DEBOJYOTI GHOSH

Curriculum Vitae

Center for Applied Scientific Computing
Lawrence Livermore National Laboratory
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http://debog.github.io/

RESEARCH INTERESTS

o *Numerical method for hyperbolic partial differential equations* – conservative finite-difference and finite-volume methods, high-order time integration methods (implicit, implicit-explicit, and multirate methods).

o *Domain discretization techniques* – overset meshes, mapped multi-block grids, immersed boundary methods.

o *Applications*: external compressible and incompressible flows, atmospheric flows, aerodynamic flows – rotorcraft and flapping wing aircraft, ideal magneto-hydrodynamics, fusion plasma applications.

o *High-performance computing* – design and implementation of scalable algorithms on HPC platforms, specifically DOE Leadership-class supercomputers.

PROFESSIONAL EXPERIENCE

o POSTDOCTORAL RESEARCH STAFF MEMBER – **LAWRENCE LIVERMORE NATIONAL LABORATORY**, October 2015 – Present
Center for Applied Scientific Computing

Implicit-explicit time integration methods for continuum kinetic systems; High-order finite-volume algorithms for tokamak edge plasma simulations; Multi-fluid models for simulation of interpenetrating plasmas in ICF applications; Multirate time integration methods for AMR-based atmospheric flow solvers.

o POSTDOCTORAL APPOINTEE – **ARGONNE NATIONAL LABORATORY**, February 2013 – October 2015
Mathematics and Computer Science Division
and FELLOW – **COMPUTATION INSTITUTE, THE UNIVERSITY OF CHICAGO**, March 2015 – October 2015

Implicit-explicit time integrators and their applications to atmospheric flows; Multirate time integration methods; Scalable implementation of nonlinear compact finite-difference schemes.

o RESEARCH ASSISTANT – **UNIVERSITY OF MARYLAND**, July 2008 – January 2013
Alfred Gessow Rotorcraft Center, Aerospace Engineering

High-resolution non-oscillatory schemes for turbulent flows; Application to DNS of turbulent flows, and flows around rotary and flapping wing aircraft; Simulation of incompressible, vortex-dominated flows; Immersed boundary methods and their applications.

o *RESEARCH ASSISTANT* – **INDIAN INSTITUTE OF TECHNOLOGY BOMBAY**, June 2005 – June 2006
Department of Aerospace Engineering

Numerical methods for ideal magneto-hydrodynamics; Finite-volume time-domain algorithms for Maxwell's equations (electromagnetics); Radar cross-section analysis of low-observable aircraft.

o *SUMMER INTERN* – **INFOTECH ENTERPRISES**, May 2004 – Aug 2004
Pratt & Whitney Center of Excellence

Computational analysis of effusion-cooled plate with commercial software.

EDUCATION

o *University of Maryland*, Department of Mathematics   Jan 2013
DOCTOR OF PHILOSOPHY in Applied Mathematics (Concentration: Scientific Computing)

o *Indian Institute of Technology Bombay*, Aerospace Engineering   July 2006
MASTER OF TECHNOLOGY in Aerospace Engineering (Concentration: Computational Aerodynamics)
BACHELOR OF TECHNOLOGY in Aerospace Engineering

OTHER COURSES AND TRAINING PROGRAMS: Argonne Training Program for Extreme Scale Computing (St. Charles, IL, 2014)

Last updated: July, 2017

PUBLICATIONS

JOURNAL ARTICLES

o Ghosh, D., Constantinescu, E. M., *Semi-Implicit Time Integration of Atmospheric Flows with Characteristic-Based Flux Partitioning*, SIAM Journal on Scientific Computing, 38 (3), 2016, A1848-A1875.

o Ghosh, D., Constantinescu, E. M., *Well-Balanced, Conservative Finite-Difference Algorithm for Atmospheric Flows*, AIAA Journal, 54 (4), 2016, 1370-1385.

o Wang, P., Barajas-Solano, D. A., Constantinescu, E. M., Abhyankar, S., Ghosh, D., Smith, B. F., Huang, Z., Tartakovsky, A. M., *Probabilistic Density Function Method for Stochastic ODEs of Power Systems with Uncertain Power Input*, SIAM/ASA Journal on Uncertainty Quantification, 3 (1), 2015, 873-896.

o 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.

o 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.

o Ghosh, D. Medida, S., Baeder, J.D., *Application of Compact-Reconstruction WENO Schemes to Compressible Aerodynamic Flows*, AIAA Journal, 52 (9), 2014, 1858-1870.

o 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.

o 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.

BOOK CHAPTER

o Ghosh, D., Constantinescu, E. M., *Nonlinear Compact Finite-Difference Schemes with Semi-Implicit Time Stepping*, in Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2014, Springer Lecture Notes in Computational Science and Engineering, Volume 106, 2015, 237-245.

PEER-REVIEWED CONFERENCE PAPERS

o Guhur, P.-L., Constantinescu, E.M., Ghosh, D., Peterka, T., Cappello, F., *Detection of Silent Data Corruption in Adaptive Numerical Integration Solvers*, IEEE Cluster Conference, September 5-8, 2017, Honolulu, HI.

o Ghosh, D., Dorf, M., Hittinger, J., Dorr, M., *Implicit-Explicit Time Integration for the Vlasov-Fokker-Planck Equations*, AIAA Paper 2017-4016, 48th AIAA Plasmadynamics and Lasers Conference, June 5-9, 2017, Denver, CO

o 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 & Space Environments Conf., June 22-26, Dallas, TX.

o 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.

o 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.

o 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 and Exhibit, June 28 – July 1, 2010, Chicago, IL.

TECHNICAL REPORTS

o Ghosh, D., Constantinescu, E.M., Brown, J., *Scalable Nonlinear Compact Schemes*, Technical Memorandum ANL/MCS-TM-340, Argonne National Laboratory, April 2014

THESES

o *Compact-Reconstruction Weighted Essentially Non-Oscillatory Schemes for Hyperbolic Conservation Laws*, Ph. D. Thesis, University of Maryland, College Park, January 2013.

o *Higher Order Non-Oscillatory Schemes in Ideal Magnetohydrodynamics*, Masters Thesis, Indian Institute of Technology Bombay, July 2006.

INVITED AND MINI-SYMPOSIUM TALKS

o Ghosh, D., Constantinescu, E. M., *Characteristic-Based Slow-Wave-Fast-Wave Partitioning for Semi-Implicit Time Integration of Atmospheric Flows*, IMAGe 2017 Theme of the Year: Workshop on Multiscale Geoscience Numerics, National Center for Atmospheric Research (NCAR), May 16 - 19, 2017, Boulder, CO.

o Ghosh, D., Dorr, M., Dorf, M., Hittinger, J., *Implementation of Implicit-Explicit Time Integration for the Kinetic Modeling of Tokamak Plasma Edge*, SIAM Conference on Computational Science and Engineering, Minisymposium on Computational Plasma Physics, February 27 - March 3, 2017, Atlanta, GA.

o Dorr, M., Colella, P., Dorf, M., Ghosh, D., Hittinger, J., *Exact Preservation of Zero Velocity Divergence in a High-Order, Mapped-Grid, Finite-Volume Discretization of a Gyrokinetic System*, SIAM Conference on Computational Science and Engineering, Minisymposium on Computational Plasma Physics, February 27 - March 3, 2017, Atlanta, GA.

o 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.

o 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.

o 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.

o 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.

o 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.

o 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.

o Ghosh, D., *Compact-Reconstruction WENO Schemes - Theory, Implementation and Applications*, NIA CFD Seminar, National Institute of Aerospace, Hampton, VA, June 2014.

OTHER CONFERENCES/TALKS/POSTERS

o Ghosh, D., Chapman, T., Berger, R. L., Khodak, M., Hittinger, J., *Simulation of interpenetrating plasmas in 1D with a multifluid approach*, 47th Annual Anomalous Absorption Conference, June 11 - 16, 2017, Florence, OR.

o Lee, W., Dorf, M., Dorr, M., Cohen, R., Ghosh, D., Hittinger, J., Umansky, M., Krasheninnikov, S., *Status of 5D continuum kinetic code COGENT and its verification with kinetic drift wave instability*, International Sherwood Fusion Theory Conference, May 1 - 3, 2017, Annapolis, MD.

o Dorf, M., Dorr, M., Ghosh, D., Hittinger, J., Lee, W., Cohen, R., *Continuum kinetic modeling of cross-separatrix plasma transport with COGENT*, International Sherwood Fusion Theory Conference, May 1 - 3, 2017, Annapolis, MD.

o Lee, W., Dorf, M., Dorr, M., Cohen, R., Ghosh, D., Rognlien, T., Hittinger, J., Umansky, M., Krasheninnikov, S., *Status of the 5D gyrokinetic code COGENT and its initial applications*, 58th Annual Meeting of the APS Division of Plasma Physics, October 31 - November 4, 2016, San Jose, CA.

o Dorf, M., Dorr, M., Ghosh, D., Hittinger, J., Rognlien, T., Cohen, R., Lee, W., Schwartz, P., *Edge-relevant plasma simulations with the continuum code COGENT*, 58th Annual Meeting of the APS Division of Plasma Physics, October 31 - November 4, 2016, San Jose, CA.

o Dorf, M., Dorr, M., Cohen, R. H., Lee, W., Ghosh, D., Hittinger, J., Rognlien, T., *Continuum Kinetic Modeling of the Tokamak Plasma Edge with the COGENT code*, International Sherwood Fusion Theory Conference, April 4 - 6, 2016, Madison, WI.

o Cohen, R. H., Dorf, M., Dorr, M., Lee, W., Ghosh, D., Hittinger, J., Rognlien, T., *Continuum Kinetic Modeling of the Tokamak Plasma Edge with the COGENT*, US Transport Task Force Workshop, March 29 - April 1, 2016, Denver, CO.

o Ghosh, D., Constantinescu, E.M., Brown, J., *A Scalable, Parallel Implementation of Weighted, Non-Linear Compact Schemes*, SIAM Annual Meeting, July 7 – 11, 2014, Chicago, IL.

o Brown, J., Ghosh, D., *Fast Solvers for Implicit Runge-Kutta*, Thirteenth Copper Mountain Conference on Iterative Methods, April 6 – 11, 2014, Copper Mountain, CO.

o Brown, J., Ghosh, D., *Fast solvers for implicit Runge-Kutta systems*, Tenth Workshop of the INRIA-Illinois-ANL Joint Laboratory on Petascale Computing, November 25 - 27, 2013, Urbana, IL.

o Brown, J., Constantinescu, E.M., Ghosh, D., McInnes, L.C., *BOUT++ and PETSc: Time integration and solver composition*, BOUT++ Workshop, September 3 - 6, 2013, Livermore, CA.

o Constantinescu, E.M., Brown, J., Smith, B., McInnes, L.C., Ghosh, D., Balay, S., *Robust Implicit-Explicit Time Stepping*, DOE Applied Math PI Meeting, August 6, 2013, Albuquerque, NM.

o Ghosh, D., Medida, S., Baeder, J.D., *Direct Numerical Simulation of Compressible Turbulent Flows with Weighted Non-Linear Compact Schemes*, 65th Annual Meeting of the APS Division of Fluid Dynamics, November 18 – 20, 2012, San Diego, CA

o Ghosh, D., Medida, S., Baeder, J.D., *High-Order Non-Oscillatory Compact Reconstruction Scheme for Overset Grids*, 11th Symposium on Overset Composite Grids and Solution Technology, October 15 – 18, 2012, Dayton, OH

o Ghosh, D., Baeder, J.D., *Application of Compact-Reconstruction WENO Schemes to the Navier-Stokes Equations*, SIAM Annual Meeting, July 9 – 13, 2012, Minneapolis, MN

o Ghosh, D., Baeder, J.D., *High Order Compact Reconstruction Scheme with Weighted Essentially Non-Oscillatory Limiting*, AMS-MAA Joint Mathematics Meetings, Jan 4-7, 2012, Boston, MA

o Ghosh, D., *Application of Weighted Essentially Non-Oscillatory Limiting to Compact Interpolation Schemes*, AIAA Region I Young Prof., Student & Education Conference, Nov 4, 2011, Laurel, MD

o Ghosh, D., Chatterjee, A., *Higher-Order Non-Oscillatory Schemes in 2D Ideal Magneto-hydrodynamics*, 9th Annual CFD Symposium, August 2006, Bangalore, India

o Ghosh, D., Chatterjee, A., *Higher-Order Non-Oscillatory Schemes in Ideal Magneto-hydrodynamics*, 8th Annual CFD symposium, August 2005, Bangalore, India

o Ghosh, D., Vaghela, M.B., Chatterjee, A., *Radar Cross Section Computations for Low Observable Configurations*, 18th National Conference for Aerospace Engineers, Institution of Engineers (I), November, 2004, IIT Kharagpur, India

o Ghosh, D., Vaghela, M.B., Chatterjee, A., *Characteristic Based FVTD Computations for Low Observable Configuration*, 7th Annual CFD symposium, August 2004, Bangalore, India

PROPOSAL AWARDS

o *Interpenetrating Plasma Simulations* (Principal Investigator) – LLNL Laboratory Directed Research and Development Program, ~$650K/yr, 2017 – 2020

O *High-Resolution Methods for Phase Space Problems in Complex Geometries* (Co-Investigator) – DOE Office of Science ASCR Program, ~$900K/yr, 2017 – 2020

PROFESSIONAL ACTIVITIES

o Reviewer
  o *Computers & Mathematics with Applications*
  o *Journal of Scientific Computing*
  o *Journal of Computational Physics*
  o *Journal of Advances in Modeling Earth Systems*
  o *International Journal of Computational Fluid Dynamics*
  o *International Journal of Numerical Methods in Fluids*

- o *International Journal of High Performance Computing Applications*
- o *International Journal of Computer Mathematics*
- o *International Conference for High Performance Computing, Networking, Storage, and Analysis 2017 (SC17)*
- o Member of the *AIAA Atmospheric and Space Environments Technical Committee* (2016 - Present).
- o Conference Session Chair/Co-Chair:
  - o 7th AIAA Atmospheric and Space Environments Conference (Numerical Weather Prediction) (with Dr. Nashat Ahmad, NASA)
  - o SIAM Annual Meeting 2014 (Numerical Methods in PDE VII)
- o Visiting researcher
  - o Scientific Computing Group in the Department of Applied Mathematics, Naval Postgraduate School, Monterey, CA (Host: Frank Giraldo), September 2015.
  - o Numerical Mathematics Group in Computer, Electrical and Mathematical Sciences & Engineering, King Abdullah University of Science and Technology (Host: David Ketcheson), June 2015.
- o Organizer of the LANS Informal Seminar Series at Argonne National Laboratory MCS Division (2013 – 2015).

SCIENTIFIC SOFTWARE CONTRIBUTIONS

- o *PETSc* (Contributor) – Portable, extensible toolkit for scientific computing.
- o *NUMA* (Contributor) – A massively parallel numerical weather prediction code.
- o *COGENT* (Contributor) – A high-order finite-volume solver for tokamak edge simulations.
- o *HyPar* (Developer) – A conservative finite-difference solver for n-dimensional hyperbolic-parabolic PDEs

HONORS AND AWARDS

- o Travel Award to attend the International Conference on Spectral and High Order Methods 2014
- o Graduate Research Assistantship (2008 – 2013) from the Alfred Gessow Rotorcraft Center, Department of Aerospace Engineering, University of Maryland, College Park
- o Block Grant Fellowship (2006 – 2008) from the Dept. of Mathematics, Univ. of Maryland
- o Research Assistantship (2005 – 2006) from Aerospace Engineering, Indian Inst. of Tech. Bombay

TECHNICAL SKILLS

- o Programming Languages: C/C++, FORTRAN, MATLAB
- o High Performance Computing: MPI, OpenMP, HPCToolkit, Alinea DDT
- o Scientific Visualization Software: Tecplot, LLNL Visit
- o Authoring and Publishing Software: Latex, Microsoft Office

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