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.

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

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 → C++)

Machine Learning for Scientific Interpolation

Developer Tooling, Debugging, and Technical Training

Professional Experience

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 **Synergi Gas, Stoner Pipeline Simulator(SPS), Attune, GTO, and TSM**.

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 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.

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 2003 **Graduate Research Assistant**, University of Houston–University Park – Houston, TX

- Explored numerical algorithms for simulating advection-diffusion-reaction equations arising in atmospheric chemistry and transport modeling;
- Built and ran NCAR's MM5 numerical weather prediction model;
- performed code validation, verification, and performance analysis on high-performance computing platforms.

Selected Projects

2024 **Pipeline model conversion between SPS, Attune/GTO/TSM and LANL GasModels.jl**

Simulator and Optimizer Interoperability

- Began initial work on a Python based tool to convert pipeline models between DNV's Synergi Pipeline Simulator (SPS), Attune/GTO/TSM, and LANL's GasModels.jl.
- The idea is to use GasModels.jl to jump start State Finding and Transient Optimization for Attune and GTO.
- Researched the model formats for SPS, Attune/GTO/TSM, and GasModels.jl to understand their differences and similarities.
- Implemented initial code to read/write pipeline models for SPS models, Attune/GTO/TSM, and GasModels.jl.

2023 **Investigate merging Attune/GTO/TSM Thermal Shell Calculations into Synergi Gas Slow Transients Engine**

Research & Development

- Researched the integration of Attune/GTO/TSM thermal shell calculations into Slow Transients Engine.
- Analyzed existing thermal shell implementations in Attune, GTO, and TSM to understand their methodologies and assumptions.
- Code spelunked finding where to insert the calculations.
- Found that manual FORTRAN memory management in Slow Transients Engine made integration challenging.
- The full thermal calculations in Attune/GTO/TSM were tightly integrated to the hydraulic calculations, so using the thermal calculations required replacing the pipe hydraulics in the slow transients engine.

2022 **Column Separation Estimation**

Advanced Numerical Methods

- Developed/Reversed engineered a novel algorithm for estimating fluid properties from column separation data in gas pipeline simulations.
- Implemented and validated the algorithm using real-world data.
- The real-time algorithm would process pressure data obtained during shut-in conditions and would estimate fluid vapor pressure, vapor volume, and time of column separation.
- The algorithm thresholds divided difference derivatives to estimate local geometry of the shut-in region of the pressure data series.
- This thresholding algorithm can be generalized with quadratures to estimate the data series geometry further.

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.

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× 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.

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.

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 performance of Attune (adjoint method based state finding data assimilation 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.

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

Advanced Numerical Methods

- Worked with and debugged(!) 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.
- Responsible for care and feeding of adjoint methods into Attune / TSM / GTO optimization workflows, enabling efficient gradient-based calibration.

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

High-Performance Scientific Computing

- Investigated automated conversion of legacy FORTRAN simulation code to modern C++ using FABLE.
- Diagnosed extreme initial performance regressions (~$10^5\times$ 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 ~10× or better, restoring feasibility for production use.
- Identified remaining challenges (row-major vs column-major ordering) and proposed generator-level improvements.

2014 **Signal Processing & Imaging Techniques**

Exploratory Research

- Applied wavelet-based signal denoising techniques to noisy engineering and SCADA data.
- Compared wavelet filtering and Empirical Mode Decomposition (EMD) 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 tradeoffs for noise suppression.

Technical Leadership & Knowledge Sharing

- Delivered recurring research reviews and innovation updates, synthesizing numerical, algorithmic, and performance findings.
- Participated in several 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)

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*
- Abstract: In the context of the optimal control problems of state-finding and time based controls, adjoint discretizations for Runge-Kutta methods were developed that converge at the same rate as the solution and objective function.
- Advisor: Prof. Jiwen He

Sept 2000 – May 2002 **University of Houston–University Park**, MS in Applied Mathematics – Houston, TX
Focused on Numerical Analysis and Scientific Computing: Numerical Odes, PDEs, Linear Algebra, Optimization, and Parallel Programming.

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

- Graduated Magna Cum Laude

Skills

Platforms: Linux, Windows, WSL

Languages: Python, FORTRAN, C++, Bash

Automatic Differentiation: Odyssee, Tapenade

Parallel Programming: MPI, OpenMP

Environments: GCC, Clang, Make/CMake,MS Visual Studio, VS Code, TFS

Document Processing: LaTeX, Markdown, HTML

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 OSes for PC's.

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

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 - *Pascall'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