DEBOJYOTI GHOSH

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SUMMARY

- 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).
- Domain discretization techniques – overset meshes, mapped multi-block grids, immersed boundary methods.
- Applications: external compressible and incompressible flows, atmospheric flows, aerodynamic flows – rotorcraft and flapping wing aircraft, fusion plasma applications.
- High-performance computing – design and implementation of scalable algorithms on HPC platforms, specifically DOE Leadership-class supercomputers.

PROFESSIONAL EXPERIENCE

COMPUTATIONAL SCIENTIST – LAWRENCE LIVERMORE NATIONAL LABORATORY (Livermore, CA) (February 2018 – Present)
Center for Applied Scientific Computing

- High-order numerical methods for fusion plasma applications: Development of computational tools for the simulation of plasmas in fusion devices and related applications, including magnetically confined fusion (MFE) and inertial confinement fusion (ICF).
- IMEX methods for multiscale problems: Efficient implementation of IMEX methods for physics applications with multiple time scales; Example application: kinetic modeling of tokamak-edge plasma dynamics

POSTDOCTORAL RESEARCH STAFF MEMBER – LAWRENCE LIVERMORE NATIONAL LABORATORY (Livermore, CA) (October 2015 – February 2018)
Center for Applied Scientific Computing

- High-order time integration methods for continuum kinetic systems: Implemented implicit-explicit time integration methods in COGENT, a high-resolution finite-volume solver for kinetic models of fusion edge plasmas.
- Multirate semi-implicit time integrators for AMR-based atmospheric flow simulations: Co-developed and tested semi-implicit multirate methods for the efficient and scalable simulation of atmospheric flows.

POSTDOCTORAL APPOINTEE – ARGONNE NATIONAL LABORATORY (Lemont, IL) (February 2013 – October 2015)
Mathematics and Computer Science Division,
and **FELLOW – COMPUTATIONAL INSTITUTE, THE UNIVERSITY OF CHICAGO** (Chicago, IL) (March 2015 – October 2015)

- High-order semi-implicit time integration methods & applications: Co-developed and tested semi-implicit time-integrators for atmospheric flows; implemented IMEX RK 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 discretizatio; derived characteristic-based splitting for efficient semi-implicit time-integration.

RESEARCH ASSISTANT – UNIVERSITY OF MARYLAND (College Park, MD) (Jul 2008 – Jan 2013)
Alfred Gessow Rotorcraft Center, Aerospace Engineering

- 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.

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)
- Computational Machine Learning for Scientists and Engineers, ECE Continuum (University of Michigan), June 2021. (tinyurl.com/x34hzvb9)

REPRESENTATIVE PUBLICATIONS

JOURNAL ARTICLES

- Ghosh, D., Chapman, T. D., Berger, R. L., Dimits, A., Banks, J. W., A Multispecies, Multifluid Model for Laser-Induced Counterstreaming Plasma Simulations, Computers and Fluids, 186, 2019, 38-57, doi:10.1016/j.compfluid.2019.04.012.
- Ghosh, D., Dorf, M. A., Dorr, M. R., Hittinger, J., Kinetic Simulation of Collisional Magnetized Plasmas with Semi-Implicit Time Integration, Journal of Scientific Computing, 77 (2), 2018, 819-849, doi:10.1007/s10915-018-0726-6.
- 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.
- Ghosh, D., Constantinescu, E. M., Well-Balanced, Conservative Finite-Difference Algorithm for Atmospheric Flows, AIAA J., 54 (4), 2016, 1370-1385.
- 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 J. Uncertain. Quant., 3 (1), 2015, 873-896.
- Ghosh, D., Constantinescu, E.M., Brown, J., Efficient Implementation of Nonlinear Compact Schemes on Massively Parallel Platforms, SIAM J. Sci. Comput., 37 (3), 2015, C354–C383.
- Ghosh, D. Medida, S., Baeder, J.D., Application of Compact-Reconstruction WENO Schemes to Compressible Aerodynamic Flows, AIAA J., 52 (9), 2014, 1858-1870.
- Ghosh, D., Baeder, J.D., Compact Reconstruction Schemes with Weighted ENO Limiting for Hyperbolic Conservation Laws, SIAM J. Sci. Comput., 34 (3), 2012, A1678–A1706.
- Ghosh, D., Baeder, J.D., A High-Order Accurate Incompressible Navier Stokes Algorithm for Vortex Ring Interactions with Solid Wall, AIAA J., 50 (11), 2012, 2408-2422.

BOOK CHAPTER

- 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.

PROPOSAL AWARDS

- Interpenetrating Plasmas (Principal Investigator) – LLNL LDRD Program, ~$500K/yr, 2017 - 2020
- High-Resolution Methods for Phase Space Problems in Complex Geometries (Co-Investigator) – DOE Office of Science ASCR Program, ~$900K/yr, 2017 - 2020

PROFESSIONAL ACTIVITIES

- Technical committee member – AIAA Atmospheric and Space Environments (2016 – Present).
- Visiting researcher: Department of Applied Mathematics, Naval Postgraduate School (Host: Francis Giraldo), September 2015; Computer, Electrical and Mathematical Sciences & Engineering, King Abdullah University of Science and Technology (Host: David Ketcheson), June 2015.
- Conference session chair/co-chair: 7th AIAA Atmospheric and Space Environments Conference (Numerical Weather Prediction), SIAM Annual Meeting 2014 (Numerical Methods in PDE VII)
- Reviewer: Comput. Math. Appl., J. Sci. Comput., J. Comput. Phys., J. Adv. Mod. Earth Sys., Int. J. Comput. Fluids Dyn., Int. J. Num. Meth. Fluids, Int. J. High Perf. Comput. Appl., Int. J. Comp. Math, and others.
- Organizer of the LANS Informal Seminar Series at the MCS Division, Argonne National Laboratory (2013 – 2015)

SCIENTIFIC SOFTWARE CONTRIBUTIONS

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

TECHNICAL SKILLS

C/C++, FORTRAN, Julia, Python, MATLAB, MPI, OpenMP, HPCToolkit, Tecplot, LLNL VisIt, Git, SVN

CURRICULUM VITAE

http://debog.github.io/Files/cv_ghosh.pdf

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