

Richard D Myers, Ph.D.

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Professional Summary

Principal research and software engineer with deep expertise in numerical methods for transient pipeline flow, scientific computing, and simulation software architecture. Led multi-year research, validation, and production deployment of advanced time-integration algorithms (notably Time-Step Doubling) within large-scale commercial pipeline simulators.

Extensive experience bridging theory and practice: PDE modeling, stability and accuracy analysis, adjoint methods, optimization, thermal-hydraulic coupling, legacy code modernization, and developer enablement. Proven ability to translate advanced mathematics into robust, production-quality software and to communicate complex technical concepts to diverse audiences.

Core Technical Expertise

Numerical Methods for PDEs and ODEs

Transient Pipeline Hydraulics (Isothermal & Thermal)

Time Integration (θ -method, Step Doubling, Local Extrapolation, Method of Characteristics)

Linear Stability & Order-of-Accuracy Analysis

Adjoint Sensitivities & Gradient-Based Optimization

State Estimation, Calibration, and Leak Detection

Scientific Computing (C++, Python)

Legacy Code Modernization (FORTRAN \rightarrow C++)

Machine Learning for Scientific Interpolation

Developer Tooling, Debugging, and Technical Training

Education

Sept 2003 – Aug 2005 **University of Houston–University Park**, PhD in Mathematics – Houston, TX

- Dissertation: Numerically Consistent Approximations for Optimal Control Problems Applied to Stiff Chemical Systems
- Advisor: Prof. Jiwen He

Sept 2000 – May 2002 **University of Houston–University Park**, MS in Applied Mathematics – Houston, TX

Sept 1995 – May 2000 **University of Houston–University Park**, BS in Mathematics – Houston, TX

- Graduated Magna Cum Laude

Professional Experience

Aug 2003 – Aug 2005 **Teaching Assistant**, University of Houston–University Park – Houston, TX

- Responsible for Calculus labs;
- provided one-on-one student assistance;
- graded exams/assignments and recorded grades.

- June 2000 – Aug 2005 **Graduate Research Assistant**, University of Houston–University Park – Houston, TX
- Developed numerical algorithms for simulating advection-diffusion-reaction equations arising in atmospheric chemistry and transport modeling;
 - implemented and tested algorithms in NCAR’s MM5 numerical weather prediction model;
 - performed code validation, verification, and performance analysis on high-performance computing platforms.
- Sept 2005 – Aug 2007 **Visiting Assistant Professor of Mathematics**, University of St Thomas – Houston, TX
- Teaching a 4/4 course load;
 - guiding undergraduate research;
 - serving on curriculum revision committee for Mathematics Department;
 - Served as department library liaison;
 - development of a computer science minor.
- Sept 2006 – Aug 2007 **Director of Computing Facilities for the Mathematics Department**, University of St Thomas – Houston, TX
- Built and maintained a departmental Beowulf cluster;
 - installed and configured operating systems and software on departmental computers and students’ personal laptops;
 - designed a Linux-based computer lab.
- Sept 2007 – Mar 2025 **Software Development Scientist**, DNV – Katy, TX
- Led research, development, and deployment of advanced numerical algorithms for real-time and offline pipeline simulation platforms including **SPS, Attune, GTO, and TSM**.

Selected Projects

2017 **Adjoint Sensitivities & Gradient-Based Optimization**

Advanced Numerical Methods

- Designed and implemented adjoint sensitivity analysis for large nonlinear systems arising in pipeline simulation.
- Derived continuous and discrete adjoint formulations for box-scheme-based transient solvers.
- Demonstrated computational advantages of adjoint methods when the number of outputs is small relative to parameter count.
- Validated adjoint implementations using inner-product tests and finite-difference comparisons.
- Integrated adjoint methods into Attune / TSM / GTO optimization workflows, enabling efficient gradient-based calibration.

2015 **Legacy Code Modernization: FORTRAN to C++**

High-Performance Scientific Computing

- Led automated conversion of legacy FORTRAN simulation code to modern C++ using the FABLE toolchain.
- Diagnosed extreme initial performance regressions ($\sim 10^5\times$ slower) and systematically optimized generated code.
- Eliminated unnecessary runtime memory allocation by replacing emulated common blocks with namespace-scoped static variables.
- Applied profiling-driven optimizations (VTune), improving memory locality and numeric efficiency.
- Reduced performance gap to $\sim 10\times$ or better, restoring feasibility for production use.
- Identified remaining challenges (row-major vs column-major ordering) and proposed generator-level improvements.

2018 **Method of Characteristics (MOC)**

Numerical Methods Review

- Presented Method of Characteristics (MOC) formulation for transient gas pipeline hydraulics.
- Reviewed thermodynamic assumptions related to compressibility, speed of sound, and heat transfer.
- Derived characteristic equations and Riemann invariants for isothermal and non-isothermal flow.
- Compared MOC with finite-difference and box-scheme approaches in terms of stability, accuracy, and applicability.
- Clarified historical trade-offs influencing solver choices in commercial simulators.

2017 **Attune vs StateFinder & Pipeline State Estimation**

Analytics Evaluation and Model Diagnostics

- Compared Attune (time-window constrained optimization) and StateFinder (single-state least-squares estimation) methodologies.
- Designed realistic SCADA-driven test cases to evaluate pressure and velocity reconstruction accuracy.
- Identified observability limits, data requirements, and workflow mismatches between analytics tools.
- Evaluated slackline flow implementations, reverse-engineering legacy algorithms and documenting assumptions.
- Provided recommendations for algorithm modernization and solver upgrades.

2019 Transient Isothermal Pipe Flow Modeling

Foundational Theory, Solver Design, and Reverse Engineering

- Derived isothermal gas pipeline governing equations from conservation of mass and momentum.
- Analyzed hyperbolicity, eigenstructure, and characteristic speeds, establishing validity regimes for transient simulations.
- Implemented finite-difference spatial discretization combined with θ -method and Newton iteration for nonlinear systems.
- Reverse-engineered legacy SPS, Attune, GTO, and TSM codebases, reconciling production implementations with theoretical formulations.
- Documented automatic time-step selection and validation logic, including pressure- and velocity-based error metrics.
- Clarified matrix formulations and discretization details used in production solvers.

2019 Thermal Transient Pipe Flow & Heat Transfer

Coupled Hydraulic-Thermal Simulation

- Extended transient flow models to include energy conservation and thermal dynamics.
- Implemented upwinding schemes to suppress numerical oscillations in temperature during sharp transients.
- Modeled radial heat conduction through pipe walls and surrounding soil using a Galerkin finite-element approach.
- Integrated thermal solvers with hydraulic box schemes using θ -weighted time integration.
- Compared thermal implementations across SPS, Attune, GTO, and TSM, identifying accuracy and feature trade-offs.
- Evaluated effects of film coefficients, soil properties, and SCADA boundary conditions on thermal response.

2018 Machine Learning & Interpolation for Thermophysical Properties

Research & Prototyping

- Designed and trained ReLU neural networks to approximate gas compressibility $Z(T,P)$ and compressor efficiency surfaces.
- Achieved sub-1% median absolute error across high-dimensional operating domains.
- Interpreted ReLU networks as continuous piecewise-linear spline approximators, enabling principled model design.
- Explored model-reduction techniques (PCA, SVD, feature selection) to balance accuracy and inference cost.
- Evaluated deployment strategies using exported ANN weights and C++ linear-algebra inference.
- Compared ANN interpolation against classical polynomial and spline methods for robustness and numerical stability.

2014 **Signal Processing & Imaging Techniques**

Exploratory Research

- Applied wavelet-based signal denoising techniques to noisy engineering and SCADA data.
- Compared wavelet filtering with traditional smoothing methods for transient preservation.
- Investigated Eulerian Video Magnification (EVM) to amplify subtle temporal variations in video data.
- Analyzed spatial derivative operators (e.g., Sobel filters) and frequency-domain trade-offs for noise suppression.

2019 **Time-Step Doubling (TSD) & Local Extrapolation for Pipeline Hydraulics**

Research, Development, Validation, and Production Deployment

- Researched, implemented, and productionized Time-Step Doubling (TSD) and Step Doubling with Local Extrapolation (SDoLE / ASDoLE) as stable, second-order time integration methods for transient pipeline hydraulics.
- Derived and analyzed linear stability regions, amplification factors, and order-of-accuracy properties, comparing explicit, implicit, Crank–Nicolson, θ -method, and TSD schemes.
- Demonstrated that TSD provides second-order accuracy with built-in error estimation, eliminating numerical oscillations during rapid boundary condition changes.
- Implemented TSD for isothermal gas flow PDEs using box-scheme discretization and Newton linearization.
- Validated methods using single-pipe, multi-pipe, and gun-barrel compressor models, benchmarking against highly resolved reference solutions.
- Conducted extensive runtime performance studies, showing TSD can be up to 6 \times faster than the θ -method in favorable regimes, while identifying cases where fallback is required.
- Integrated TSD into Synergi Pipeline Simulator (SPS), including runtime enable/disable logic and automatic fallback to θ -method under challenging hydraulic conditions.
- Authored and delivered reviewed internal seminars, ISS virtual seminars, and PSIG conference presentations, translating numerical analysis into practical operational guidance.

2022 **Python Integration & Debugging for SPS**

Developer Enablement & Training

- Developed and delivered training on debugging Python scripts integrated with SPS, covering both API-driven and embedded execution.
- Demonstrated live attachment to SPS runtime processes for breakpoint-based debugging and stack inspection.
- Standardized workflows using Visual Studio Community Edition, improving developer productivity and script reliability.
- Documented challenges related to Python versioning, symbols, and enterprise deployment constraints.

Technical Leadership & Knowledge Sharing

- Delivered recurring research reviews and innovation updates, synthesizing numerical, algorithmic, and performance findings.
- Helped launch and support an internal Simulation Software Seminar Series focused on hands-on technical learning.
- Communicated complex mathematical concepts clearly to cross-disciplinary engineering audiences.
- Served as a technical bridge between research, product development, and customer-facing teams.

Publications

May 2019 **Step Doubling for Pipeline Flow**

This paper defines and studies a simple, efficient method for discretizing pipeline equations in time.

Todd F Dupont, Richard D Myers

onepetro.org/PSIGAM/proceedings-abstract/PSIG19/PSIG19/PSIG-1923/2121 (Paper presented at the PSIG Annual Meeting, London, UK, May 2019)

Courses Taught

Calculus I, MATH 1431, University of St. Thomas: Summer 2006

Calculus II, MATH 1432, University of St. Thomas: Fall 2005, Spring 2006, Fall 2006

Calculus III, MATH 2431, University of St. Thomas: Spring 2007

Differential Equations, MATH 2343, University of St. Thomas: Fall 2005, Fall 2006

Intro to Technical Computing, MATH 2338, University of St. Thomas: Spring 2007

Numerical Analysis, MATH 3339, University of St. Thomas: Fall 2005, Spring 2007

Linear Algebra, MATH 3334, University of St. Thomas: Spring 2006

Probability, MATH 3335, University of St. Thomas: Fall 2006

Real Analysis, MATH 4331, University of St. Thomas: Fall 2006

Junior Research Seminar, MATH 3181, University of St. Thomas: Fall 2005, Spring 2006, Fall 2006

Senior Research Seminar, MATH 4181, University of St. Thomas: Spring 2006, Fall 2006

Independent Study, MATH 4392, University of St. Thomas: Spring 2006, Summer 2006, Fall 2006

Courses Developed

Junior/Senior Research Seminar, MATH 3181/4181, University of St. Thomas

Introduction to Technical Computing, MATH 2338, University of St. Thomas

Undergraduate Research Projects Directed

Michael Deeb - The Mathematics Behind Basket Ball, Fall 2006
Ashley Gibbs - Mathematics of Stringed Instruments, Fall 2006
David Gutierrez - The Use of Mathematics in Predicting Human Strength Performance, Fall 2006
Kulvir Kaur - The Techniques of Teaching Mathematics in Grades 8-12, Fall 2006
Hai Le - The Mathematics of Digital Photography, Fall 2006
Michael Nguyen - P vs. NP, Fall 2006
Claudia Oramas - Stabilization of Structures, Fall 2006
Linh Tran - Mathematics and Pool, Fall 2006
Mary Tapado - The Golden Mean, Fall 2006
Giselle Ramos-Bryan - Pascal's Triangle, Spring 2006
Moses Khan - The Relevance of Mathematics in Our Daily Lives, Spring 2006
Ashley Gibbs - Bezier Curves, Spring 2006
Michael Nguyen - Cryptology: The Study of Cryptography and Cryptanalysis, Spring 2006
Janie Garcia - Tomography: A mathematical Background for Medicine's Image Machine, Spring 2006
Randhi Panapitiya - Mathematical Relationships with Traffic Flow, Spring 2006
Robin Stone - Chaos, Fractals, and Perlin Noise in the Generation of Virtual Landscapes, Spring 2006
Mary Tapado - Wallpaper Patterns, Spring 2006
Janie Garcia - Galileo Galilei: His Life, His Work, Fall 2005
Moses Khan - The Life and Philosophy of Pythagoras, Fall 2005
Dominic Novak - Algorithmic Composition: How can math be used in the composition of music?, Fall 2005
Giselle Ramos-Bryan - Math in Art: Prospective Geometry, Fall 2005
Robin Stone - Unlocking Young Minds: Methods of Teaching Mathematics, Fall 2005

The University of St. Thomas Research Symposium

Ashley Gibbs - Bezier Curves in Application, Spring 2006
Christopher LaVallee - The Use of Mathematics in the Design of a Long-Bow, Spring 2006

Skills

Platforms: Linux, Windows

Languages: Python, FORTRAN, C/C++, Matlab/Octave

Automatic Differentiation: Odyssee, Tapenade

Parallel Programming: MPI, OpenMP

Environments: Emacs, make, gdb, MS Visual Studio, VS Code

Document Processing: LaTeX, Markdown, HTML

CAS: Maple, Mathematica

Research Areas: Numerical Analysis, Scientific Computing, Signal Processing, Machine Learning

Additional Training

Python Boot Camp, Jan. 2007. Covered using Python programming language in a scientific computing context.

Sun Application Tuning Seminar, Mar. 2004. Focused on using Sun's application profiler to locate code bottlenecks. Bottlenecks were then optimized. MPI and OpenMP were used for writing code for various parallel computing architectures.

CompTIA A+ Certification, July 2003. Focused on building, repairing, and configuring PCs for PC's.

Parallel Programming with MPI Seminar at UH, taught by Marc Garbey, Oct. 2000. Covered parallel programming on distributed memory systems using the MPI message passing interface.

Professional Profile

Combines **deep mathematical rigor** with **production software impact**

Operates effectively across **research, architecture, and implementation**

Strong communicator of complex technical concepts to both expert and non-expert audiences

Proven record of **long-horizon technical ownership** and sustained innovation