Resume of Donald F. Hawken, SmartNumerics Simulation Solutions Inc.

Ph.D. 1989 University of Toronto, Computational Fluid Dynamics
M.Sc. 1977 University of Toronto, Low Temperature Physics
B.Sc. 1974 University of Toronto, Physics Specialist

ACHIEVEMENTS

- Developed the comprehensively tested EasyFlowfield code by persistent work over 16 years.
- Developed solution-adaptive method for FCT solver.
- Developed K-ε model used for simulation of fast multiphase turbulent reactive flows.
- Developed front-tracking method using Level-Set method on adaptive Cartesian mesh.
- Developed real-gas, condensed-phase, and particle equations of state for reactive multiphase flows.
- Developed code to generate unstructured, structured, or hybrid grids about airfoils.
- Developed TVD multi-block multi-grid Euler code and modelled 2-D wind-tunnel wall interface; stimulated further research into improved correction techniques for transonic conditions.
- Modified 3-D Navier-Stokes code, ARC3D, and simulated 3-D tunnel interference.
- Generated innovative multi-block grid about deHavilland Dash-8 aeroplane using GRIDGEN; reduced memory usage by 45% and improved grid quality at aeroplane surfaces.
- Evaluated commercial unstructured 3-D Navier-Stokes codes for CF-18 stores separation; chose 2-D and 3-D test cases and collaborated in subsequent validation of RAMPANT.
- Evaluated and improved 3-D Euler code and simulated 3-D transonic flows about CF-18 wing.
- Developed vectorized Euler code on CRAY to simulate flows in hypersonic impulse tunnel.
- Invented a dynamic solution-adaptive finite-difference technique to earn my Ph.D.
- Developed wave-tracing code to simulate explosive compression of graphite powder.
- Patent: Optics for Infrared Intrusion Detector #1095302 Canadian Patent, 10 Feb. 1981, D. Hawken and Z.W. Turleg, used in intruder alarms manufactured by Dicon Systems Limited.
- Developed a Monte Carlo lens-design program and used it for optical smoke-alarm design.

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WORK HISTORY

2006-2022 Work on the EasyFlowfield code. Created videos and smartnumerics.com website.

1996-June 2005 **Senior Research Scientist**, Martec Ltd./Combustion Dynamics Ltd.
Developed finite-rate chemistry module, K-ε module, flux-accurate front-tracking module, Flux-Corrected Transport solution-adaptive module, JWL equation of state modules, HOM equation of state module, and dense-particle equation of state module. Implemented moving-surface boundary condition to couple structural code for dynamic modelling of rocket vibrations. Did extensive work on solution adaptive Cartesian grids with immersed solids treated using the cut-cell technique. Implemented various explicit and implicit flow solvers. Implemented sparse matrix algorithms.

1995-1996
Developed unique CFD software for PC's, and a web page to present my qualifications and software. Produced UGRID, a code to create unstructured, structured, and hybrid grids under GUI control.

1991-1995 **Associate Research Officer**, National Research Council of Canada (NRC).
Developed TVD multi-block multi-grid Euler code and grid-generation software. Modified the 3-D Navier-Stokes code, ARC3D, and simulated 3-D tunnel interference. Generated innovative multi-block grid about deHavilland Dash-8 aeroplane using GRIDGEN. Evaluated commercial unstructured 3-D Navier-Stokes codes for CF-18 stores separation. Extensive experience with flow codes ARC2D, FLO67, and FLO52 for computing flows over airfoils. Used the visualisation codes PLOT3D, SSV, and Fast and generated grids using GeoMesh, EagleView, and HYGRID.

1990-1991 **Computational Fluid Dynamicist,** Logiscan Inc.
Contractor at NRC: Testing and development of a multi-grid Euler code applied to the prediction of 3D transonic flows about a CF-18 wing. Used as part of flutter analysis suite developed at NRC.

1988-1990 **Computational Fluid Dynamicist,** Viatec Resource Systems Inc.
Developed 2D TVD Euler code at University of Toronto Institute for Aerospace Studies (UTIAS) to simulate flows in inlets in the test section of a hypersonic impulse tunnel. Ran code on a CRAY.

1983-1989 **Ph.D. student** (part-time after Feb. 1988), UTIAS
Thesis title: "Adaptive Node Movement in Finite-Element and Finite-Difference Solutions of Partial Differential Equations with Applications to Gasdynamics." Node speeds were adjusted so they remained concentrated in regions with high solution gradient, such as moving shocks.

1980-1983 **Experimental Physicist**, 3M Canada Inc. at UTIAS
Member of a multi-disciplinary research team. Developed methods and apparatus to produce diamond particles by explosively compressing graphite/metal mixtures. Wrote simulation code.

1978-1980 **Applied Physicist**, Dicon Systems Ltd.
Played a key role in the design of optical smoke alarm, infrared intruder alarm, and gas alarm. Developed a Monte Carlo lens-design program and used it for optical smoke alarm design. Developed a novel optical assembly for an infrared intrusion detector. Designed, constructed, and tested various components of alarms.

1974-1978 **Masters student,** University of Toronto
Master's dissertation: "Design and Construction of an Apparatus to do Two-Dimensional Lattice Gas Measurements". Learned advanced instrumentation techniques.

PUBLICATIONS

Papers and Symposia

P.G. Harris, S. Guzik, R. Farinaccio, R.A. Stowe, D. Whitehouse, T. Josey, D. Hawken, R. Ripley, R. Link, A.J. Higgins, P.A. Thibault, "Comparative evaluation of performance models of pulse detonation engines", AIAA 2002-3912, 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 July 2002, Indianapolis, Indiana, Utah.

D.F. Hawken, F. Zhang, J. Penrose, P.A. Thibault, "A level-set front-tracking algorithm on adaptive unstructured Cartesian grid," presented at the Sixth Annual Conference of the CFD Society of Canada held in Quebec City, Canada, June 7-9, 1998.

D.J. Jones, F. Fortin, D. Hawken, G.F. Syms, Y. Sun, "The computation of aircraft store trajectories using hybrid (structured/unstructured) grids," in proceedings of the 77th Fluid Dynamics Symposium on Progress and Challenges in CFD Methods and Algorithms, Seville, Spain, October 2-5, 1995.

F. Fortin, D.F. Hawken, D.J. Jones, G.F. Syms, "A comparison of two commercial Euler and Navier-Stokes CFD codes," in proceedings of the Third Annual Conference of the CFD Society of Canada, Banff, Canada, June 25-27, 1995.

D.F. Hawken, D.J. Jones, "Production of a multiblock Navier-Stokes grid about the Dash 8-300 airplane," presented at the Fifth CASI Aerodynamics Symposium, Montreal, Canada, May 8-10, 1995.

D.F. Hawken, "A TVD multi-grid multi-block Euler code applied to wind-tunnel wall corrections," presented at the Second Annual Conference of the CFD Society of Canada, Toronto, Canada, June 1-3, 1994.

D.F. Hawken, "Computation of wind-tunnel side-wall interference using 3D Navier-Stokes code," presented at the Fourth CASI Aerodynamics Symposium, Toronto, Canada, May 3-4, 1993.

D.F. Hawken, J.S. Hansen, J.J. Gottlieb, "A new finite-difference solution-adaptive method," Philosophical Transactions of the Royal Society of London, Series A, Vol. 341, pp. 373-409, 1992.

D.F. Hawken, J.J. Gottlieb, J.S. Hansen, "Review of some adaptive node-movement techniques in finite-element and finite-difference solutions of partial differential equations," Journal of Computational Physics, Vol. 95, No. 2, pp. 254-302, 1991.

Reports

D.F. Hawken, Level-Set Front Tracking for Compressible Flows on Cartesian Meshes with Solution Adaptive Refinement, Martec Ltd., Canada, June 2005.

D. Hawken, Design document for pulse detonation engine equilibrium chemistry, Revision 1, Martec Ltd., Canada, June 29, 2005.

D. Hawken, Design document for pulse detonation engine finite-rate chemistry, Revision 3, Martec Ltd., Canada, June 27, 2005.

D. Hawken, Design document for JWL EOS models, CDL 1024, Revision 4, Martec Limited, Combustion Dynamics Group, Canada, June 21, 2005.

D. F. Hawken, Numerical modelling support for TDP on force protection against enhanced blast. Work Package 7: Simulation of blast tests to determine details of flowfield and reactions, II, Martec Technical Report # TR-05-25, Martec Ltd., Canada, March 2005.

D. F. Hawken, Preliminary investigation of finite-rate chemistry implementations for CFD analysis using Chinook, II, Martec Technical Report # TR-05-15, Martec Ltd., Canada, January 2005.

D. F. Hawken, Preliminary investigation of finite-rate chemistry implementations for CFD analysis using Chinook, Martec Technical Report # TR-04-71, Martec Ltd., Canada, December 2004.

D. Hawken, Investigation of numerical methods for reacting flows in scramjets, Revision 2, Martec Technical Report # TR-04-51, Martec Ltd., Canada, October 6, 2004.

D. Hawken, Numerical modelling support for TDP on force protection against enhanced blast. Work Package 7: Simulation of blast tests to determine details of flowfield and reactions, Martec Technical Report # TR-04-50, Martec Ltd., Canada, July 2004.

D. Hawken, Modelling support for near-field explosion of enhanced blast weapons, Martec Technical Report # TR-04-07 Revision 1, Martec Ltd., Canada, June 2004.

D. Hawken, Extension and validation of computer modelling of non-ideal explosives, Interim report, Martec Ltd., Combustion Dynamics Group, Canada, December 18, 2003.

D. Hawken, Modelling of an exploding cylinder of Pentolite, Revision 1, Martec Ltd., Combustion Dynamics Group, Canada, September 15, 2003.

D. Hawken, Godunov Algorithm used in IFSAS Code, CDL 1021, Revision 4, Martec Ltd., Combustion Dynamics Group, Halifax, Canada, September 2, 2003.

D. Hawken, Design document for dual equations of state, CDL 1022, Revision 6, Martec Ltd., Combustion Dynamics Group, Canada, August 29, 2003.

D. Hawken, L. Martin, Calculation of JWL coefficients using Cheetah, Martec Ltd., Combustion Dynamics Group, Canada, August 15, 2003.

D.F. Hawken, HLLC solver on Cartesian grid, Martec Ltd., Combustion Dynamics Group, Halifax, Canada, July 18, 2003.

D. Hawken, Design document for Tillotson equation of state for water, Revision 1, Martec Ltd., Combustion Dynamics Group, Halifax, Canada, July 4, 2003.

D. Hawken, Design document for Arbitrary Lagrangian Eulerian code, Martec Ltd., Combustion Dynamics Group, Halifax, Canada, July 2, 2003.

L. Martin, D. Hawken, R. Ripley, Numerical modeling of detonations: A combustion model review, Martec Technical Report # TR-03-45, Martec Ltd., Combustion Dynamics Group, Canada, May 21, 2003.

D. Hawken, Final report: Computer modelling of non-ideal underwater explosives, Martec Technical Report # TR-03-21, Martec Ltd., Combustion Dynamics Group, Canada, May 16, 2003.

D. Hawken, Design document for Tait equation of state, CDL 1023, Revision 1, Martec Ltd., Combustion Dynamics Group, Canada, March 27, 2003.

D.F. Hawken, Design document for GM JWL model, CDL 1020, Version 8, Combustion Dynamics Limited, Canada, February 7, 2003.

D. Hawken, Mine exploding in soil, Revision 2, Martec Ltd., Combustion Dynamics Group, Canada, February 4, 2003.

D. Whitehouse, D. Hawken, L. Martin, J. Penrose, J. Wallace, Landmine simulation using dense multiphase model, Martec Ltd., Canada, January 25, 2003.

D.F. Hawken, Design document for two phase flows, CDL 1016, Revision 11, Combustion Dynamics Limited, Canada, August 30, 2002.

D.F. Hawken, Design document for 2D flow interface trackers in AGS code, CDL 1013, Revision 12, Combustion Dynamics Limited, Canada, August 28, 2002.

D.F. Hawken, Initial flowfield for rocket code, Revision 7, Combustion Dynamics Limited, Canada, August 20, 2002.

D.F. Hawken, Design document for improving rocket CFD code, CDL 1005, Revision 2, Combustion Dynamics Limited, Canada, August 20, 2002.

D.F. Hawken, Modelling support to heterogeneous blast waves from a condensed charge with metal particles, Final Report Contract W7702-8-R696, Work Package 6, Combustion Dynamics Limited, Canada, June 19, 2002.

D.F. Hawken, Design document for HOM equation of state, CDL 1018, Revision 6, Combustion Dynamics Limited, Canada, June 19, 2002.

D.F. Hawken, FCT Algorithm used in IFSAS 2 code, CDL 1017, Revision 6, Combustion Dynamics Limited, Canada, June 19, 2002.

D.F. Hawken, Design document for van der Waals' equation of state, CDL 1019, Revision 2, Combustion Dynamics Limited, Canada, May 30, 2002.

D.F. Hawken, Implementation document for slow-speed solver in tracker-AGS code, Revision 1, Combustion Dynamics Limited, Canada, September 22, 2000.

D. Hawken, Calculation of bubble conditions in tracker-AGS code, CDL 1015, Revision 3, Combustion Dynamics Limited, Canada, September 21, 2000.

D.F. Hawken, Design document for 3D flow interface trackers, CDL 1012, Combustion Dynamics Limited, Canada, July 24, 2000.

D.F. Hawken, Implementation document for flow interface trackers in AGS code, CDL 1011, Revision 8, Combustion Dynamics Limited, Canada, May 15, 2000.

D.F. Hawken, Design document for SCFD rocket CFD code, CDL 1000, Combustion Dynamics Limited, Canada, July 18, 1998.

D.F. Hawken, Implementation of fast multiphase reactive flow model--Part I, Combustion Dynamics Limited, Canada, August 30, 1997.

D. Jones, F. Fortin, D. Hawken, M. Mokry, Y. Sun, J. Syms, Interim report on CFD for predicting store trajectories from the CF-18 aircraft, Institute for Aerospace Research, Aerodynamics Laboratory, Report LM-A-006, March 14, 1996.

D.F. Hawken, Analysis of buffet response from AETE test flights, National Research Council, LTR-HA-91, Canada, March 1993.

D. Hawken, Implementation of Euler code into the NRCC/NAE flutter analysis computer code, IAR contractor report IAR-CR-11, National Research Council, Canada, April 1991.

D.F. Hawken, J.J. Gottlieb, Prediction of two-dimensional time-dependent gasdynamic flows for hypersonic studies, UTIAS Report 335, Canada, 1990.

D. F. Hawken, Adaptive node movement in finite-element and finite-difference solutions of partial differential equations with applications to gasdynamics, Ph.D. thesis, Canada, 1989 (also UTIAS Report 333, 1990).

Letter of recommendation from Martec Limited.

MARTEC™

June 30, 2005
Re: Letter of recommendation for Donald Hawken

Dear Sir,

I have been the manager of the Combustion Dynamics group at Martec Ltd since December 2002. I have worked with Donald Hawken from his commencement of employment at Combustion Dynamics Limited in the Fall of 1996 through to June 2005.

During this time I have become familiar with Donald's work both by working with him directly, through reviewing his reports and delivering results of his work to customers. I have come to have great respect for Donald's abilities as a developer and analyst. He has repeatedly demonstrated the ability to take complex problem descriptions and implement solutions quickly.

Donald is particularly impressive when tasked with technical problems associated with the implementation of complex mathematical algorithms in computer software. He has done this as both a lead developer and in implementing models he has developed into other software projects. During this process he has shown both patience and discipline, taking the time to understand underlying assumptions in the software design and the code's final application. On several occasions his efforts have been key to enabling the company to meet key contract deliverables.

Donald conducts himself in a very professional manner. He is very responsive to customer and coworker requests for information and assistance and takes great care in the execution of his work. He readily produces high quality documentation at both the design and final reporting stages. He has also taken an active role in software testing, helping to ensure that Martec's automatic testing systems are being used and monitored effectively.

On several occasions, he has had the opportunity to work directly with customer on various analysis projects. Customers have been pleased with the quality of his work and impressed with his ability to quickly implement solutions to complex problems.

I am confident that Donald will bring a wealth of experience and skill to any future employment.

Regards

David R Whitehouse

David R. Whitehouse
Manager, Combustion Dynamics Group

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