

EDUCATION

Purdue University, West Lafayette

PhD in Aeronautics and Astronautics,

Focus: Design of numerical schemes for PDEs, CGPA : 3.89/4.0 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

Altair Engineering, Troy, MI 17 May'21 - Present

Sr. Software Developer - High Performance Computing

Development of multi-threaded asynchronous event-driven systems for job-scheduling and resource allocation.

Mentor Graphics (Siemens), Wilsonville, OR 6 May'19 - 6 Sep'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

High performance computing, Quantum computing, Augmented Reality, Computational Fluid Dynamics, Finite elements, Numerical methods for PDEs, Numerical relativity.

PATENTS

- [1] F. G. Pikus and **S. Jaiswal**, **Limited basis quantum particle definitions in applications of quantum computing to electronic design automation processes**, (2020), US Patent 10,846,448.
- [2] F. Pikus and **S. Jaiswal**, **Adaptive penalty term determinations in applications of quantum computing to electronic design automation processes**. (2020), US Patent App. 16/688,028

MONOGRAPHS

- [3] S. Jaiswal, *Isogeometric schemes in rarefied gas dynamics context*, **Computer Methods in Applied Mechanics and Engineering** **383**, 113926 (2021).
- [4] S. Jaiswal, *Non-linear Boltzmann equation on unstructured-hybrid non-conforming multi-domains*, **Journal of Computational Physics** (2021), Accepted

SKILLS

Programming: C++, Python, Tcl, MPI, CUDA, Linux

Scientific computing: Discretization for PDEs, Quantum algorithms, Parallel/distributed algorithms

Specific Tools: Tensorflow, PyTorch, Unity, Qiskit, OpenFOAM, ZeroMQ

- Experience with programming in Python, C++ (8+ years).
- 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, JAX.
- 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 writing performance portable codes, profiling (LLVM sanitizers, valgrind, udb, gdb).
- Proficient working in a Linux/UNIX environment; git/subversion/p4, build/test systems, testing/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

Created a numerical scheme, termed discontinuous Galerkin fast spectral (DGFS), for solving full-Boltzmann equation with general collision-kernels on massively parallel CPU/GPU architectures. More specifically:

- a) Developed an $O(N^4 \log N)$ algorithm (fastest known) for solving multi-species Boltzmann collision operator ⁵
- b) Developed an efficient, robust, and highly-accurate deterministic method for general 1D/2D/3D flows ⁶

- c) Implemented and demonstrated a parallel efficiency of 0.96-0.99 on 36 GPUs for flows involving ~ 5 billion unknowns⁷
- d) Applied these theoretical mathematical ideas for solving actual engineering flow problems involving 10^{12} unknowns⁸

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 $\sim \$0.35$ million based on my Masters research work, 2018. Purdue University, West Lafayette.
- Awarded **Undergraduate Research Excellence** (among $\sim 1\%$ of the batch), 2016. Indian Institute of Technology, Hyderabad.
- **All India Rank 1335** among ~ 1.3 million examinees (top $\sim 0.1\%$), in All India Engineering Entrance Examination (**AIEEE**), 2012.

OPEN SOURCE CODES (AS PRINCIPLE DEVELOPER)

- dgfs1D: Discontinuous Galerkin fast spectral** (https://github.com/jaisw7/dgfs1D_gpu) Released: Jan'19
 A multi-CPU/multi-GPU research code for solving single/multi-species 1D-3V full Boltzmann equation. This code achieved a parallel efficiency of 99% on 36 GPUs⁷.
- frfs: Flux-reconstructed fast spectral** (<https://github.com/jaisw7/frfs>) Released: Dec'19
 A multi-CPU/multi-GPU research code for solving single/multi-species full 3D-3V Boltzmann equation.

PUBLICATIONS

- [5] **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).
- [6] **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).
- [7] **S. Jaiswal**, J. Hu, J. K. Brillouin, 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.
- [8] **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].
- [9] **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).
- [10] **S. Jaiswal**, I. B. Sebastião, A. Strongrich, and A. A. Alexeenko, *FEMTA micropropulsion system characterization by DSMC*, **AIP Conference Proceedings** **2132**, 070006 (2019).
- [11] **S. Jaiswal**, I. B. Sebastião, and A. A. Alexeenko, *DSMC-SPARTA implementation of M-1 scattering model*, **AIP Conference Proceedings** **2132**, 070023 (2019).
- [12] 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).
- [13] **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).
- [14] 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).
- [15] **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)