



# MOHAMMAD AFZAL SHADAB

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## EDUCATION

- Doctor of Philosophy** | *Computational Science, Engineering & Mathematics* Aug 2019 – Dec 2024 (Expected)  
The University of Texas at Austin, United States GPA: 3.85/4.0  
*Advisor:* Prof. Marc Hesse
- Master of Science** | *Computational Science, Engineering & Mathematics* Aug 2019 – Dec 2021 (Expected)  
The University of Texas at Austin, United States GPA: 3.85/4.0  
*Advisor:* Prof. Marc Hesse
- Master of Philosophy** | *Mechanical Engineering* Aug 2016 – Sept 2018  
The Hong Kong University of Science and Technology, Hong Kong GPA: 4.0(A)/4.3(A+)  
*Thesis:* Fifth-order Finite Volume WENO in General Orthogonally-curvilinear Coordinates 📄  
*Advisor:* Prof. Kun Xu
- Bachelor of Technology** | *Mechanical Engineering* Aug 2012 – June 2016  
Aligarh Muslim University, India GPA: 9.62/10.0  
*Thesis:* Designing and Analysis of Supersonic Combustion Ramjet Engine 📄  
*Advisor:* Prof. M.F. Baig

## RESEARCH

- Two Phase Flow in Viscously Compacting Matrix** The University of Texas at Austin, USA  
Graduate Research Assistant, *Doctoral Thesis* August 2019 – Present  
*Advisor:* Prof. Marc Hesse
- Developed and validated a conservative finite-difference based solver in Python for simulating a 2D two-phase flow in non-deforming porous media.
  - Implemented the solver to study the behavior of Post Impact Hydrothermal systems on Mars.
  - Implementing the solver to investigate the melt percolation on ice masses to study effects of global warming.
- Investigating Fluid Drainage using Physics Informed Neural Networks** 📄 UT Austin, USA  
*Independent Research* August 2019 – Present  
*Collaborators:* DingCheng Luo, Yiran Shen, Eric Hiatt, and Prof. Marc Hesse
- Wrote python codes for data-driven discovery of steady-state PDE from experimental data.
  - Investigated the effect of PDE regularization in PINNs and the role of PDE & data misfit.
  - Learned the PDE parameters and boundary conditions for the transient seepage across edge of a porous reservoir simulated using finite-differencing.
- Free Fall of a Viscous Drop in a Viscoelastic Medium** 📄 Massachusetts Institute of Technology, USA  
Visiting Graduate Student Researcher October 2018 – April 2019  
*Advisor:* Prof. Irmgard Bischofberger
- Performed a literature review of computational and experimental methods for investigating drop dynamics.
  - Designed the experiments and apparatus with high-speed imaging.
  - Wrote MATLAB scripts for analysing moving camera videos using template matching.
- High-Order Finite-Volume Reconstruction in Curvilinear Coordinates** 📄 HKUST, Hong Kong  
Graduate Research Assistant, *M.Phil. Thesis* December 2016 – September 2018  
*Advisor:* Prof. Kun Xu
- Proposed a general theory for state-of-art fifth order finite volume WENO in curvilinear coordinates.
  - Derived analytical relations and developed Fortran codes along with Riemann solvers and gas-kinetic scheme.

## **Modal Decomposition Techniques on a Thermoacoustic System**

Collaborative Research

HKUST & U of Cambridge

August 2016 – December 2016

Advisor: Prof. Larry Li

- Analyzed and compared the prominent modal decomposition techniques for developing low order models.
- Investigated nonlinear interactions between flame & external forcing for different amplitudes & frequencies.

## **Designing & Analysis of Supersonic Combustion Ramjet Engine**

Aligarh Muslim University, India

Bachelor's Thesis

September 2015 – June 2016

Advisor: Prof. M.F. Baig

- Developed and validated Fortran codes for designing Scramjets and analyzed its performance during unstart.
- Proposed Single-Input-Single-Output mechanism based on pressure feedback to avert engine unstart.

## **Effective Lewis Number for Multicomponent Hydrocarbon-Air Mixtures**

IIT-Delhi, India

Summer Research Intern

June 2015 – August 2015

Advisor: Prof. M.R. Ravi

- Analyzed combustion characteristics of methane and natural gas mixtures with varying hydrogen blending.
- Performed the experiments using constant pressure combustion chamber apparatus with Schlieren imaging.
- Simulated the corresponding flames in 1D on CHEMKIN using PREMIX module.

## **INDUSTRIAL EXPERIENCE AND PROJECTS**

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### **Hummingbird – Wearable Device for Exchanging Information**

MIT & Hong Kong Innovation Node

Co-founder (*US based Startup Project*)

May 2018 – February 2019

- Ideated and validated consumer problems and market opportunities through market research.
- Designed prototype on AutoCAD, fabricated using 3D printing, and implemented fast & accurate algorithms.
- Received MIT Sandbox Innovation Fund worth \$5000 and won both Judge's & Audience Awards at MIT Entrepreneurship and Maker Skills Integrator program (2018).

### **Industrial Compressors and Gas Turbines**

Gas Authority of India Limited, India

Summer Intern

June 2014 – July 2014

- Worked at a C2C3 plant at GAIL, participating in its pre-commissioning and commissioning testing.
- Studied the working of several industrial compressors and a gas turbine (Siemens SGT700).

### **Formula Student Race Car and Hybrid Tricycle**

Society of Automotive Engineers, Aligarh Chapter

Technical Member & Team Lead

January 2013 – June 2014

- Conceptualized ergonomically designed the vehicles with improved aerodynamic performance.
- Designed the vehicles on AutoCAD, simulated on ANSYS, and then finally fabricated.

## **TRAVEL GRANTS AND FUNDED SHORT SCHOOLS**

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### **ICOSAHOM Conference Travel Grant**

July 2018

Awarded a student travel grant to attend the International Conference on Spectral And High Order Methods at Imperial College London.

### **Numerical Simulations ICNM 2017 Conference Travel Grant**

July 2017

Awarded full funding from HKUST for attending the 5th International Conference on Numerical Simulations for Multimaterial and Multiphysics Problems in China.

### **Advanced Research in Turbomachinery Summer School Grant**

July 2019

Received a scholarship of EUR800 to attend this summer school organized by the University of Florence, Italy and sponsored by ANSYS and GE.

### **MIT StartMIT Course Grant**

January 2019

Received full sponsorship from MIT Martin Trust Center to attend this hands-on MIT course on entrepreneurship involving multiple trips to companies within USA.

### **Fluid Dynamics across Scales Summer School Grant**

July 2018

Received full-funding from HKUST to attend the Centre for Doctoral Training in Fluid Dynamics across Scales at Imperial College London.

### **MIT Entrepreneurship and Maker Skills Integrator Bootcamp Funding**

June 2018

Received full funding from MIT and Hong Kong Innovation Node to attend the program involving trips to startup incubators in China.

## HONORS AND AWARDS

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| <b>SIAM Certificate of Recognition by Society for Industrial and Applied Mathematics</b><br>For outstanding service and contributions to the UT Austin Student Chapter of SIAM.                         | February 2021                         |
| <b>University of Texas Institute for Geophysics Student Fellowship by UTIG, UT Austin</b><br>Year-long fellowship covering tuition, insurance & stipend awarded for collaborative research.             | January 2021<br>2500USD/month         |
| <b>Best Teaching Assistant Award - II by Dept of Mech &amp; Aero Engg, HKUST</b><br>Awarded for MECH-1907 Introduction to Aerospace Engineering course based on student surveys and jury of professors. | August 2018<br>300HKD                 |
| <b>Judge's Award and Audience Award at MIT MEMSI Program</b><br>Awarded by MIT and Hong Kong Innovation Node to best startup idea & pitch in the program.                                               | June 2018                             |
| <b>Outstanding Contribution in Reviewing Recognition by Journal of Computational Physics</b><br>For being in the top 10th percentile of reviewers.                                                      | June 2018                             |
| <b>Postgraduate Studentship by HKUST</b><br>Competitive stipend for research postgraduate students (M.Phil.) at HKUST.                                                                                  | Aug 2016 – Sept 2018<br>USD2150/month |
| <b>Global Scholar Award by Sir Syed Education Society of North America</b><br>For top 20 students of AMU based on their academic achievements and research, for higher education.                       | May 2015<br>USD1000                   |
| <b>National Summer Research Fellowship by Indian Academy of Sciences</b><br>Awarded national fellowship to pursue research in Indian research institutes like IITs/IISc.                                | March 2015<br>USD220/month            |
| <b>University Merit Scholarship by AMU Alumni Association Toronto, Canada</b><br>Merit based scholarship for students pursuing education at AMU.                                                        | March 2015<br>USD70                   |
| <b>School Topper Medal and AIR 1478 in 11th National Science Olympiad</b>                                                                                                                               | Feb 2009                              |

## TEACHING EXPERIENCE

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| <b>MECH-3690 Aerospace Engineering Laboratory</b><br>The Hong Kong University of Science and Technology<br><i>Instructor:</i> Prof. Jinglei Yang   | Spring 2017<br>Hong Kong |
| <b>MECH-1907 Introduction to Aerospace Engineering</b><br>The Hong Kong University of Science and Technology<br><i>Instructor:</i> Prof. Rhea Liem | Spring 2018<br>Hong Kong |

For all teaching feedback reports, click [↗](#).

## COMMUNITY INVOLVEMENT

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| <b>President, Society for Industrial &amp; Applied Mathematics, Austin Chapter</b> <a href="#">↗</a><br>Spearheaded several programs including Distinguished Speaker Seminar Series.              | Sept 2020 – Present<br>Austin, USA      |
| <b>Mentor, Sir Syed Global Scholar Award</b> <a href="#">↗</a><br>Mentoring top AMU students from humble backgrounds for US grad school applications.                                             | Jan 2016 – Present<br>Aligarh, India    |
| <b>Vice-Chairperson, American Society of Mechanical Engineers, Aligarh Chapter</b> <a href="#">↗</a><br>Organized various events including paper presentation and annual technical festival.      | Sept 2014 – June 2016<br>Aligarh, India |
| <b>Zonal Head &amp; College Head Ambassador, Smilyo Educational Charitable Society</b> <a href="#">↗</a><br>Managed multi-university teams & provided educational resources to not-so-privileged. | Jan 2014 – Jan 2015<br>New Delhi, India |
| <b>Senior Under Officer, National Cadet Corps, Govt. of India (Similar to ROTC)</b> <a href="#">↗</a><br>C certificate holder, best cadet, organized blood donation, awareness, & army camps      | Jan 2013 – April 2015<br>Aligarh, India |

## SKILLS

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**Languages:** C, C++, Fortran 77/90, Python (SciPy, NumPy, Matplotlib, Pandas, Tensorflow), MATLAB, Mathematica, Shell Scripting, L<sup>A</sup>T<sub>E</sub>X, High Performance Computing  
**Software:** AutoCAD, SolidWorks, ANSYS, Fluent, COMSOL Multiphysics, TecPlot, ParaView, CHEMKIN, COSILAB, Microsoft Office, Git, Travis CI, Docker  
**OS:** Linux, Windows, Mac

## STUDENT MEMBERSHIP

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Society for Industrial and Applied Mathematics  
American Geophysical Union  
American Physical Society

## PEER REVIEWED PUBLICATIONS

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**Shadab, M.A.**, Balsara, D., Shyy, W. and Xu, K., 2019. Fifth order finite volume WENO in general orthogonally - curvilinear coordinates. *Computers & Fluids* (Elsevier), 190, pp.398-424.

**Shadab, M.A.**, Ji, X. and Xu, K., 2018. Fifth-order finite-volume WENO on cylindrical grids. *Spectral and High Order Methods for Partial Differential Equations* (Springer), p.637.

## CONFERENCES

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**Shadab, M.A.**, Luo, D., Shen, Y., Hiatt, E., and Hesse, M.A., 2021. Investigating fluid drainage from the edge of a porous reservoir using Physics Informed Neural Networks. 2021 SIAM Annual Meeting. (submitted)

**Shadab, M.A.**, Divoux, T. and Bischofberger, I., 2020. Suppression of drop breakup in a viscoelastic bath. *Bulletin of the American Physical Society*.

Hiatt, E., **Shadab, M.A.** et al., 2020. Groundwater filling times for large impact basins on early Mars and implications for the onset of post impact hydrothermal systems. American Geophysical Society 2020 Fall Meeting.

**Shadab, M.A.**, Ji, X. and Xu, K., 2018. Fifth-order finite-volume WENO on Cylindrical Grids: Flux Evaluation Using Riemann Solvers and Gas-kinetic Scheme. In *International Conference on Spectral And High Order Methods (ICOSAHOM)*, Imperial College London.

**Shadab, M.A.**, and Xu, K., 2017. Fifth order finite volume WENO in orthogonally-curvilinear coordinates. In *5th International Conference on Numerical Simulations for Multimaterial and Multiphysics Problems*.

**Shadab, M.A.** and Baig, M.F., 2017. Investigation and Control of Unstart Phenomenon in Scramjets. In *21st AIAA International Space Planes and Hypersonics Technologies Conference* (p. 2298).

## REFERENCES

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**Prof. Marc Hesse**, Associate Professor of Geological Sciences, UT Austin, USA mhesse@jsg.utexas.edu  
Relationship: *PhD Thesis Advisor*, Knows for last 2 years

**Prof. Irmgard Bischofberger**, Assistant Professor of Mechanical Engineering, MIT, USA irmgard@mit.edu  
Relationship: *Visiting Student Research Advisor*, Knows for last 2.5 years

**Prof. Kun Xu**, Chair Professor of Mathematics, HKUST, Hong Kong makxu@ust.hk  
Relationship: *MPhil Thesis Advisor*, Knows for last 5 years