Gregory Davidson

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Education

University of Michigan, *Ann Arbor, MI*

Ph.D. in Nuclear Engineering and Radiological Sciences and Computational Science *Dec 2009*

- Thesis Title: Time-Dependent Radiation Transport Using the Staggered-Block Jacobi Method
- Advisor: Edward W. Larsen
- GPA: 8.15/9.00

Oregon State University, *Corvallis, OR*

M.S. in Nuclear Engineering *July 2004*

- Thesis Title: Finite Element Transport using Wachspress Rational Basis Functions on Quadrilaterals in Diffusive Regions
- Advisor: Todd S. Palmer
- GPA: 3.93/4.00

Honor's B.S. in Nuclear Engineering *June 2002*

- Thesis Title: Finite Element Diffusion Solutions on Arbitrary Quadrilaterals using Wachspress Rational Functions
- GPA: 3.94/4.00

Research Experience

My research experience has involved the derivation, analysis, and implementation of deterministic and stochastic numerical radiation transport methods, including:

- Team developer on Denovo, a 3D, massively multiparallel S_N radiation transport code under active development at ORNL.
- Team member in the VERA-PSS and VERA-VRI groups of CASL.
- Sensitivity analysis of radiation flux for nuclear events in urban environments.
- Researched the Staggered-Block Jacobi space-time discretization as a student member of the Center for Radiation Shock Hydrodynamics (CRASH) program, and as a Graduate Student Research Assistant and Department of Energy Computational Science Graduate Fellow.
- Researched a finite-element transport discretization using Wachspress basis functions as a Computational Science Graduate Fellow.
- Various transport research at internships and practicums.

Research Interests

Research interests include deterministic transport algorithms, such as finite-element S_N discretizations and time-differencing methods, Monte Carlo transport, sensitivity/uncertainty analysis, discrete diffusion Monte Carlo methods, multiphysics methods, hydrodynamics, software engineering, and object-oriented programming.

Practicums and Internships

Los Alamos National Laboratory (CCS-4) *Los Alamos, NM*
Fellowship Practicum *June 2005 – August 2005*

Implemented an emissivity-preserving discrete diffusion Monte Carlo (DDMC) transport scheme in C++. Wrote and tested the asymptotically-correct angular distribution functionality for transport-diffusion interfaces in DDMC methods.

Bettis Atomic Power Laboratory (Reactor Physics) *West Mifflin, PA*
Fellowship Practicum *June 2003 – September 2003*

Derived the equations for the constant-constant, constant-linear, and linear-linear short characteristics methods on rectangular zones. Wrote the constant-linear characteristics method into an existing S_N code

in Fortran 90.

Lawrence Livermore National Laboratory (A Division) *Livermore, CA*
Intern *June 2002 – September 2002*
Researched a finite-element method using Wachspress rational basis functions for solving the discrete-ordinates neutron transport equation.
Intern *June 2001 – September 2001*
Investigated a one-dimensional computational hydrodynamics scheme based on rational basis functions.
Intern *June 2000 – September 2000*
Implemented relativistic fluid motion corrections and momentum deposition into the particle Monte Carlo package of Kull (a 3-D multiphysics code) in C++ and Python.

Journal Publications

Yesilyurt, G., Clarno, K.T., Evans, T.M., Davidson, G. G., and Fox, P.B., "C5 Benchmark Problem with Discrete Ordinate Radiation Transport Code Denovo," Nucl. Tech., (to appear).

G. Davidson and T.S. Palmer, "Finite Element Transport Using Wachspress Rational Functions on Quadrilaterals in Thick Diffusive Regions," Nucl. Sci. Eng., **159**, 242 (2008).

J.D. Densmore, G. Davidson, and D.B. Carrington, "Emissivity of Discretized Diffusion Problems," Ann. Nucl. Energy, **33**, (2006).

Conference Proceedings

T.M. Evans, G.G. Davidson, and R.N. Slaybaugh, "Three-Dimensional Full Core Power Calculations for Pressurized Water Reactors," SciDAC 2010, Chattanooga, TN, July 11-15, (to appear).

G. Davidson and E.W. Larsen, "Sweepless Time-Dependent Transport Calculations using the Staggered Block Jacobi Method," International Conference on Mathematics, Computational Methods, and Reactor Physics (M&C 2009), Satatoga Springs, NY, May 3-7, on CD-ROM, American Nuclear Society, LaGrange Park, IL (2009).

G. Davidson and T.S. Palmer, "Finite Element Transport Using Wachspress Rational Basis Functions on Quadrilaterals in Diffusive Regions," Palais des Papes, Avignon, France, September 12-15, on CD-ROM, American Nuclear Society, LaGrange Park, IL (2005).

Conference Abstracts

Vacaliuc, B., Munro, J.K. Jr., Bell, Z.W, Evans, T.M., and Davidson, G.G, "Accelerated Solution of One-Dimensional Neutron Transport on General Purpose Graphics Processing Unit," International Conference on Preconditioning Techniques for Scientific and Industrial Applications, May 16-May 18, Bordeaux, France (2011).

G.G. Davidson, T.M. Evans, R.N. Slaybaugh, and C.G. Baker, "Massively Parallel Solutions to the k-Eigenvalue Problem," ANS 2010 Winter meeting (to appear).

G. Davidson and E.W. Larsen, "An Unconditionally-Stable Time-Dependent Transport Method Without Sweeps," Trans. Am. Nucl. Soc., **97**, 530-532 (2007).

G. Davidson, J.D. Densmore, A.K. Prinja, and J.E. Morel, "Asymptotically Correct Angular Distributions for Monte Carlo-Diffusion Interfaces," Trans. Amer. Nucl. Soc., **94**, (2006).

G.G. Davidson and T.S. Palmer, "Finite Element Diffusion on Arbitrary Quadrilaterals using Rational Basis Functions," Trans. Am. Nucl. Soc., **87**, (2002).

Thesis

G. Davidson, "Time-Dependent Radiation Transport Using the Staggered-Block Jacobi Method," Doctoral Dissertation, Department of Nuclear Engineering and Radiological Sciences, University of Michigan (2010).

G. Davidson, "Finite Element Transport Using Wachspress Rational Basis Functions on Quadrilaterals in Diffusive Regions," Master's Thesis, Department of Nuclear Engineering and Radiation Health Physics, Oregon State University (2004).

G. Davidson, "Finite Element Diffusion Solutions on Arbitrary Quadrilaterals using Rational Basis Functions," Undergraduate Honor's Thesis, Department of Nuclear Engineering and Radiation Health Physics, Oregon State University (2002).

Contributed Presentations

G. Davidson and E.W. Larsen, "An Unconditionally-Stable Finite-Element Transport Method Without Sweeps," American Nuclear Society, Annual Meeting, November 11-15, 2007, Washington, DC.

G. Davidson and T.S. Palmer, "Finite-Element Particle Transport using Wachspress Rational Basis Functions," Computational Science Graduate Fellowship, Annual Conference, June 20-22, 2006, Washington D.C., available at http://www.cs-pi.org/csgf/conf/2006/presentations/davidson.shtml.

G. Davidson, J.D. Densmore, A.K. Prinja, and J.E. Morel, "Asymptotically Correct Angular Distributions for Monte Carlo-Diffusion Interfaces," American Nuclear Society, Annual Meeting, June 4-8, 2006, Reno, NV.

G. Davidson and T.S. Palmer, "Finite Element Transport Using Wachspress Rational Basis Functions on Quadrilaterals in Diffusive Regions," Palais des Papes, Avignon, France, September 12-15, 2005, on CD-ROM, American Nuclear Society, LaGrange Park, IL.

G. G. Davidson and T.S. Palmer, "Finite Element Diffusion on Arbitrary Quadrilaterals using Rational Basis Functions," American Nuclear Society, Annual Meeting, November 17-21, 2002,Washington, DC.

Honors and Awards

- D.O.E. Computational Science Graduate Fellowship Recipient
- Master's Thesis of the Year, *Nuclear Engineering Dept., Oregon State University*
- Honor's College Member, *Oregon State University*
- Tau Beta Pi Engineering Honor Society
- Phi Kappa Phi Honor Society
- Alpha Lambda Delta, *Honorary Fraternity*
- National Academy for Nuclear Training Scholarship
- Oregon Space Grant Scholarship
- D.O.E. NEHP Scholarship
- OSU Achievement Scholarship
- Schuette Engineering Scholarship
- Leo Adler Foundation Scholarship
- Sanford Adler Scholarship
- Nadie Strayer Scholarship
- Grant-Baker Federal Credit Union Scholarship
- Elks Scholarship

Professional Activities

- Accelerators for Science and Engineering Applications: GPUs and Multicores summer school, *Participant*, 2008
- American Nuclear Society, *Member*, 1998-present
- Associated Students of Oregon State University, *Graduate Senator*, 2004-2006
- American Nuclear Society, *Student Chapter Vice President, Oregon State University*, 1999-2000

Skills

- Programming Languages: C++ (advanced), C (advanced), Python, Fortran90
- Code libraries: C++ Standard Template Libraries, BOOST, Trilinos, Silos
- Version control software: Subversion, CVS
- Documentation: LaTex, Doxygen, reStructuredText
- Analysis Software: Mathematica, Matlab, Maple
- Transport Software: MCNP, SCALE, Attila, CASMO
- Office Software: MS Office, OpenOffice.org