include an Eulerian-Lagrangian moving immersed interface method for simulating burning solids including and finite element model for the thermal response of charring materials in fire environments including:

- contributed to and maintained Computational Energy Transport Lab physics simulation framework
- built custom implementation of Java based MPI launchers and visual debuggers
- developed/implemented Eulerian-Lagrangian moving immersed interface method for simulating burning solids
- developed/implemented finite element model for the thermal response of charring materials in fire environments
- designed and implemented parallel finite element solver currently in use at the University at Buffalo's Center for Computational Research supercomputing facilities
- developed unstructured communication model implemented in the finite volume flow solver for the study of complex geometries

Education

University at Buffalo, the State University of New York — *Buffalo, NY*

Doctor of Philosophy in Mechanical Engineering — *February 2013*

Dissertation: "Numerical Modeling and Simulation of Flame Spread Over Charring Materials"

University at Buffalo, the State University of New York — *Buffalo, NY*

Master of Science in Mechanical Engineering — *June 2010*

Project: "A Parallel Computing Domain Decomposition Approach for Finite Element Models"

University at Buffalo, the State University of New York — *Buffalo, NY*

Bachelor of Science in Mechanical and Aerospace Engineering — *June 2007*

Professional Projects

High Fidelity Multi-Dimensional Fire Modeling and Simulation for Composite Structure Response — *Army SBIR Phase I: $149,982.48*

Principal Investigator — *2018*

Leveraging the Uintah Computational Framework for Commercial Simulation of Industrial Flares — *DoE SBIR Phase II: $1,300,000.00*

Developer/Engineer — *2018*

HPC-based Validation of Water/Natural Gas Mixtures as a Fracturing Fluid for Effective Multiple Stage Hydraulic Fracturing — *DoE SBIR Phase I: $154,954.00*

Principal Investigator — *2017*

Skills & Experience

- C++
- Java
- TypeScript
- Go
- C#
- React + Redux
- JavaFX
- Python
- SQL
- JavaScript
- WPF
- REST
- MS Office
- MPI
- Git
- Uintah
- PETSc
- Trilinos
- GRPC
- HPC
- LaTeX
- macOS, Linux, Windows

Invited Talks and Tutorials

MAE 502 - Research Methods in Mechanical and Aerospace Engineering — *University at Buffalo*

Guest Lecturer — *Spring 2023*

Developed and presented lectures covering basics in modern software development methodology, programming, and visualization/plotting.

Coding ABLATE Self-Guided Tutorial — *University at Buffalo - CHREST*

Developer — *2022*

Developed online course designed to prepare new developers for contributing to ABLATE and include git/version control, IDE/debugging, c/c++, PETSc, and ABLATE. The course is composed from multiple resources including book chapters, online tutorials, videos, manuals, and custom content.

CCR's Learning Lab Seminar Series — *Buffalo, NY*

Invited Speaker — *December 8, 2021*

Provided overview of the Center for Hybrid Rocket Exascale Simulation Technology framework development and methodology.

Community Animal Welfare Society Foster/Volunteer Orientation *Salt Lake City, Utah*

Developer & Author *2019 - 2020*

Developed the framework and contributed to the content for a volunteer and foster based online tutorial/course series. Courses included text and video content customized for each volunteer based upon their roles.

Reports, Publications & Conference Proceedings

- Sementilli, Mae L., McGurn, Matthew T., Chen, James "A scalable compressible volume of fluid solver using a stratified flow model" International journal for numerical methods in fluids, 2023, Vol.95 (5), p.777-795. https://doi-org.gate.lib.buffalo.edu/10.1002/fld.5169
- McGurn, Matthew. "A HPC-Based Flowback and Cleanup Simulator Tool for Horizontal Well Completion and Optimization." Reaction Engineering International, Murray, UT (United States), December 10, 2018. https://www.osti.gov/biblio/1498094.
- DesJardin, Paul E., Brian T. Bojko and Matthew T McGurn. "Droplet Flame Generated Manifolds for Use in Large Eddy Simulations of Two-Phase Reacting Flows." In 55th AIAA Aerospace Sciences Meeting. Grapevine, Texas: American Institute of Aeronautics and Astronautics, 2017. https://doi.org/10.2514/6.2017-0376.
- DesJardin, Paul E., Brian T. Bojko, and Matthew T. McGurn. "Initialization of High-Order Accuracy Immersed Interface CFD Solvers Using Complex CAD Geometry." International Journal for Numerical Methods in Engineering 109, no. 4 (2017): 487–513. https://doi.org/10.1002/nme.5294.
- McGurn, M.T., K.P. Ruggirello, and P.E. DesJardin. "An Eulerian–Lagrangian Moving Immersed Interface Method for Simulating Burning Solids." Journal of Computational Physics 241 (May 2013): 364–87. https://doi.org/10.1016/j.jcp.2013.01.045.
- McGurn, M. T. "Numerical Modeling and Simulation of Flame Spread Over Charring Materials." 2013. https://www.semanticscholar.org/paper/Numerical-Modeling-and-Simulation-of-Flame-Spread-McGurn/508cfa1611c0c2fa529249be6bbd50c0036d7451.
- McGurn, Matthew T., Paul E. DesJardin, and Amanda B. Dodd. "Numerical Simulation of Expansion and Charring of Carbon-Epoxy Laminates in Fire Environments." International Journal of Heat and Mass Transfer 55, no. 1–3 (January 2012): 272–81. https://doi.org/10.1016/j.ijheatmasstransfer.2011.09.013.
- McGurn, Matt, Paul Desjardin, and A. Dodd. "Thermal Modeling of Carbon-Epoxy Laminates in Fire Environments." Fire Safety Science 10 (2011): 1193–1205.
- McGurn, Matthew Thomas, Paul E. DesJardin, Thomas W. Goodrich, Brian Y. Lattimer, and Jim Lua. "Thermal Modeling of Balsa Wood for Fire Environments.," Vol. 54, 2009.

Select Training Activities

Argonne Training Program on Extreme-Scale Computing *St. Charles, IL*

(ATPESC) *July 30 – August 11, 2017*

Two-week training on the key skills, approaches, and tools to design, implement, and execute computational science and engineering applications on current high-end computing systems and the leadership-class computing systems of the future.

Non-Profit Leadership

Community Animal Welfare Society *Salt Lake City Utah*

Board President & Board Secretary *2017 - 2019*

- Implement policies and procedures to ensure governing accountability and transparency
- Provide the tools and resources to engage with and support new and long term fosters
- Establish the CAWS Hub, a central location for foster supplies, donations, meet & greets, and other resources thereby reducing the entry to fostering.
- As a volunteer based organization, CAWS's most valuable resource is volunteers. During the time as secretary, I focused upon providing policy and technological tools to volunteers including:
  - developed on-line course work and system for training new foster applicants
  - automated adopter follow-up system after one-month and six-months
  - developed Google gMail/sheets Add-On that integrates with custom adopter/animal database
  - automated animal kennel card creation replacing Word based template

Friends of Ellicott Island *Amherst, New York*

Founding Board Member, Secretary *2013 - 2014*

The organization was founded to work with Erie County Park office to establish an off-leash dog park within the county parks. The organization is responsible for fundraising, dog park rules/regulations, improvement projects, liability insurance, and community outreach.

- Responsible for website development, maintained, and other IT concerns
- Developed and implemented membership program.
- Contributed to community outreach and fundraising

Personal Project

Rescue Den (rescueden.org)

A central resource for animal rescue's volunteers and fosterers *2018 - present*

Serving in both a volunteer and leadership role within CAWS, the need for a central location for communication was needed. To address this need The RescueDen was developed. The primary objectives behind the development of The RescueDen were:

- provide fosterers and volunteers an easy resource for information thereby reducing work for head volunteers in leadership positions
- integrate into existing tools including familiar to the head volunteers
- reduce head volunteers time-commitment using streamed lined practices and automation
- the RescueDen is composed of a single page web application built using React-Redux and a custom Go server responsible for merging local and remote data from multiple resources