

DEBOJYOTI GHOSH

Mathematics & Computer Science • Argonne National Laboratory • Lemont, IL 60439
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SUMMARY OF SKILLS

- Numerical algorithms for partial differential equations (specifically compressible and incompressible fluid dynamics).
- Computational simulations and analyses of external flow problems – aerodynamic and atmospheric flows.
- High-order conservative finite-difference and finite-volume discretization methods, and time-integration schemes – derivation, numerical analysis, and implementation.
- Scalable algorithms on high-performance computing platforms (including peta-scale DOE Leadership-class supercomputers).
- Experienced with different domain discretization techniques – overset meshes, multi-block meshes, immersed boundaries.
- Excellent communications skills (oral and written) acquired through presentations at conferences, interactions with research collaborators and writing papers for journals.

PROFESSIONAL EXPERIENCE

POSTDOCTORAL APPOINTEE – ARGONNE NATIONAL LABORATORY (Lemont, IL)

Mathematics and Computer Science Division (February 2013 – Present)

- *High-order semi-implicit time integration methods & applications*: Co-developed and tested efficient semi-implicit multi-stage time-integrators for atmospheric flows; implemented implicit-explicit Runge-Kutta and Rosenbrock methods in an operational numerical weather prediction code.
- *Scalable non-linear compact finite-difference schemes*: Developed a scalable and efficient implementation of non-linear compact schemes for massively parallel simulations; demonstrated their performance on DOE Leadership-class supercomputer.
- *Conservative, high-resolution methods for limited-area atmospheric flows*: Derived well-balanced conservative finite-difference discretization for the Navier-Stokes equations under gravitational forcing; derived characteristic-based splitting for efficient semi-implicit time-integration.
- *Modeling power systems under uncertainty*: Developed a high-order algorithm to simulate power systems (generator, transmission, and load) under uncertainty in system parameters.
- *Active contributor to PETSc*: Implemented multi-stage explicit and semi-implicit time-integrators.

RESEARCH ASSISTANT – UNIVERSITY OF MARYLAND (College Park, MD)

Alfred Gessow Rotorcraft Center, Aerospace Engineering (Jul 2008 – Jan 2013)

- *High-resolution non-oscillatory schemes for turbulent flows*: Derived and implemented a new class of weighted non-linear compact schemes for hyperbolic PDEs; applied them to DNS of benchmark turbulent flow problems, and flows around rotary and flapping wing aircraft.
- *Numerical simulation of vortex-dominated flows*: Developed a high-order accurate unsteady flow solver for incompressible flows on staggered meshes; simulated the impingement of multiple vortices on solid surface; implemented immersed boundaries to study effect of idealized fuselage shapes on rotorcraft wake flow.

RESEARCH ASSISTANT – INDIAN INSTITUTE OF TECHNOLOGY BOMBAY (Mumbai, India)

Department of Aerospace Engineering (June 2005 – June 2006)

- *Numerical algorithms for ideal magneto-hydrodynamics*: Developed a finite volume solver for the equations of ideal MHD.
- *Finite-volume time-domain algorithms for electromagnetics*: Applied a characteristic-based solver for Maxwell's equations to radar cross-section analysis of low-observable aircraft.

SUMMER INTERN – INFOTECH ENTERPRISES (Bangalore, India)

Pratt & Whitney Canada Center of Excellence (May 2004 – Aug 2004)

- *Computational analysis of effusion-cooled plate*: Generated the grid and performed a CFD and heat transfer analysis of an effusion-cooled plate with commercial software (CFX-TASCFlow and ANSYS).

EDUCATION

- **DOCTOR OF PHILOSOPHY** (January 2013)
University of Maryland, Applied Mathematics & Statistics, and Scientific Computation
Application Areas: Fluid Mechanics, Rotorcraft Aerodynamics
- Dual Degree (**BACHELOR OF TECHNOLOGY** and **MASTER OF TECHNOLOGY**) (July 2006)
Indian Institute of Technology Bombay, Aerospace Engineering
Application Areas: Aerodynamics, Computational Fluid Dynamics

OTHER TRAINING PROGRAMS

- **Argonne Training Program in Extreme-Scale Computing (ATPESC)** (St. Charles, IL, 2014)

TECHNICAL SKILLS

- **Programming Languages**: C/C++, FORTRAN, MATLAB
- **High Performance Computing**: MPI, OpenMP, PThreads, HPCToolkit, Alinea DDT
- **Scientific Visualization Software**: Tecplot, LLNL Visit
- **Version Control**: Git, SVN, Mercurial

PUBLICATIONS

JOURNAL ARTICLES

- **Ghosh, D.**, Constantinescu, E.M., Brown, J., *Efficient Implementation of Nonlinear Compact Schemes on Massively Parallel Platforms*, SIAM Journal on Scientific Computing, 37 (3), 2015, C354–C383, DOI: 10.1137/140989261.
- **Ghosh, D.**, Baeder, J.D., *Weighted Non-Linear Compact Schemes for the Direct Numerical Simulation of Compressible, Turbulent Flows*, Journal of Scientific Computing, 61 (1), 2014, 61-89, DOI: 10.1007/s10915-014-9818-0.
- **Ghosh, D.**, Medida, S., Baeder, J.D., *Application of Compact-Reconstruction WENO Schemes to Compressible Aerodynamic Flows*, AIAA Journal, 52 (9), 2014, 1858-1870, DOI: 10.2514/1.J052654.
- **Ghosh, D.**, Baeder, J.D., *Compact Reconstruction Schemes with Weighted ENO Limiting for Hyperbolic Conservation Laws*, SIAM Journal on Scientific Computing, 34 (3), 2012, A1678–A1706, DOI: 10.1137/110857659.
- **Ghosh, D.**, Baeder, J.D., *A High-Order Accurate Incompressible Navier Stokes Algorithm for Vortex Ring Interactions with Solid Wall*, AIAA Journal, 50 (11), 2012, 2408-2422, DOI: 10.2514/1.J051537.

PEER-REVIEWED CONFERENCE PAPERS

- **Ghosh, D.**, Constantinescu, E.M., *Well-Balanced Formulation of Gravitational Source Terms for Conservative Finite-Difference Atmospheric Flow Solvers*, AIAA Paper 2015-2889, 7th AIAA Atmospheric and Space Environments Conference, June 22-26, Dallas, TX, DOI: 10.2514/6.2015-2889.
- **Ghosh, D.**, Medida, S., Baeder, J.D., *Compact-Reconstruction Weighted Essentially Non-Oscillatory Schemes for Unsteady Navier-Stokes Equations*, AIAA Paper 2012-2832, 42nd AIAA Fluid Dynamics Conference and Exhibit, June 25-28, 2012, New Orleans, LA, DOI: 10.2514/6.2012-2832.
- **Ghosh, D.**, Baeder, J.D., *Numerical Simulation of Vortex Ring Interactions with Solid Wall*, AIAA Paper 2011-675, 49th AIAA Aerospace Sciences Meeting, Jan 4-7, 2011, Orlando, FL, DOI: 10.2514/6.2011-675.
- **Ghosh, D.**, Baeder, J.D., *A High Order Conservative Upwind Algorithm for the Incompressible Navier Stokes Equations*, AIAA Paper 2010-5030, 40th AIAA Fluid Dynamics Conference, June 28 – July 1, 2010, Chicago, IL, DOI: 10.2514/6.2010-5030.

INVITED AND MINI-SYMPOSIUM TALKS

- **Ghosh, D.**, Constantinescu, E. M., *Characteristic-Based Flux Splitting for Implicit-Explicit Time Integration of Low-Mach Number Flows*, 13th U.S. National Congress on Computational Mechanics (USNCCM13), Mini-symposium on *Advances in Implicit / Explicit (IMEX) Time integration of Multiphysics Systems*, July 26 - 30, 2015, San Diego, CA.
- **Ghosh, D.**, Constantinescu, E. M., *A Finite-Difference Algorithm with Characteristic-Based Semi-Implicit Time-Integration for the Euler Equations with Gravitational Forcing*, SIAM Conference on Mathematical & Computational Issues in the Geosciences, Mini-symposium on *Modeling and Simulation of Multiscale and Coupled Processes in Atmospheric Physics*, June 29 - July 2, 2015, Stanford, CA.
- **Ghosh, D.**, Constantinescu, E.M., *A Compact-Reconstruction WENO Scheme with Semi-Implicit Time Integration*, SIAM Conference on Computational Science and Engineering, Mini-symposium on *Recent Advances in High Order Spatial Discretization Methods for PDEs*, March 14 – 18, 2014, Salt Lake City, UT.
- Ketcheson, D., **Ghosh, D.**, *Stability-Optimized Time Integrators for WENO Discretizations*, SIAM Conference on Computational Science and Engineering, Mini-symposium on *Advances in Time-stepping Methods*, March 14 – 18, 2014, Salt Lake City, UT.
- Barajas-Solano, D.A., Tartakovsky, A., **Ghosh, D.**, Constantinescu, E.M., Abhyankar, S., *Probability Density Methods for the Analysis of Power Grids Under Uncertainty*, SIAM Conference on Computational Science and Engineering, Mini-symposium on *Distributed Cyber-Physical Systems: Modelling and Controlling the Power Grid*, March 14 – 18, 2014, Salt Lake City, UT.
- **Ghosh, D.**, Constantinescu, E.M., Brown, J., *Scalable Non-Linear Compact Schemes*, International Conference on Spectral and High Order Methods (ICOSAHOM), Mini-symposium on *Aspects of Time Stepping*, June 23 – 27, 2014, Salt Lake City, UT.
- **Ghosh, D.**, *Compact-Reconstruction WENO Schemes - Theory, Implementation and Applications*, NIA CFD Seminar, National Institute of Aerospace, Hampton, VA, June 2014

PROFESSIONAL ACTIVITIES

- Visiting researcher at the *Numerical Mathematics Group* in Computer, Electrical and Mathematical Sciences & Engineering, King Abdullah University of Science and Technology (Host: David Ketcheson), June 2015.
- Session Co-Chair at 7th AIAA Atmospheric and Space Environments Conference (*Numerical Weather Prediction*)
- Session Chair at SIAM Annual Meeting 2014 (*Numerical Methods in PDE VII*)
- Reviewer: *Computers & Mathematics with Applications, Journal of Scientific Computing*
- Organizer of the *LANS Informal Seminar Series* at the MCS Division, Argonne National Laboratory (2013 – Present)

CURRICULUM VITAE http://www.mcs.anl.gov/~ghosh/Files/cv_ghosh.pdf