Dr. Md. Mizanur Rahman

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CAREER PROFILE

- PhD-qualified researcher in Mechanical Engineering and Applied Mathematics with 14+ years of academic and applied research experience across Australia and Bangladesh.
- Independent researcher specialising in computational fluid dynamics (CFD), aerosol transport, particle deposition, multiphase flow, artificial intelligence, scientific machine learning and respiratory environmental health modelling.
- Author/co-author of 20+ peer-reviewed journal articles, including publications in International Journal of Multiphase Flow, Powder Technology, Physics of Fluids, Scientific Reports and Results in Engineering.
- Experienced in research leadership, competitive grant management, international collaboration, scientific communication and postgraduate supervision.
- No significant career interruption: continuous academic and research engagement through doctoral training, research appointments and current faculty position

EDUCATION

2023	**PhD Mechanical Engineering:** Western Sydney University, Australia. Thesis: Numerical Modelling of Airflow Dynamics and Particle Deposition in Human Lungs Scholarships: Australian Government RTP and WSU Postgraduate Research Scholarship
2009	**MSc Applied Mathematics:** Khulna University, Bangladesh CGPA 3.96/4.00 (High Distinction) Thesis: Numerical Analysis and Mathematical Modelling of the General Index of DSE using Wavelet Function
2007	**BSc (Honours) Mathematics:** Khulna University, Bangladesh (2007) CGPA 3.61/4.00

EMPLOYMENT HISTORY

2023-present	Associate Professor, Department of Mathematics, Islamic University, Bangladesh
2023-present	Adjunct Research Fellow, School of Engineering, Design & Built Environment, Western Sydney University, Australia
2019-2022	Casual Lecturer, Western Sydney University, Australia
2015-2019	Assistant Professor, Department of Mathematics, Islamic University, Bangladesh
2012-2015	Lecturer in Mathematics, Islamic University, Bangladesh
2011-2012	Lecturer, Bangladesh University of Business & Technology, Bangladesh
2022	Research Assistant, School of Engineering, Design & Built Environment, Western Sydney University, Australia

INNOVATION / COMMERCIALISATION ACTIVITY

- Developed computational frameworks for respiratory particle transport, aerosol deposition, microplastic inhalation assessment and health-risk modelling with potential applications in environmental health, biomedical engineering and drug delivery.
- Current KAUST Global Fellowship concept proposes an Aerosol-to-Lung Digital Twin combining aerosol characterisation, respiratory CFD, physics-guided AI and uncertainty quantification for dose prediction.

HISTORY OF MENTORING AND SUPERVISION

- Supervises PhD and MPhil researchers within Professor Ming Zhao's research environment at Western Sydney University.
- Supervises undergraduate and postgraduate research projects at Islamic University, Bangladesh.
- Mentors students in mathematical modelling, CFD, biomedical engineering applications and computational research methodology.

KEY ACHIEVEMENTS (RESEARCH AND IMPACT)

Achievement 1: Realistic respiratory CFD frameworks for aerosol exposure assessment

Role: Developed CFD-DPM models integrating realistic airway geometry, particle properties, breathing conditions and deposition mechanisms.

Impact: Improved understanding of regional pollutant deposition and respiratory exposure risks beyond conventional PM concentration assessment.

Achievement 2: International contributions in aerosol science and biomedical modelling

Role: Produced research outputs on aerosol transport, particle deposition, microplastic inhalation, nanoparticle behaviour and drug delivery.

Impact: Advanced interdisciplinary research connecting computational engineering, environmental health and biomedical applications.

Achievement 3: Independent research leadership and competitive funding

Role: Led and contributed to eight funded research projects as Project Director, Principal Investigator and Supervisor.

Impact: Demonstrated capacity to establish independent research directions in environmental health and computational science.

Achievement 4: AI-enabled computational health research

Role: Applied AI and advanced computational methods to biomedical and health-related problems.

Impact: Supported the development of physics-guided AI approaches, including the proposed Aerosol-to-Lung Digital Twin.

Achievement 5: Research communication and collaboration

Role: Presented research internationally and contributed to interdisciplinary collaborations.

Impact: Strengthened knowledge exchange across engineering, mathematics, environmental science and health research.

SELECTED RESEARCH GRANTS

Period	Role	Project (condensed)	Agency	Value
2023-24	Project Director	Microplastic particle deposition in the human lung: health impacts from hazard and air pollution	Islamic University/UGC Special	BDT 175,000
2023-24	Principal Investigator	Age-specific aerosol particle inhalation as targeted drug delivery in human lungs	UGC research project	BDT 300,000
2024-25	Principal Investigator	Microplastic inhalation in the human respiratory system: modelling health impacts from hazardous environment	Ministry of Science & Technology	BDT 500,000
2024-25	Project Director	Aerosol particle inhalation as targeted drug delivery in age-specific human lungs	Islamic University/UGC	BDT 210,000
2024-25	Principal Supervisor	Thermal performance of heat exchangers with phase-change materials	Islamic University/UGC student project	BDT 70,000
2024-25	Principal Supervisor	Optimal control model for reducing dengue transmission in Bangladesh	Islamic University/UGC student project	BDT 70,000
2025-26	Principal Supervisor	Mathematical model for tuberculosis transmission dynamics and control strategies	Islamic University/UGC student project	BDT 60,000

Period	Role	Project (condensed)	Agency	Value
2025-26	Principal Supervisor	Mathematical Model Development for Tuberculosis Transmission Dynamics in Bangladesh	National Science & Technology Fellowship	BDT 54,000

SELECTED PUBLICATIONS

Selected primary research outputs:

1. **Rahman, M.M.,** Hye, M.A., Miah, M.S., Islam, R. and Hossain, M.S., 2026. Insights and implications of a dynamical systems approach to dengue transmission and epidemic behaviour. Scientific Reports, **16**, 8191(2026), (**Q1, IF = 3.9, Springer Nature**). https://www.nature.com/articles/s41598-026-38445-3
2. Roknujjaman, M., **Rahman, M.M.,** Rahman, M.M., Hasan, M. M., Baki, A. B. M., Zhao, M., 2026. Pulsatile flow dynamics in biomedical engineering: A comprehensive review of methods and applications. Physics of Fluids, 38(3), 031302, **(Q1, IF = 4.3, AIP)**. https://doi.org/10.1063/5.0318753
3. Zerin, R.I., Hossain, M.K., Rashid, H., Tasnim, S., Ali, M.J., **Rahman, M.M.,** Maniruzzaman, M. and Islam, R., 2026. Integrated spatial analysis and Gaussian dispersion modelling of airborne particulate matter from rice processing mill hubs in rural Bangladesh and associated public health risks. Environmental science and pollution research, PMID:42484793, **(Q1, IF = 5.8, Springer Nature).** https://doi.org/10.1007/s11356-026-38036-9
4. Miah, M.S., Hye, M.A., Hossain, M.S. and **Rahman, M.M.,** 2025. Optimal-Control Techniques for Managing Dengue Outbreaks: An Advanced Mathematical Modeling. Natural Sciences, p.e70035(**Q1, IF = 3.1, Wiley)**. https://doi.org/10.1002/ntls.70035
5. Roknujjaman, M., **Rahman, M.M.,** Chowdhury, M.S.A., Uddin, M.B., Khatun, R. and Zhao, M., 2025. Pulsatile flow in elastic tubes: A literature review of experimental techniques, flow behavior, and biomedical applications. Physics of Fluids, 37(10), 101305, **(Q1, IF = 4.3, AIP)**. https://doi.org/10.1063/5.0291574
6. Al Mashud, M.A., Kumer, A., Jahan, I., Somrat, M.M.H., Talukder, M.E.K., Rahman, M.M., Uddin, A.S., Harun-Or-Rashid, M., **Rahman, M.M.,** Harun-Ur-Rashid, M. and Shazly, G.A., 2025. Chemoinformatics analysis of Mangifera indica leaves extracted phytochemicals as potential EGFR kinase modulators. Frontiers in Chemistry, 13, p.1524384, **(Q1, IF = 4.2, Frontiers)**. https://doi.org/10.3389/fchem.2025.1524384
7. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2024. A numerical study on the sedimentation effect of dust, smoke and traffic particle deposition in a realistic human lung. International Journal of Multiphase Flow, 171, 104685(**Q1, IF = 3.9, Elsevier**). https://doi.org/10.1016/j.ijmultiphaseflow.2023.104685
8. Mirzaaghaian, A., Zhao, M., **Rahman, M.M.**, Dong, K., 2024. Numerical simulation of targeted drug delivery to different regions of realistic human lung model under realistic aerosol breathing condition. Powder Technology, 444, p.120039, (**Q1, IF = 5.5, Elsevier**). https://doi.org/10.1016/j.powtec.2024.120039
9. Islam, M.S., Larpruenrudee, P., **Rahman, M.M.,** Li, G., Husain, S., Munir, A., Zhao, M., Sauret, E., Gu, Y., 2024. Pharmaceutical aerosol transport in airways: A combined machine learning (ML) and discrete element model (DEM) approach. Powder Technology, p.120271, (**Q1, IF = 5.5, Elsevier**). https://doi.org/10.1016/j.powtec.2024.120271
10. Huang, X., Francis, I., Saha, G., **Rahman, M.M.**, Saha, S.C., 2024. Large Eddy Simulation-Based Modeling of Cold-Air Inhalation from Nasal Cavities to the Distal Lung: Insights for Athlete Health and Performance. Results in Engineering, 23, p.102475, (**Q1, IF = 9.4, Elsevier**). https://doi.org/10.1016/j.rineng.2024.102475
11. Hye, M.A., Biswas, M.H.A., Uddin, M.F., **Rahman, M.M.,** 2024. A mathematical model for the transmission of co-infection with COVID-19 and kidney disease. Scientific Reports, 14(1), p.5680,(**Q1, IF = 3.9, Springer Nature**). https://www.nature.com/articles/s41598-024-56399-2

12. Islam, M.S., **Rahman, M.M.,** H.M., Larpruenrudee, Arsalanloo, A., Beni, P., Islam, M.A., and Gu, Y. and Sauret, E. 2023. How microplastics are transported and deposited in realistic upper airways?. *Physics of Fluids* 35, 063319, (**Q1, IF = 4.3, AIP**). https://doi.org/10.1063/5.0150703
13. Bala, D., Hossain, M.S., Hossain, M.A., Abdullah, M.I., **Rahman, M.M.,** Manavalan, B., Gu, N., Islam, M.S. and Huang, Z., 2023. MonkeyNet: A robust deep convolutional neural network for monkeypox disease detection and classification. *Neural Networks, 161,* 757-775, (**Q1, IF = 6.3, Elsevier**).http://dx.doi.org/10.1016/j.neunet.2023.02.022
14. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2022. Nanoparticle transport and deposition in a heterogeneous human lung airway tree: An efficient one path model for CFD simulations. **European Journal of Pharmaceutical Sciences,** vol. 177, 106279, (**Q1, IF = 5.1, Elsevier**). https://doi.org/10.1016/j.ejps.2022.106279
15. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2022. Numerical study of nano and micropollutant particle transport and deposition in realistic human lung airways. Powder Technology, 402, 117364, (**Q1, IF = 5.5, Elsevier**). https://doi.org/10.1016/j.powtec.2022.117364
16. Islam, M.S., **Rahman, M.M.,** Arsalanloo, A., Beni, H.M., Larpruenrudee, P., Bennett, N.S., Collins, R., Gemci, T., Taylor, M. and Gu, Y., 2022. How SARS-CoV-2 Omicron droplets transport and deposit in realistic extrathoracic airways. Physics of Fluids, 34(11), 113320, (**Q1, IF = 4.3, AIP**). https://doi.org/10.1063/5.0123213
17. Islam, M.S., Fang, T., Oldfield, C., Larpruenrudee, P., Beni, H.M., **Rahman, M.M.**, Husain, S. and Gu, Y., 2022. Heat wave and bushfire meteorology in New South Wales, Australia: air quality and health impacts. International journal of environmental research and public health, 19(16), 10388, **(Q1, IF = 4.6, MDPI)**. https://doi.org/10.3390/ijerph191610388
18. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2021. Aerosol Particle Transport and Deposition in Upper and Lower Airways of Infant, Child and Adult Human Lungs. Atmosphere, 12, 1402, (**Q2**, **IF = 2.6, MDPI**).http://dx.doi.org/10.3390/atmos12111402
19. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2021. Aging effects on airflow distribution and micron-particle transport and deposition in a human lung using CFD-DPM approach. Advanced Powder Technology, 32, 3506-3516, (**Q1, IF = 4.5, Elsevier**). http://dx.doi.org/10.1016/j.apt.2021.08.003
20. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2021. Numerical study of nanoscale and microscale particle transport in realistic lung models with and without stenosis. International Journal of Multiphase Flow, 145, 103842, (**Q1, IF = 3.9, Elsevier**). http://dx.doi.org/10.1016/j.ijmultiphaseflow.2021.103842

SELECTED CONFERENCE COMMUNICATIONS

Invited speaker, "Advanced Mathematical Modelling: Application to Biomedical Engineering - Airflow Dynamics and Aerosol Particle Transport and Deposition in Human Lungs," Jashore University of Science and Technology, 13 Dec 2023.

PhD research and respiratory-pollution work received external media coverage through AJMC and EurekAlert (https://www.ajmc.com/view/pollutant-particle-size-affects-deposition-in-the-lung-study-finds; https://www.eurekalert.org/news-releases/991960).

The list of the selected conferences is as follows:

1. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2021. The Effects of Physical Activity on Pollutant Particle Deposition in the Realistic Human Lung Airways. Proceedings of *3rd International Symposium on Computational Particle Technology*, 17-21 November 2021, Suzhou and Melbourne *(*Presenter)**.** https://www.monash.edu/simpascpthub-congress
2. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2021. The effects of density on particle deposition in the human respiratory tract. Proceedings of Fifth Australasian Conference on Computational Mechanics (ACCM), 13-15 December 2021, WSU, Sydney, Australia *(*Presenter). https://researchdirect.westernsydney.edu.au/islandora/object/uws:62044

3. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2019. Airflow dynamics and aerosol particle transport in a human lung. Proceedings of 1st International Conference on Mechanical and Manufacturing Engineering Research and Practice, 24-28 November 2019, Sydney, Australia *(*Presenter). *http://icmmerp.net.au/Proceedings/2019/ProceedingsiCMMERP2019.pdf*
4. **Rahman, M.M.,** Zhao, M., Islam, M.S., Dong, K., Saha, S.C., 2020. Airflow dynamic and particle deposition in age-specific human lungs. Proceedings of *22nd Australasian Fluid Mechanics Conference (AFMC)*, 7-10 December 2020, Brisbane, QLD, Australia *(*Presenter). https://espace.library.uq.edu.au/view/UQ:6506e6f
5. Saha, S.C., Francis, Isabella**.,** Huang, Xinlei., **Rahman, M.M.,** 2022. Fluid-Particle Dynamics of Nasal Drug Delivery in a Realistic Human Airway Lung Model. Proceedings of 23rd Australasian Fluid Mechanics Conference (AFMC), 4-8 December 2022, Sydney, Australia *(*Participant) *https://afmc2022.eng.sydney.edu.au*

AWARDS & RECOGNITION

- Best Research Paper Award (2025), "MonkeyNet: A robust deep convolutional neural network for monkeypox disease detection and classification," Neural Networks.
- Best Thesis Award (2022).
- Australian Government Research Training Program (RTP) Stipend Scholarship and Western Sydney University Postgraduate Research Scholarship (2019).
- University Merit Scholarships, Khulna University - MSc (2007-2008) and BSc (2002-2006).

TECHNICAL EXPERTISE

• Computational Fluid Dynamics (CFD) and CFD-DPM modelling
• Aerosol transport and regional lung deposition
• Environmental particle exposure and respiratory health risk
• Physics-guided artificial intelligence and surrogate modelling
• Multiphase flow and particle-fluid interaction
• Scientific computing, MATLAB, Mathematica, ANSYS Fluent, SOLIDWORKS

PROFESSIONAL, ORGANISATIONAL & COMMITTEE MEMBERSHIP

1. Engineering Australia (EA), ID Number: 5701543
2. Bangladesh Mathematical Society (BMS), ID Number: 859
3. Bangladesh Society for Mathematical Biology (BSMB), ID Number: LM0033
4. Australasian Fluid Mechanics (AFM)

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