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Shashank Jaiswal
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Education

Purdue University, West Lafayette
PhD in Aeronautics and Astronautics,
Focus: Design of numerical schemes, CGPA : 3.89/4.0
AMS: 35L99, 65M05, 76P05, 82B40, 35Q20, 65Y05 ..... May'18 - May'21

MS in Physics and Astronomy,
Major: Quantum Information Science, CGPA: 3.80/4.0 ..... Aug'19 - May'21

MS in Aeronautics and Astronautics,
Major: Aerodynamics, CGPA : 3.88/4.0 ..... Aug'16 - May'18

Indian Institute of Technology (IIT), Hyderabad
B.Tech in Mechanical Engineering (Honors),
Focus: Computational Fluid Dynamics, CGPA : 8.28/10.0 ..... Aug'12 - May'16

Work Experience

Mentor Graphics (Siemens), Wilsonville, OR ..... May'19 - Aug'19
R&D Calibre Design-to-silicon Intern with *Dr. Fedor Pikus (Chief engineering scientist)*
Research in development of quantum algorithms for Electronic Design Automation (EDA) [1][2].

Research interests

Computational Fluid Dynamics, High performance computing, Kinetic theory, Quantum computing, Augmented Reality, Direct simulation Monte Carlo, Finite elements, Rarefied Gas Dynamics.

Skills

Programming: C++, Python, MPI, CUDA, Linux
Scientific computing: Discretization for PDEs, Quantum algorithms, GPGPU computing
Specific Tools: Tensorflow, PyTorch, Unity, Qiskit, OpenFOAM, Git

- Experience with programming in Python, C++ (8+ years)
- Experience with development of numerical schemes for solving partial differential equations (PDE)
- Experience with finite element, isogeometric schemes, multi-physics design, simulation, and analysis
- Experience with PDE based machine-learning models (optimal transport viewpoint)
- Experience with development of quantum algorithms and quantum software stacks
- Experience with parallel computing: MPI, CUDA, OpenMP, pThreads.
- Experience with writing performance portable codes, profiling
- Proficient working in a Linux/UNIX environment; git/subversion, automated build/test systems, testing and release processes

Research Experience

Development of high-performance deterministic full Boltzmann solvers ..... Jan'17 - Present
Research Assistant with *Prof. Alina Alexeenko, and Prof. Jingwei Hu, Purdue University*

Developed the discontinuous Galerkin fast spectral (DGFS) method for solution of full-Boltzmann equation with general collision-kernels on massively parallel CPU/GPU architectures. More specifically, I developed:

a) an $O(N^4 \log N)$ algorithm (fastest known) for general multi-species molecular interactions
b) an efficient, robust, and highly-accurate deterministic method for general 1D/2D/3D flows
c) implemented with demonstrated parallel efficiency of 0.96-0.99 on 36 GPUs for flows involving ∼5 billion unknowns [1]
d) applied these recent theoretical mathematical ideas for actual engineering flow calculations.

For both single/multi species non-equilibrium rarefied flows, this is the first deterministic Boltzmann solver for ***general*** repulsive interactions, including, the well known Variable Soft Sphere model—necessary for simulating flows involving diffusive transport (Project Lead, Sole Developer, Only student involved).

Distinctions

- Awarded **ACM SIGHPC Travel Grant for PASC'19** (1/4 awardees internationally, 1/2 awardees outside EU), 2019.
- At 22, I co-wrote the first **National Science Foundation (NSF CDS&E #1854829)** proposal for ∼ $0.35 million based on my Masters research work, 2018. Purdue University, West Lafayette.
- Awarded **Undergraduate Research Excellence** (among ∼ 1% of the batch), 2016. Indian Institute of Technology, Hyderabad.
- **All India Rank 1335** among ∼ 1.3 million examinees (top ∼ 0.1%), in All India Engineering Entrance Examination (AIEEE), 2012.

Open source codes

dgfs1D: Discontinuous Galerkin fast spectral (https://github.com/jaisw7/dgfs1D_gpu)

A multi-CPU/multi-GPU code for solving single/multi-species 1D-3V full Boltzmann equation. This code achieved a parallel efficiency of 99% on 36 GPUs.

frfs: Flux-reconstructed fast spectral (https://github.com/jaisw7/frfs)

A multi-CPU/multi-GPU code for solving single/multi-species full 3D-3V Boltzmann equation.

Publications

[1] **S. Jaiswal**, J. Hu, J. K. Brillon, and A. A. Alexeenko, *A discontinuous Galerkin fast spectral method for multi-species full Boltzmann on streaming multi-processors,* in *Proceedings of the Platform for Advanced Scientific Computing Conference*, PASC '19 (ACM, 2019) pp. 4:1–4:9.

[2] **S. Jaiswal**, A. A. Alexeenko, and J. Hu, *A discontinuous Galerkin fast spectral method for the full Boltzmann equation with general collision kernels.* Journal of Computational Physics **378**, 178 (2019).

[3] **S. Jaiswal**, A. A. Alexeenko, and J. Hu, *A discontinuous Galerkin fast spectral method for the multi-species Boltzmann equation.* Computer Methods in Applied Mechanics and Engineering **352**, 56 (2019).

[4] **S. Jaiswal**, A. Pikus, A. Strongrich, I. B. Sebastião, J. Hu, and A. A. Alexeenko, *Quantification of thermally-driven flows in microsystems using Boltzmann equation in deterministic and stochastic contexts.* Physics of Fluids **31**, 082002 (2019), [Invited].

[5] **S. Jaiswal**, J. Hu, and A. A. Alexeenko, *Fast deterministic solution of the full boltzmann equation on graphics processing units,* AIP Conference Proceedings **2132**, 060001 (2019).

[6] **S. Jaiswal**, I. B. Sebastião, A. Strongrich, and A. A. Alexeenko, *FEMTA micropropulsion system characterization by DSMC,* AIP Conference Proceedings **2132**, 070006 (2019).

[7] **S. Jaiswal**, I. B. Sebastião, and A. A. Alexeenko, *DSMC-SPARTA implementation of M-1 scattering model,* AIP Conference Proceedings **2132**, 070023 (2019).

[8] A. Pikus, I. B. Sebastião, **S. Jaiswal**, M. Gallis, and A. A. Alexeenko, *DSMC-SPARTA implementation of majorant collision frequency scheme,* AIP Conference Proceedings **2132**, 070026 (2019).

[9] **S. Jaiswal**, R. Reddy, R. Banerjee, S. Sato, D. Komagata, M. Ando, and J. Okada, *An efficient GPU parallelization for arbitrary collocated polyhedral finite volume grids and its application to incompressible fluid flows.* in *23rd IEEE High Performance Computing Workshop* (IEEE, 2016).

[10] S. Holay, R. Reddy, **S. Jaiswal**, and R. Banerjee, *High fidelity simulations of binary collisions of liquid drops.* in *18th Annual Conference on Liquid Atomization and Spray Systems* (ILASS, 2016).

[11] **S. Jaiswal** and N. Dongari, *Implementation of knudsen layer effects in open source cfd solver for effective modeling of microscale gas flows.* in *Proceedings of 1st International ISHMT-ASTFE and 23rd National Heat and Mass Transfer conference* (ISHMT-ASTFE, Kerala, India, 2015)

Patents

[12] F. G. Pikus and **S. Jaiswal**, "Limited basis quantum particle definitions in applications of quantum computing to electronic design automation processes," Patent, Nov. 24, 2020, US Patent 10,846,448.

[13] F. Pikus and **S. Jaiswal**, "Adaptive penalty term determinations in applications of quantum computing to electronic design automation processes." U.S. Patent, Dec, 2019, Filed; Assignee: Mentor Graphics, Wilsonville, OR.