Vignesh Vittal Srinivasaragavan

Doctoral candidate with strong research background in applied mathematics, scalable algorithms and high-performance computing complemented by seasoned software development skills

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🎓 EDUCATION

Rensselaer Polytechnic Institute (RPI)　　　　　*Aug 2017 - Dec 2022 (expected)*
PhD in Mechanical Engineering　　　　　GPA: **3.84/4.00**
Coursework: *Parallel Computing, Machine Learning with Data, Uncertainty Quantification, Inverse Uncertainty Quantification, Finite Element Methods, Computational Fluid Dynamics*

Indian Institute of Technology, Madras (IITM)　　　　　*Aug 2012 - Jul 2017*
B.Tech/M.Tech in Mechanical Engineering　　　　　GPA: **8.38/10.00**
Coursework: *Computational Engineering, Linear Algebra, Differential Equations, Computational Structural Dynamics, Transportation Network Analysis, Fundamentals of Operations Research*

💼 EXPERIENCE

Graduate Research Assistant at **SCOREC, RPI**　　　　　*Aug 2018 - Dec 2022*
- Developed a minimal memory anisotropic structured mesh for a large-scale plasma particle simulator
- Improved allocatable memory for particles in the simulator from 70% to >99% of processor memory
- Designed novel algorithms on anisotropic structured mesh for scalable CPU & GPU performance
- Developed a multi-scale impurity tracking algorithm on unstructured meshes for fusion simulations
- Packaged algorithms into 3 open-source libraries & integrated each with HPC plasma physics codes
- Achieved >100x mesh entity reduction, >30x performance speedups on large-scale fusion simulations
- Collaborated with over 20 research scientists from 4 institutions on the SciDAC PSI2 project

Graduate Teaching Assistant at **RPI**　　　　　*Aug 2017 - May 2018*
- Co-taught classes of 150 students over 2 semesters for a sophmore level Engineering Dynamics course
- Hosted regular technical discussion sessions on kinematics & dynamics coursework and mentored students in dynamic system design and simulation projects

Internship at **General Electric (GE) India Pvt. Ltd**　　　　　*May 2015 - Jul 2015*
- Investigated sources of controllable noise and heat emissions in commercial GE Locomotive engines
- Researched commercial viability of micro-perforated plates as a singular hybrid noise/heat control solution with projected savings of $5000 (customization and installation costs) per engine

⚙️ TECHNICAL SKILLS

Programming	**:** C, C++, Python, MATLAB, Bash
High Performance Computing	**:** Cuda, OpenMP, MPI, Kokkos
Build systems and Toolchains	**:** Cmake, Make, Linux, Git, Github
Documentation and Design	**:** LATEX, Doxygen, Inkscape/Illustrator

📑 RELEVANT PROJECTS

High-performance PIC procedures for anisotropic meshes　　　　　*Jul 2019 - Dec 2022*
Skills/Tools: HPC, C, C++, Kokkos, Python, software development　　　　　*SCOREC, RPI*
- Developed anisotropic block-structured mesh and scalable algorithms for particle-in-cell (PIC) models
- Employed efficient data structures to compactly store the mesh for complex domains -- O(10M) elements with O(100 kB) block-structured mesh vs O(1 GB) unstructured mesh
- Improved allocatable memory for simulation particles to more than 99% of processor rank memory
- Realized >30x runtime speedup for PIC through savings in field-solve on a reduced anisotropic mesh
- Packaged the algorithms into 2 HPC OSS mesh libraries, PUMImbbl-GPU & PUMImbbl
- Integrated the libraries into massively parallel PIC simulator codes and demonstrated scalability (weak & strong scaling) with about 3.2 billion particles on upto 64 GPUs

Unstructured mesh-based plasma impurity transport simulations *Sep 2020 - Dec 2022*
Skills/Tools: HPC, C++, Kokkos, MATLAB, Python, Paraview *SCOREC, RPI*

- Devised a robust unstructured mesh control workflow for novel device-scale impurity transport simulations of fusion tokamaks including asymmetrical geometries
- Led the developments in unstructured mesh capabilities for a first-of-its-kind scalable 3D plasma impurity transport simulator
- Developed a GPU-performant unstructured mesh particle tracking HPC OSS library, GITRm-Sheath, and integrated into the impurity transport code for multi-physics coupling
- Demonstrated effectivity of the multi-physics coupling through weak scaling studies with about 1.5 billion particles on up to 144 GPUs

Virtual simulation environment for serial manipulators *Aug 2015 - May 2016*
Skills/Tools: MATLAB, Simulink, SolidWorks, Dynamic analysis *IIT Madras*

- Reverse engineered a defunct 5 arm robot & performed dynamic analysis for end-effector path traversal
- Designed torque control modules for robot arms to ensure precise/accurate path adherence for minimally invasive orthopeadic surgery applications
- Integrated above control algorithms in MATLAB-Simulink with realistic 3D model in ADAMS and demonstrated path adherence upto 0.5% error i.e., upto 0.5mm error on 1m adult limb

SOFTWARES

- **PUMI-MBBL-GPU**
  GPU-performant anisotropic structured mesh HPC library for PIC codes *C++, OOP, HPC*
- **GITRm-Sheath**
  GPU-performant unstructured mesh based particle-tracking HPC library *C++, OOP, HPC*
- **PUMI-MBBL**
  An implicit anisotropic structured mesh library for HPC PIC codes *Modern C, Python*

PUBLICATIONS

- A multi-block implicit non-uniform mesh approach for particle-in-cell schemes
  ***Vittal-Srinivasaragavan**, Huq, Sahni, Curreli* *(under review) J. Comp .Physics 2022*
- An unstructured mesh 3D PIC code for impurity transport in fusion tokamaks
  *Nath, **Vittal-Srinivasaragavan**, et al* *(under review) J. Comp .Physics 2022*
- hPIC2: a hardware-accelerated, hybrid particle-in-cell code for plasma-material interactions
  *Meredith, Rezazadeh, Huq, **Vittal-Srinivasaragavan**, et al* *(under review) CPC 2022*
- ADAMS-MATLAB co-simulation of a serial manipulator
  ***Vittal-Srinivasaragavan**, Parthasarathy, Santhanakrishnan* *ICMME 2016*

ACHIEVEMENTS

- Ranked in **top 1%** in IIT-JEE 2012 (over 0.5 million applicants)
- Ranked in **top 1%** in AIEEE 2012 (over 1.2 million applicants)
- Qualified for Indian National Maths Olympiad 2011 (Among **top 500** in India)