Aashish Goyal

Ph.D. Candidate, University of British Columbia

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SUMMARY

A final-year Ph.D. candidate working to develop fast and scalable code in order to solve non-linear Partial Differential Equations (mass, momentum, and energy equations) for flows laden with non-spherical rigid bodies and complex geometries. Specialized in scientific computing, programming, and transport phenomena with applications to food, pharmaceutical, and oil-gas industries. Over 8 years of experience in high-performance code development in C/C++ and FORTRAN.

EDUCATION

DOCTOR OF PHILOSOPHY   Sep 2019-present
Chemical and Biological Engineering, University of British Columbia (UBC)

MASTER OF TECHNOLOGY   May 2014-Jul 2015
Chemical Engineering, Indian Institute of Technology Kanpur (IITK)

BACHELOR OF TECHNOLOGY   Aug 2010-Apr 2014
Chemical Engineering, Indian Institute of Technology Kanpur (IITK)

TECHNICAL SKILLS

Fundamental Proficiencies: Scientific computing, Fluid mechanics, Particle-laden flows, Discrete Element Methods, Molecular Dynamics, Direct Numerical Simulations, Computational Fluid Dynamics (CFD)
Programming Languages: C/C++, FORTRAN, Python, Java, SQL, Julia, Bash
Computer Programs: MATLAB, OpenMPI/OpenMP, GIT
Platforms: Windows, Linux, High-Performance Computing (HPC), Cloud Computing
Softwares: Ansys Fluent, Autodesk Inventor, Ansys Spaceclaim, OpenFOAM, LIGGGHTS, MS office, VScode

ACADEMIC WORK EXPERIENCE

GRADUATE RESEARCH ASSISTANT, UNIVERSITY OF BRITISH COLUMBIA   Sep 2019-present
Supervisor: Dr. Anthony Wachs
- Developed fast and scalable code in **C/C++** to solve complex non-linear **Partial Differential Equations**
- Deployed the code on **High-Performance Computing** (HPC) platforms and proved its scalability up to **7000 cores**
- Designed the framework using **object-oriented programming** for extensive modularity, inheritance, and adaptability
- Collaborated and guided researchers to extend the code to solve other challenging flow problems with **complex geometries** and deformable **Red Blood Cells**
- Developed a **Fourier Predictive Model** to determine the force modulations on a binary sphere system near a wall
- Designed probability and **machine learning** models to predict the hydrodynamic interactions on non-spherical particle suspension

WORK-INTEGRATED LEARNING, MATH^INDUSTRY WORKSHOP ([M2PI.CA](m2pi.ca))   Jul 2023
- Participated in a green-themed workshop aimed at solving problems related to clean energy and clean technology
- Analyzed **carbon emissions** from wood burning, automobiles, and wood processing machinery
- Developed a fundamental mathematical model in Python to calculate the release of **toxic gas emissions** from burning
- Quantified monetary gains for the industry (**Innovatree Carbon Group**) to use the wood for power generation

Graduate Teaching Assistant, University of British Columbia   Sep 2020-Apr 2023
- Instructed **250 students** in Python for the application of **computational methods**
- Designed the problem statements for tutorials to help students understand the course efficiently
- Introduced regular questionnaires and quizzes to enhance the practical learning of numerical methods
- Managed students concerns and requests to provide effective, timely, and appropriate feedback to support student's learning

Graduate Research Assistant, Indian Institute of Technology Kanpur   Jan 2014-Jun 2015
Supervisor: Dr. Pankaj Apte
- Developed a **Molecular Dynamics** simulation on **FORTRAN** for the phase transition of Silicon (Si) from a supercooled state to an amorphous state
- Implemented mathematical techniques such as **Fourier Transform** to detect alterations in Si vibrational frequency
- Confirmed a unique dynamic equilibrium point with the sharp increase in four-coordinated Si molecules

Industry Work Experience

Project Engineer, Tridiagonal Solutions   Dec 2015-Jun 2018
Supervisor: Dr. Mothivel Mummudi
- Built computational models for solid handling processes using **fluid mechanics**, granular physics, and data analysis
- Developed a standard operating procedure to model the processes, including **particle tumbling**, **coating**, and **drying**
- Enabled industries to conduct **design of experiments** and optimize process operations using the projects below
- Received **outstanding performance** award for efficient project execution and innovative solutions in 2016 and 2017

Summer Intern, Reliance Industries Limited   May 2013-Jul 2013
- Analyzed the drying of Poly Vinyl Chloride (PVC) to increase the plant production from **13.5MT** to **22MT**
- Developed a mathematical model using the first principle of PVC drying taking environmental impacts into account
- Integrated plant data in the model to optimize the design parameters and operating conditions
- Recommended modifications for the Debottlenecking of the PVC plant to increase plant production by **60%**

Scientific Computing Projects for Industry

SuDEM: Speed-Up of DEM simulations   Jan 2018-Jun 2018
- Developed a framework to simulate large-scale processes using Eulerian flow fields along with discrete modeling steps to simulate granular media in LIGGGHTS framework.
- Implemented the model on factory-scale equipment and reduced the computing time by 90%.

Hybrid Modelling of Sand Transport in Oil Industry   Jul 2017-Dec 2017
- Developed a model for the particle suspension in turbulent flow in a pipe based on stochastic models
- Created an interface to couple two open-source platforms for particle and flow modeling, respectively
- Correctly computed the quantitative behavior of flow for the sand cluster movement and re-suspension

On-The-Fly Data Processing and Optimization   Dec 2016-Jun 2018
- Developed a generalized framework for data processing to run in parallel with the simulations
- Eliminated humongous post-simulation data and reduced the overall process time.
- Enabled the users to control the process parameters during the execution of simulation in LIGGGHTS

Liquid Coating on Granular Particles for Food and Pharma Industry   Dec 2015-Jun 2018
- Developed a FORTRAN code to model spray coating, liquid transfer, and moisture evaporation
- Parallelize the computational model by using OpenMPI which reduced the computing time by 80%
- Recommended operating conditions for industries to optimize operation time and energy consumption

PUBLICATIONS AND CONFERENCES

PUBLICATIONS

- **Aashish Goyal,** Gai Guodong, Zihao Cheng, and Anthony Wachs, "Flow past a random array of statistically homogeneously distributed stationary Platonic polyhedrons: Data analysis, Probability maps, and PINN model", **In Preparation** for submission to **International Journal of Multiphase Flows**
- **Aashish Goyal,** Jean-Lou Pierson, and Anthony Wachs, "Pairwise hydrodynamic interaction of two spheres in a wall-bounded linear shear flow near a wall and another sphere", **Submitted** for review to **International Journal of Multiphase Flows**
- **Aashish Goyal** and Anthony Wachs, "An accurate and scalable direction-splitting solver for flows laden with non-spherical rigid bodies - Part 2: moving rigid bodies", **Submitted** for review to **Computers and Fluids**
- **Aashish Goyal** and Anthony Wachs, "An accurate and scalable direction-splitting solver for flows laden with non-spherical rigid bodies - Part 1: fixed rigid bodies", **In Press** in **Communication in Computational Physics**
- Antoine Morente, **Aashish Goyal** and Anthony Wachs, "A Highly Scalable Direction Splitting Solver on Regular Cartesian Grid to Compute Flow in Complex Geometries Described by STL files", **Fluids** 2023, Link
- A.K. Gautam, Nandlal Pingua, **Aashish Goyal** and P.A. Apte, "Dynamical instability causes the demise of a supercooled tetrahedral liquid", **Journal of Statistical Physics** 2017, Link

CONFERENCES

- **Aashish Goyal** and Anthony Wachs, "A fast and highly scalable Direction splitting algorithm to solve momentum and heat transfer in flow laden with non-spherical rigid bodies", ICNMMF-4 2022, Link
- Antoine Morente, A. Asuri Mukundan, **Aashish Goyal** and Anthony Wachs, "Blood flow in Capillary Networks", APS-DFD 2022, Link
- A. Asuri Mukundan, Antoine Morente, **Aashish Goyal** and Anthony Wachs, "A 3D numerical membrane model for simulating red blood cells (RBC) dynamics and transport", APS-DFD 2022, Link
- **Aashish Goyal** and Mothivel Mummudi, "Smart Strategies for DEM modeling of industrial processes", CFDEM conference 2017
- Harshavardhan Babu, **Aashish Goyal**, Tukaram Suryawanshi and Mothivel Mummudi, "Accelerated Process Innovation through Hybrid Computational Modeling", AIChE 2017, Link

LEADERSHIP SKILLS

CLUSTER ADMINISTRATOR, COSMOS LAB, UNIVERSITY OF BRITISH COLUMBIA   Aug 2020-present
- Managing the cluster to process and visualize big simulation data for all users
- Defined the standard procedure for data management from the start to the end of a certain project
- Documented guidelines on Gitlab wiki to setup and run remote visualization on clusters

MAINTAINER, GITLAB REPOSITORY, COSMOS LAB, UNIVERSITY OF BRITISH COLUMBIA   Jan 2020-present
- Responsible for maintaining best practices for writing code and merging it into the master branch
- Defined the structure of an object-oriented framework for easy integration of code from multiple developers
- Created a Gitlab wiki repository to collaborate with users to document the installation instructions, test cases, and guidelines to submit jobs on HPC platforms

HEAD, ROBOCON, IIT KANPUR   Sep 2012-Mar 2013
- Led a 3-tier team of 50 members to represent IITK at the National round of Asia-Pacific robotics competition
- Pitched the competition to unaware senators and professors, leading to a two-fold increase in the funding
- Introduced new fabrication and actuation methods that were readily adopted by the campus community for their projects
- Qualified among the Top 15 participants out of ~100 teams in India, and received the best design award the next year