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 → 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*
- Abstract: In the context of the optimal control problems of statefinding 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

Professional Experience

Sept 2007 – Mar 2025 **Software Devlopment 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 Themal 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 calulations.
- 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 thersholds 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 Metods 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 trade-offs 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)

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

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, 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