Mohammad Mehedi Hasan Akash, PhD
Postdoctoral Fellow in Mechanical Engineering
Joint College of Engineering
Florida A&M University - Florida State University, USA

☎605-651-5096 makash@fsu.edu
LinkedIn | Google Scholar

Research Interests

Focus: Computational Fluid Dynamics (CFD) modeling for multiphase, and turbulent flows; Quantum Computing in Fluid Mechanics
Specific Interests: Fluid Structure Interaction (FSI), BioFluid modeling, Multiphase modeling, Hemodynamics modeling using CFD

Research Experience

Postdoctoral Fellow 07/2025-
Computational and Theoretical Multiphysics Laboratory
Department of Mechanical Engineering, Joint College of Engineering
Florida A&M University - Florida State University, USA
Supervisor: Dr. Kourosh Shoele

Project 1: Fluid–Structure Interaction (FSI) — Investigating drag-reduction mechanisms inspired by dolphin skin using high-fidelity simulations (code is written in FORTRAN). Leveraged High-Performance Computing (HPC) resources, coupling CCNS (fluid solver) with TAHOE (solid solver).
Project 2: Quantum-Based Multiscale Turbulence Modeling — Developing quantum algorithms for homogenized multiscale simulations of turbulence, and using quantum simulator (QISKIT)

Postdoctoral Fellow 04/2025-07/2025
Computational and Theoretical Multiphysics Laboratory
Department of Mechanical Engineering, Florida State University
Supervisor: Dr. Kourosh Shoele

Project: Fluid–Structure Interaction (FSI) — Investigating drag-reduction mechanisms inspired by dolphin skin using high-fidelity simulations (code is written in FORTRAN). Leveraged High-Performance Computing (HPC) resources, coupling CCNS (fluid solver) with TAHOE (solid solver).

Graduate Research Assistant 01/2021 -04/2025
Research Topic: Modeling multiphase blood flow inside tumor microenvironment and CFD in respiratory airways - targeted drug delivery
Supervisor: Dr. Saikat Basu
Department of Mechanical Engineering, South Dakota State University, USA
Software used in PhD and MS : ANSYS Fluent, ICEM, Workbench, Multiphase simulation using Euler from ANSYS Fluent with **User Defined Function (UDF)**

Education

Ph.D. in Mechanical Engineering

South Dakota State University, Brookings, SD, USA 01/2021 - 04/2025
Supervisor: Dr. Saikat Basu
Focus: Multiphase flow in complex biological systems

PhD Dissertation Title: Modeling Fluid Flow in Complex Biological Systems: Implications for Dense Tumor Microenvironments, Metastasis, and Bone Cancer | Link

M.S. in Mechanical Engineering

South Dakota State University, Brookings, SD, USA 01/2021 - 05/2023
Supervisor: Dr. Saikat Basu
Focus: Drug delivery and viral infection dynamics

M.S. Thesis Title: Modeling of Transport in Anatomic Respiratory Airways: Applications in Targeted Drug Delivery and Airborne Pathogenic Transmissions | Link

M.Sc. in Mechanical Engineering

Bangladesh University of Engineering and Technology, Dhaka, Bangladesh 08/2018 - 12/2020
Specialization: Application of Fluid Dynamics

B.Sc. in Mechanical Engineering

Bangladesh University of Engineering and Technology, Dhaka, Bangladesh 02/2013 - 07/2018
Specialization: Application of Fluid Dynamics

Funding and Grantsmanship

NSF ACCESS Allocation| MCH250066
Turbulent Flow Interaction with Flexible Branched Canopies
Period: 10/2025 - 09/2026 | Estimated Award Amount : $25,372 | Role : Co-PI (written the proposal)
Award Resources: SDSC Expanse Projects Storage: 40,000.0 GB
SDSC Expanse CPU: 5,312,000.0 Core-hours

Publications and Presentations

Peer-reviewed journal publications

Note Underline denotes students supervised by Dr. Akash | * = Akash is corresponding author

9. **MMH Akash***, M Yeasin, S Mahmoudirad, RA Niloy, J Mohammad, K Reindl, A Pandey, S Basu
   Reduced-order modeling of solute transport within physiologically realistic solid tumor microenvironment
   Frontiers in Pharmacology 17: 1746751.

8. M Yeasin, **MMH Akash**, A Malakar, AA orojeni, A Tummala, J Wu, WD Bennett, WM Bodnar, JS Kimbell, A Chakravarty, and JR Port, S Basu
   Decoding the mechanophysiology for inhaled onset of smallpox with model-based implications for mpox spread
   Scientific Reports. 2025 Dec 14.

7. MT Hossain, A Malakar, M Yeasin, W O'Connell, **MMH Akash** , AA Borojeni, A Samanta, G Williams, J Reineke, G Farias,S Jung, J Suman, S Basu.
   Mechanics-guided parametric modeling of intranasal spray devices and formulations for targeted drug delivery to the nasopharynx
   Frontiers in Drug Delivery. 2025 Dec 12;5:1721960

6. A-B Merife, A Poudel, A Polshchikova, Z Geffert, **MMH Akash**, D Fougnier, J Horton; S Basu, A Pandey, P Soman
   3D osteocyte networks under Pulsatile Unidirectional Fluid Flow Stimuli (PUFFS)
   ACS Biomaterials Science Engineering, accepted, **2025**

5. **MMH Akash**, N Chakraborty, J Mohammad, K Reindl, S Basu
   Development of a multiphase perfusion model for biomimetic reduced-order dense tumors
   Experimental and Computational Multiphase Flow, Volume 5, **2023**

4. **MMH Akash**, Y Lao, PA Balivada, P Ato, NK Ka, A Mituniewicz, Z Silfen, J Suman, A Chakravarty, D Joseph-McCarthy, S Basu
   On a model-based approach to improve intranasal spray targeting for respiratory viral infections
   Frontiers in Drug Delivery, Sec. Respiratory Drug Delivery, Volume 3, **2023**

3. J Yuk, **MMH Akash**, A Chakraborty, S Basu, LP Chamorro, S Jung
   Morphology of pig nasal structure and modulation of airflow, thermal conditioning, and olfactory functionality
   Integrative and Comparative Biology, Volume 63(2), **2023**

2. S Basu, **MMH Akash**, NS Hochberg, BA Senior, D Joseph-McCarthy, A Chakravarty
   From SARS-CoV-2 infection to COVID-19 morbidity: an in silico projection of virion flow rates to the lower airway via nasopharyngeal fluid boluses
   Rhinology Online, Volume 5, 10–18, **2022**

Preprints

1. ML Tesch, A Malakar, SAA Rizvi, **MMH Akash**, G Ferrer, S Basu
   Enhancing intranasal therapeutic penetration for treating respiratory illness: A clinical human factor feasibility study preprints.org, Link, 2023
   submitted to Journal of Patient Experience

Peer-reviewed Conference Articles

1. M Yeasin, **MMH Akash**, A Malakar, A Chakravarty, S Basu
   On modeling the mechanics of smallpox transmission through inhaled pathogens in respiratory domains
   International Congress of Theoretical and Applied Mechanics (ICTAM), August 2024, Daegu, Korea

Conference Oral Presentations

Note: Lead author is the presenter

13. **MMH Akash**, T Dev, Q Nguyen, Y Chen, H Wu, & K Shoele
    Quantum-Classical Hybrid Time-Marching Algorithm for a Linear Viscous Transport Model.
    Florida Fluid Symposium V, May 2026, Gainesville, FL, USA

12. **MMH Akash**, T Dev, Q Nguyen, Y Chen, H Wu, & K Shoele
    Quantum–Classical Iterative Homogenization Framework for Linear Multiscale Physical Systems.
    American Physical Society (APS) Joint March Meeting and April Meeting - Global Physics Summit 2026, Denver, CO, USA

11. Q Nguyen, **MMH Akash**, T Dev, K Shoele, H Wu, & Y Chen
    Variational Spacetime Simulation of the 1D Burgers Equation.
    American Physical Society (APS) Joint March Meeting and April Meeting - Global Physics Summit 2026, Denver, CO, USA

10. **MMH Akash**, Q Nguyen, Y Chen, H Wu, & K Shoele
    Toward Quantum-Native Multiscale Frameworks for Turbulent Flow Simulation.
    American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2025, Houston, TX, USA.

9. **MMH Akash**, M Yeasin, A pandey and S Basu
   Physics-Based Modeling of Transport Phenomena in Biological and Bioinspired Systems
   Florida Fluid Symposium IV, May 2025, Tampa, FL, USA

8. **MMH Akash**, M Yeasin, P Ran, A Merife, A Pandey, P Soman and S Basu
   Modeling transport in physiologically realistic tumor microenvironment
   American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2024, Salt Lake City, UT, USA

7. M Yeasin, **MMH Akash** and S Basu
   Smallpox revisited: A mechanics-based model for its inhaled transmission
   American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2024, Salt Lake City, UT, USA

6. **MMH Akash**, S Basu
   Computational modeling of multiphase transport in physiologically realistic solid tumor vasculature and intratumoral domains
   American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2023, Washington DC, USA

5. AAT Borojeni, **MMH Akash**, A Malakar, S Basu
   An integrative modeling platform for smallpox transmission via respiratory routes
   American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2023, Washington DC, USA

4. **MMH Akash**, Z Silfen, D Joseph-McCarthy, A Chakravarty, S Basu
   Can Machine Learning predict particle deposition at specific intranasal regions based on computational fluid dynamics inputs/outputs and nasal geometry measurements?
   SDSU Data Science Symposium, February 2023, Brookings, SD, USA

3. **MMH Akash**, A Tummala, S Basu
   When fluid mechanics meets virology: revisiting smallpox – a modeling framework for its airborne transmission
   American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2022, Indianapolis, IN, USA

2. Z Silfen, **MMH Akash**, M Cherepashensky, A Chakravarty, S Basu, D Joseph-McCarthy
   In Silico Prototyping for Intranasally Administered Agents for COVID-19 and Other Respiratory Pathogens
   APS April Meeting, April 2022, New York, NY, USA

1. **MMH Akash**, A Mituniewicz, Y Lao, P Balivada, P Ato, N Ka, Z Silfen, A Chakravarty, D Joseph-McCarthy, S Basu
   A better way to spray? – a model-based optimization of nasal spray use protocols
   American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2021, Phoenix, AZ, USA

Poster Presentations

7. **MMH Akash**, T Dev, Q Nguyen, Y Chen, H Wu, & K Shoele
   A Fully Coherent Quantum Simulation of Nonlinear Transport Equation
   Florida Quantum Conference, April 2026, Tallahassee, FL, USA

6. T Dev, **MMH Akash**, Q Nguyen, Y Chen, H Wu, & K Shoele
   Quantum-Inspired Tensor Networks for Three-Dimensional Turbulence
   Florida Quantum Conference, April 2026, Tallahassee, FL, USA

5. Q Nguyen, **MMH Akash**, K Shoele, Y Chen, & H Wu
   Quantum Variational Simulation of the One-Dimensional Burgers Equation.
   Florida Quantum Conference, April 2026, Tallahassee, FL, USA

4. **MMH Akash**, M Yeasin and S Basu
   Integrative modeling of solute transport phenomena in solid tumor microenvironments bridging computational and theoretical fluid dynamics
   SDSU Graduate Research, Scholarship and Creative Activity Day (GRSCAD) symposium, April 2024, Brookings, SD, USA

3. **MMH Akash** and S Basu
   Theoretical and computational fluid mechanics modeling for transport in dense tumors
   American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2023, Washington DC, USA

2. **MMH Akash** and S Basu
   Computational and theoretical fluid mechanics modeling for transport in dense tumors
   NIH-NIGMS The Centers of Biomedical Research Excellence (COBRE) Symposium, July 2023, Fargo, ND, USA

1. **MMH Akash**, N Chakraborty, S Basu
   A multiphase tracking of perfusion through in silico dense tumor domain
   American Physical Society (APS) Division of Fluid Dynamics (DFD) Annual Meeting, November 2021, Phoenix, AZ, USA

Teaching Experience

- As **solo Instructor during Ph.D. years** (Department of Mechanical Engineering, South Dakota State University)
  - Vibration
    - Semester: Spring 2023
    - Course: ME 303; class-size 30 students
    - Duties: Classroom instruction, developing lectures & exams, grading exams, supervising teaching assistant
  - Vibration
    - Semester: Fall 2022
    - Course: ME 303; class-size 27 students
    - Duties: Classroom instruction, developing lectures & exams, grading exams, supervising teaching assistant
- As **Graduate Teaching Assistant** Engineering Mechanics in Biomedical Applications (ME 546/446; Fall 2023)
    - Duties: Grading assignments

Computational Resources

- High-Performance Computing (HPC) for Computational Fluid Dynamics (CFD) - split MPI

- Scientific Software – ANSYS Fluent, ICEM CFD, Quirk, Simulink, SolidWorks, CFD-POST, FieldView, Workbench

- Scripting Languages – Wolfram Mathematica, MATLAB, ANSYS-APDL
- Programming Languages – C
- Documentation / Graphics – LaTeX, Adobe Illustrator, Inkscape, ImageJ

Professional Experience

Postdoctoral Fellow 2025-
Graduate Research Assistant 2023 - 2025
Graduate Teaching Assistant-Instructor 2022 - 2023
Graduate Research Assistant 2021 - 2022
Department of Mechanical Engineering, South Dakota State University

Awards, Fellowships, & Grants

2022 Travel Grant, American Physical Society (APS)
2022 Bangladesh Sweden Trust Fund
2012 Higher Secondary Educational General Scholarship, Bangladesh Educational Board
2009 Primary General Scholarship, Bangladesh Educational Board

Media Coverage

- On **The Brookings Register**, dated 1-May-2023; News Link
  Basu Lab applies fluid mechanics modeling to cancer research at South Dakota State University
  Caption: Mohammed Mehedi Hasan Akash, a Ph.D. candidate at South Dakota State University, working with Saikat Basu, an assistant professor in the Department of Mechanical Engineering, on a project.

- On **The Brookings Register**, dated 11-February-2022; News Link
  Inhaling virus-laden droplets may increase COVID-19 severity
  Caption: Using a model of the upper airway, doctoral student Mohammad Mehedi Hasan Akash, left, and assistant professor Saikat Basu of South Dakota State University's Department of Mechanical Engineering discuss adjustments to a computational aerosol transport model of how the novel coronavirus may spread from the nasopharynx into the lungs via aspiration of virus-laden droplets or boluses. Their results are published in Rhinology Online

Mentorship

- **Middle / High School outreach and other related activities (at SDSU)**

  1. SoDAK HUMANS CAREER Education Outreach (2024)
  2. Dakota Dreams Summer Camp for middle school students (2022, 2023)
  3. Youth Engineering and Technology Summer Camp for high school students (2023)

- U.G. student (2021): M. Diab | Topic: Modeling particle filtration in face masks
- High school student (Summer 2022): A Tummala

Experimentation Experience

- Performed table-top experiments testing liquid media penetration in 3D-printed nasal cavity casts
- Experimented with a setup that I independently designed and arranged, administering sprays into a 3D-printed nasal cast at various angles to the horizontal to reflect common nasal spray usage guidelines

Service

- **Manuscript Reviewer:**
    1. PLOS One
    2. Frontiers in Bioinformatics
- Member (08/2022 – Present): Biomedical Engineering Society (BMES) Chapter at SDSU
- President (02/2022 - 05/2023): Bangladesh Student Association (BDSA) at SDSU

References

Dr. Saikat Basu
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Mechanical Engineering
South Dakota State University
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Dr. Kourosh Shoele
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Associate Professor
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Dr. Pranav Soman
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Professor
Biomedical and Chemical Engineering
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