

Mohammad Afzal Shadab

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EXPERIENCE

Future Faculty in Physical Sciences Fellow, Postdoctoral Research Associate Department of Civil and Environmental Engineering, <i>Princeton University</i>	Aug 2024 - Present Princeton
Graduate Research Assistant Oden Institute for Computational Engineering and Sciences, <i>University of Texas at Austin</i>	Aug 2019 - Aug 2024 Austin
NASA Jet Propulsion Laboratory Graduate Fellow Planetary Science Division, <i>NASA Jet Propulsion Laboratory, California Institute of Technology</i>	June - Aug 2023 Pasadena
NASA Jet Propulsion Laboratory Graduate Fellow Earth Science Division, <i>NASA Jet Propulsion Laboratory, California Institute of Technology</i>	April - June 2022 Pasadena
MIT Visiting Graduate Student Researcher Department of Mechanical Engineering, <i>Massachusetts Institute of Technology</i>	Oct 2018 - April 2019 Cambridge
Graduate Research Assistant Dept. of Mechanical and Aerospace Engg., <i>Hong Kong University of Science and Technology</i>	Sept 2016 - Sept 2018 Hong Kong

EDUCATION

Doctor of Philosophy Computational Science, Engineering & Mathematics The University of Texas at Austin, United States Title: Modeling Subsurface Flow of Water in Earth and Planetary Sciences Advisor: Dr. Marc Hesse, Professor of Earth and Planetary Sciences	Aug 2019 – Aug 2024 GPA: 3.90/4.0
Master of Science Computational Science, Engineering & Mathematics The University of Texas at Austin, United States Advisor: Dr. Marc Hesse, Professor of Earth and Planetary Sciences	Aug 2019 – Aug 2021 GPA: 3.90/4.0
Master of Philosophy Mechanical Engineering The Hong Kong University of Science and Technology, Hong Kong Thesis: Fifth-order Finite Volume WENO in General Orthogonally-curvilinear Coordinates 📄 Advisor: Dr. Kun Xu, Chair Professor of Math and Mechanical and Aerospace Engineering	Sept 2016 – Sept 2018 GPA: 4.0(A)/4.3(A+)
Bachelor of Technology Mechanical Engineering Aligarh Muslim University, India	Aug 2012 – June 2016 GPA: 9.62/10.0

PEER REVIEWED PUBLICATIONS


- [8] **Shadab, M.A.**, Adhikari, S., Rutishauser, A., Grima, C. and Hesse, M.A., 2024. A mechanism for ice layer formation in glacial firn. *Geophysical Research Letters*, 51(15), p.e2024GL109893.
- [7] **Shadab, M.A.** and Hesse, M.A., 2024. A hyperbolic-elliptic PDE model and conservative numerical method for gravity-dominated variably-saturated groundwater flow. *Advances in Water Resources*, p.104736.
- [6] Hiatt, E. **Shadab, M.A.**, Hesse, M., Goudge, T., Gulick, S., 2024. Limited Recharge of a Deep Groundwater Aquifer In the Southern Highlands On Early Mars, *Icarus*, Elsevier, 115774, DOI: 10.1016/j.icarus.2023.115774
- [5] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 2023. PKgui: A GUI software for Polubarinova-Kochina's solutions of steady unconfined groundwater flow, *SoftwareX*, Elsevier, 101573, DOI: 10.1016/j.softx.2023.101573 📄
- [4] **Shadab, M.A.**, Luo, D., Hiatt, E., Hiatt, E. and Hesse, M.A., 2023. Investigating Steady Unconfined Groundwater Flow using Physics Informed Neural Networks, *Advances in Water Resources*, Elsevier, 104445, ISSN 0309-1708, DOI: 10.1016/j.advwatres.2023.104445
- [3] **Shadab, M.A.** and Hesse, M.A., 2022. Analysis of gravity-driven infiltration with the development of a saturated region, *Water Resources Research (AGU)*, DOI: 10.1029/2022WR032963

- [2] **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.
- [1] **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.

UNDER REVIEW PUBLICATIONS (PREPRINT AVAILABLE ON REQUEST)

- [4] **Shadab, M.A.**, Hiatt, E., Bahia, R.S., Bohacek, E.V., Steinmann, V. and Hesse, M.A., 202X. Infiltration dynamics on early Mars: Geomorphic, climatic, and water storage implications (submitted to *Geophysical Research Letters*)
- [3] **Shadab, M.A.**, Rutishauser, A., Grima, C. and Hesse, M.A., 202X. A unified kinematic wave theory for melt infiltration into firn. *arXiv preprint arXiv:2403.15996* (submitted to *Journal of Glaciology*).
- [2] Vanek, S., Labe, Z., Lauter, O., Shionalyn, K., **Shadab, M.A.**, Adasheva, E., Margevich, A., Helmberger, M.N., Ashokkumar, L., Naoukin, J., 202X. Exploring the Past, Present, and Future of USAPECS: Lessons from a Decade of Supporting Early Career Research Across National and International Polar Networks. *Arctic Yearbook* 2024.
- [1] Barnes, R., ... **Shadab, M.A.**, ..., 202X. The History and Habitability of the LP 890-9 Planetary System. *Planetary Science Journal*, American Astronomical Society. (under revision)

IN PREPARATION

- [4] **Shadab, M.A.**, Vance, S.D., Silber, E.A., Crósta, A.P., Carnahan, E., Jordan, J.S., Hesse, M.A., 202X. Rapid migration of impact melt through ocean world ices (to be submitted to *Earth & Planetary Science Letters*)
- [3] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 202X. Analytical solutions of a low-aspect-ratio unconfined aquifer on a spherical shell: Application to early Mars (in preparation)
- [2] **Shadab, M.A.** and Hesse, M.A., 202X. An open source discrete operator toolbox (DOT) to solve geophysical flow problems. (for *Geoscientific Model Development*)
- [1] Hesse, M.A. and **Shadab, M.A.**, 202X. *Numerical Modeling for Geoscientists* (book draft )


CONTRIBUTED TALKS

- [41] **Shadab, M.A.**, Adhikari, S., Rutishauser, A., Grima, C., Stevens, C.M. and Hesse, M.A., 2024. Multi-scale multi dimensional infiltration in glacial firn and mechanism of ice layer and chunk formation. 2024 AGU Fall Meeting. (submitted)
- [40] **Shadab, M.A.**, Vance, S.D., Silber E.A., Crósta, A.P., Carnahan, E., Jordan, J.S. and Hesse, M.A., 2024. Evolution of Impact Generated Melt at Selk Crater. 2024 AGU Fall Meeting. (submitted)
- [39] Helmberger, M.N., Labe, Z., **Shadab, M.A.**, Lauter, O., Vanek, S., Adasheva, E. and Ashokkumar, L. 2024. Empowering Polar Science community: A Decade of USAPECS in supporting Early Career Researchers globally. 2024 AGU Fall Meeting. (submitted)
- [38] Hiatt, E., **Shadab, M.A.**, Bahia, R.S., Bohacek, E.V., Steinmann, V. and Hesse, M.A., 2024. Dynamics of Infiltration on Early Mars 2024 AGU Fall Meeting. (submitted).
- [37] Hiatt, E., **Shadab, M.A.**, Gulick, S.P.S., Goudge, T. and Hesse, M.A., 2024. Transient Groundwater Models Suggest Short Lived Recharge Events on Early Mars. 2024 AGU Fall Meeting. (submitted)
- [36] Hiatt, E., **Shadab, M.A.**, Gulick, S.P.S., Goudge, T. and Hesse, M.A., 2024. Constraining Early Mars Paleoclimate Forcing via Groundwater Modeling as Limited by Observed Geomorphology. Texas Area Planetary Science (TAPS) Meeting 2024.
- [35] **Shadab, M.A.**, Vance, S.D., Styczinski M.J., Silber E.A., Crósta, A.P., Carnahan, E., Jordan, J.S. and Hesse, M.A., 2024. Evolution of Impact Generated Melt at Selk Crater. 55th Lunar & Planetary Science Conference, ID# 1317.
- [34] **Shadab, M.A.**, Hiatt, E., Bahia, R.S., Bohacek, E.V., Steinmann, V. and Hesse, M.A., 2024. Infiltration on early Mars & its implications toward aeolian-fluvial interactions. 55th Lunar and Planetary Science Conference, # 1383.

- [33] Hiatt, E., **Shadab, M.A.**, Gulick, S.P.S., Goudge, T. and Hesse, M.A., 2024. Martian lakes: a critical requirement for transient groundwater models. 55th Lunar and Planetary Science Conference 2024, Abstract ID#2408.
- [32] Barnes, R., ... **Shadab, M.A.**,..., 2024. The History and Habitability of the LP 890-9 Planetary System. 2024 Astrobiology Science Conference, ID# 1498545.
- [31] Adasheva, E., Ashokkumar, L., Helmberger, M.N., Labe, Z., Lauter, O., **Shadab, M.A.**, Vanek, S., 2024. Exploring the Past, Present, and Future of USAPECS: Lessons from a Decade of Supporting Early Career Research Across National and International Polar Networks. Arctic Congress 2024. ID# 1310
- [30] **Shadab, M.A.**, Adhikari, S. Rutishauser, A., Grima, C., and Hesse, M.A., 2023. Mechanism and factors controlling ice layer formation in glacial firn. 2023 AGU Fall Meeting.
- [29] **Shadab, M.A.**, Rutishauser, A., Grima, C., and Hesse, M.A., 2023. A unified kinematic wave theory for melt infiltration into firn. 2023 AGU Fall Meeting.
- [28] Ashokkumar, L., Labe, Z., **Shadab, M.A.**, Lauter, O., Schreiber, E., Weinberg, E., 2023. Advancing Inclusion, Diversity, Equity, and Accessibility (IDEA) in the Polar Sciences by USAPECS. 2023 AGU Fall Meeting.
- [27] **Shadab, M.A.**, Hiatt, E., Bahia, R.S., Bohacek, E.V., Steinmann, V. and Hesse, M.A., 2023. Infiltration on early Mars and its implications toward aeolian-fluvial interactions. Fluvial-Aeolian Interactions on Planetary Surfaces (FAIRPLAY) workshop, European Space Agency.
- [26] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 2023. A Deep Crustal Aquifer Model for Southern Highlands of Noachian Mars Shows Groundwater Age and Near-Surface Dynamics. NASA Exploration Science Forum 2023.
- [25] Hiatt, E., **Shadab, M.A.**, et al, 2023. Limited Recharge of the Southern Highlands Aquifer on Early Mars. Texas Area Planetary Science Meeting (TAPS) TAPS2023-55, 2023.
- [24] Vance, S.D. Carnahan, E., **Shadab, M.A.**, Hesse, M.A., Silber, E.A., Crosta, A.P., 2023. Impact foundering and material transport through ice shells of various compositions. Impact Processes as a Path to Habitability of Planetary Habitability Workshop, Brazil.
- [23] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 2023. A Deep Crustal Aquifer Model for Southern Highlands of Noachian Mars Shows Groundwater Age and Near-Surface Dynamics. Brines Across the Solar System: Ancient and Future Brines Conference 2023, Abstract #2025.
- [22] Barnes, R., ... **Shadab, M.A.**,..., 2023. The History and Habitability of the LP 890-9 Planetary System. Biennial European Astrobiology Conference (BEACON) 2023.
- [21] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 2023. Investigating groundwater dynamics and residence times on early Mars using unconfined aquifer model with vertical heterogeneity. 54th Lunar and Planetary Science Conference 2023, Abstract #1736.
- [20] Hesse, M.A., **Shadab, M.A.** and Hiatt, E., 2023. Time scales for Terminal Groundwater Drainage from the Southern Highlands on Mars. 54th Lunar and Planetary Science Conference 2023, Abstract #1637.
- [19] Hiatt, E., **Shadab, M.A.** and Hesse, M.A., 2023. Planetary Scale Groundwater and Surface Water Interaction on Early Mars. 54th Lunar and Planetary Science Conference 2023, Abstract #2415.
- [18] Barnes, R., ... **Shadab, M.A.**,..., 2023. History and Habitability of the LP 890-9 Planetary System. 241st American Astronomical Society Meeting 2023.
- [17] **Shadab, M.A.**, and Hesse, M.A., 2022. An extended kinematic-wave theory for infiltration in soils with declining porosity causing delayed perching. 2022 American Geophysical Union (AGU) Fall Meeting.
- [16] **Shadab, M.A.**, and Hesse, M.A., 2022. Extending Richards equation to simulate variably saturated flows. 2022 AGU Fall Meeting.
- [15] Hiatt, E. **Shadab, M.A.**, Hesse, M., Goudge, T., Gulick, S., 2022. Limited Recharge On Early Martian Aquifers: Numeric Analytic Recharge Rate Estimates As Constrained By Geomorphic and Geochemical Observations. 2022 AGU Fall Meeting.









- [14] **Shadab, M.A.**, Hiatt, E., and Hesse, M.A., 2022. Estimates of Martian mean recharge rates from analytic groundwater models. 53rd Lunar and Planetary Science Conference 2022, Abstract #1775.
- [13] Hiatt, E., **Shadab, M.A.**, et al, 2022. Estimates of groundwater divides and basins on Noachian Mars. 53rd Lunar and Planetary Science Conference 2022, Abstract #2618.
- [12] **Shadab, M.A.**, Grima, C., Rutishauser, A., and Hesse, M.A., 2021. Analytical Solutions for Melt Percolation in Ice Masses and a Pathway to Ice Lens Formation. 2021 AGU Fall Meeting.
- [11] **Shadab, M.A.**, and Hesse, M.A., 2021. Fluid Infiltration in Unsaturated Porous Medium with The Development of a Saturated Region. 2021 AGU Fall Meeting.
- [10] Hesse, M.A., **Shadab, M.A.**, Luo, D., Shen, Y., and Hiatt, E., 2021. Investigating Groundwater Flow Dynamics using Physics Informed Neural Networks (PINNs). 2021 AGU Fall Meeting.
- [9] Hiatt, E., **Shadab, M.A.**, et al, 2021. Experimental and Numerical Investigation of Seepage Face Dynamics. 2021 AGU Fall Meeting.
- [8] Hesse, M.A., **Shadab, M.A.**, Hiatt, E., Liebeck, J., 2021. Groundwater-ocean interaction on Mars. 2021 AGU Fall Meeting.
- [7] Hiatt, E., **Shadab, M.A.**, et al, 2021. Numerical Modeling of the Formation of Hellas Planitia with Focus on Spatio-Temporal Scales Required for Hydrologic Equilibration. 2021 AGU Fall Meeting.
- [6] **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.
- [5] **Shadab, M.A.**, Divoux, T. and Bischofberger, I., 2020. Suppression of drop breakup in a viscoelastic bath. Bulletin of the American Physical Society.
- [4] 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.
- [3] **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.
- [2] **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.
- [1] **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).

INVITED TALKS AND SEMINARS

- [9] April 2024: Mathematics on Ice Forum (worldwide, virtual)  - Modeling infiltration of meltwater and formation of ice layers in glacial firn
- [8] Jan 2024: California Institute of Technology, GALCIT and Fu Research Group - A voyage through fluid mechanics
- [7] Oct 2023: Center for Planetary Systems Habitability, UT Austin - Impact generated melt foundering on icy ocean worlds
- [6] Sept 2023: Institute for Geophysics, UT Austin - Modeling the meltwater percolation and formation of ice layers in glacial firn
- [5] August 2023: NASA Jet Propulsion Laboratory, Planetary Science Division Seminar - Impact generated melt foundering on icy ocean worlds
- [4] June 2022: NASA Jet Propulsion Laboratory, Earth Science Division Seminar - Modeling meltwater percolation in Greenland's firn



- [3] June 2022: California Institute of Technology, Fu Research Group - Modeling the meltwater percolation in Greenland's firn
- [2] May 2017: 5th International Conference on Numerical Simulation for Multimaterial and Multiphysics Problems (ICNM), Beijing - Fifth Order Finite Volume WENO in General Orthogonally Curvilinear Coordinates
- [1] 2016-2017: The Hong Kong University of Science and Technology, Aeronautics Interest Group (AIG) - Workshops on Aerodynamics and Propulsion.



HONORS AND AWARDS

Princeton University Future Faculty in Physical Sciences Postdoctoral Fellowship 	August 2024-27
A postdoctoral fellowship to increase research excellence and faculty diversity	\$75,000/year
UT Austin Professional Development Award 	January 2024
For presenting two research works conducted at UT Austin.	\$500
NASA Open Science Badge 	Jan 2024
Completed 5 open science modules offered by NASA TOPS Program 	
AGU Cryosphere Innovation Award / Flash Freeze Competition Winner 	Dec 2023
Awarded based on a two-minute pitch of innovative idea to a panel of five judges at AGU 2023.	\$1,500
UT Austin Graduate School Summer Fellowship 	June - Aug 2024
Awarded based on academic standing and research experience supported by recommendations.	\$11,527
UT Austin Graduate School Spring Dissertation Writing Fellowship 	Jan - May 2024
Granted for academic and research excellence, substantiated by recommendations.	\$22,127
NASA Jet Propulsion Laboratory Graduate Fellowship 	June - Aug 2023
To investigate life-supporting conditions on Europa with Dr. Steve Vance at JPL.	\$12,100
UT Austin Professional Development Award 	October 2022
For presenting two research works conducted at UT Austin.	\$500
NASA Jet Propulsion Laboratory Graduate Fellowship 	April - June 2022
To study effect of climate change on Greenland ice sheet with Dr. Surendra Adhikari at JPL.	\$9,000
Purdue Climate Scholar by Purdue University and Office of Naval Research 	June - Aug 2022
To attend Summer Institute for Sustainability & Climate Change at Purdue University.	\$4,000
MIT - Houston Energy Innovation Student Fellow 	Mar 2022 - May 2023
Representing UT Austin as a liaison between MIT's Martin Trust Center and Greentown Labs.	
Lunar and Planetary Institute Career Development Award 	Feb 2022
For first author abstract and application materials submitted at LPSC 2022.	\$1,000
UT Austin Cactus Standout Award (estd. 1894) 	April 2022
For academic excellence and leadership contributions. Inducted into Annual Yearbook, 2022.	
Student Research Award in Planetary Habitability by Cent. for Planetary Sys. Habitability 	Jan 2022
For proposal on finding life-supporting conditions on Europa using computational methods.	\$16,425
Outstanding Student Presenters Award by Unsaturated Zone Technical Committee, AGU 	Dec 2021
Third prize for oral presentation: H52D-10 Rainwater Infiltration at AGU Fall Meeting 2021. 	\$175
SIAM Certificate of Recognition by Society for Industrial and Applied Mathematics	Feb 2021
For outstanding service and contributions to the UT Austin Student Chapter of SIAM.	
Blue Sky Student Fellowship by University of Texas Institute for Geophysics	August 2021 - July 2022
Year-long fellowship covering tuition, insurance & stipend awarded for research proposal.	\$2,491/month
Best Teaching Assistant Award by Dept of Mech & Aero Engg, HKUST	August 2018
Awarded for MECH-1907 Introduction to Aerospace Engineering course based on student surveys and jury of professors.	HK\$300






Judge's Award and Audience Award at MIT MEMSI Program	June 2018
Awarded by MIT and Hong Kong Innovation Node to best startup idea & pitch in the program.	
Outstanding Contribution in Reviewing Recognition by Journal of Computational Physics	June 2018
For being in the top 10th percentile of reviewers.	
Postgraduate Studentship by HKUST	Aug 2016 – Sept 2018
Competitive stipend for research postgraduate students (M.Phil.) at HKUST.	\$2,150/month
Global Scholar Award by Sir Syed Education Society of North America	May 2015
For top 20 students of AMU based on their academic achievements and research, for higher education.	\$1,000
National Summer Research Fellowship by Indian Academy of Sciences	March 2015
Awarded national fellowship to pursue research in Indian research institutes like IITs/IISc.	\$220/month
University Merit Scholarship by AMU Alumni Association Toronto, Canada	March 2015
Merit based scholarship for students pursuing education at AMU.	\$70

RESEARCH EXPERIENCE

Improving the Numerical Toolset for Geodynamics of Icy Oceans World	NASA Jet Propulsion Lab
NASA Jet Propulsion Lab Graduate Fellow (Stipend: \$1,100/week)	June 2023 – August 2023
<i>Advisor:</i> Dr. Steven Vance	
<ul style="list-style-type: none"> Developed a code for single phase flow in viscously compacting matrix. Implementing tracers into melt migration code across ice shells of icy ocean worlds. Developed a theoretical model, validated with simulations, for calculating time scales of melt foundering. 	
Modeling Meltwater Percolation in Greenland's Firn	NASA Jet Propulsion Lab, Caltech
NASA Jet Propulsion Lab Graduate Fellow (Stipend: \$900/week)	May 2022 – July 2022
<i>Advisor:</i> Dr. Surendra Adhikari	
<ul style="list-style-type: none"> Developed a two-dimensional, three-phase (snow/water/air), firn infiltration simulator. Derived and validated vertically integrated model for meltwater gravity currents. Formulated kinematic wave theory of firn infiltration, inverted for model parameters and investigated meltwater infiltration in Greenland. 	
Modeling Subsurface Flow of Water in Earth and Planetary Sciences	The University of Texas at Austin
Graduate Research Assistant, <i>Doctoral Thesis</i> (Stipend: \$2,609/month)	August 2019 – Present
<i>Advisor:</i> Prof. Marc Hesse	
<ul style="list-style-type: none"> 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 Groundwater Flows using Physics Informed Neural Networks 	UT Austin
<i>Independent Research</i>	August 2020 – June 2023
<i>Collaborators:</i> DingCheng Luo, Yiran Shen, Eric Hiatt, and Prof. Marc Hesse	
<ul style="list-style-type: none"> 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
Visiting Graduate Student Researcher (Stipend: \$2,150/month)	October 2018 – April 2019
<i>Advisor:</i> Prof. Irmgard Bischofberger	
<ul style="list-style-type: none"> 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 analyzing moving camera videos using template matching. 	


- High-Order Finite-Volume Reconstruction in Curvilinear Coordinates**  HKUST, Hong Kong
 Graduate Research Assistant, *M.Phil. Thesis* (Stipend: \$2,150/month) 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**  HKUST & U of Cambridge
 Collaborative Research (Stipend: \$2,150/month) September 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.

TEACHING EXPERIENCE

- GEO 325C/398C Continuum Mechanics**  (Level: Graduate) Fall 2023
 University of Texas at Austin Austin
Position: Teaching Assistant, *Instructor:* Prof. Marc Hesse
Responsibilities: Taught tutorial lectures, clarified doubts on Piazza, evaluated assignments
- GEO 325M/398M Numerical Modeling in the Geosciences**  (Level: Graduate) Spring 2023
 University of Texas at Austin Austin
Position: Teaching Assistant, *Instructor:* Prof. Marc Hesse
Responsibilities: Conducted tutorials and coding exercises, resolved coding/conceptual issues
- SIAM Applied Mathematics Mentorship Program Lectures (Level: Undergrad/Graduate)** Fall 2022
 University of Texas at Austin Austin
Position: Instructor
Responsibilities: Conducted lectures such as Intro to \LaTeX (video available , )
- GEO 325C/398C Continuum Mechanics**  (Level: Graduate) Fall 2022
 University of Texas at Austin Austin
Position: Teaching Assistant, *Instructor:* Prof. Marc Hesse
Responsibilities: Gave tutorial lectures, clarified doubts on Piazza, evaluated assignments
- MECH-1907 Introduction to Aerospace Engineering (Level: Freshman, Sophomore)** Spring 2018
 The Hong Kong University of Science and Technology Hong Kong
Position: Teaching Assistant, *Instructor:* Prof. Rhea Liem
Responsibilities: Designed & evaluated exams & HWs, taught tutorial and two class lectures
- MECH-3690 Aerospace Engineering Laboratory (Level: Senior, Junior)** Spring 2017
 The Hong Kong University of Science and Technology Hong Kong
Position: Teaching Assistant, *Instructor:* Prof. Jinglei Yang
Responsibilities: Taught multiple class lectures and lab briefings, contributed to lab manual
- Indian (IIT) Joint Engineering Entrance Exam Physics Tutor (Level: High school)** 2012-13
 Self-Employed Aligarh, India
Position: Instructor
Responsibilities: Conducted lectures and designed crux materials, question bank & quizzes

For all teaching feedback reports and certificates, click .

PEDAGOGICAL TRAINING



- Inclusive Course Design Institute 2023**  Summer 2023
 The University of Texas at Austin Austin
 Using Universal Design for Learning (UDL) and best-practices, designed a course from ground up.
- Inclusive Classrooms Leadership Certificate Seminar Series** Spring 2023
 The University of Texas at Austin Austin
 Learned strategies for developing and sustaining an inclusive classroom along with course design.

Advanced Teaching Preparation Series Certificate	Spring – Fall 2022
The University of Texas at Austin	Austin
Advance teaching certificate for learning and practicing techniques of good classroom teaching.	
Graduate Teaching Assistant Training Program	Fall 2017 – Spring 2018
The Hong Kong University of Science and Technology	Hong Kong
Learned the fundamentals of teaching assistantship and effective pedagogy.	

TRAVEL GRANTS AND FUNDED SHORT SCHOOLS

Center for Planetary Systems' Habitability Student Travel Award	February 2024
Awarded a travel grant to attend the LPSC 2024.	\$1000
Early Career Travel Award by European Space Agency	September 2023
Received a travel award by ESA to attend the FAIRPLAY 2023 Workshop in the Netherlands.	€2048
Center for Planetary Systems' Habitability Student Travel Award	February 2023
Received a travel grant to attend the LPSC 2023.	\$1000
Early Career Tiny Grants - AGU Ecohydrology Committee	December 2022
For early-career scientists presenting ecohydrology-related work at the AGU Fall Meeting 2022.	\$214
Center for Planetary Systems' Habitability Student Travel Award	February 2022
Awarded a travel grant to attend the LPSC 2022.	\$1000
AGU Fall Meeting Grant	December 2021
Awarded a travel grant by UT Austin to attend the AGU Fall Meeting 2021.	
SIAM Student Travel Award	June 2021
Awarded a student travel grant to attend the SIAM Annual Meeting 2021.	\$650
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.	\$2500
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.	\$2200
Advanced Research in Turbomachinery Summer School Grant	July 2019
Received a scholarship to attend this summer school organized by the University of Florence, Italy and sponsored by ANSYS and GE.	€800
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.	\$1000
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.	

COMMUNITY INVOLVEMENT

AGU24 Sessions' Convener and OSPA Liaison, Three Sessions 	Aug 2023 – Dec 2024
Designing 3 sessions with AGU Cryo team "C24A/C41C/C43C. The Cryosphere Is for All: Overcoming Barriers to Participation in the Cryospheric Sciences" oral/poster.	
Executive Secretary and/or Reviewer, Six NASA Proposal Review Panels 	Jan 2023 – Present
Managing panel review, assisting group chief and reviewing the proposals in panels.	\$1840 * 3 + \$1490 * 2 + \$1140

Executive Committee Member, AGU Cryosphere Division	March 2024 – Present
Serving in the Diversity, Equity, and Inclusion (DEI) and Canvassing Working groups.	
Judge, AGU Fall Meeting Travel Award	August 2024 - Sept 2024
Reviewed cryosphere division related applications for AGU 2024 from around the world.	
Judge, International Mission to Mars Engineering Design Contest	June 2024 - July 2024
Organized by Mars Society for high school students from around the world.	
Young Professional Mentor, Zed Factor Fellowship Program	May 2023 - Aug 2024
Mentor rising undergraduate students in Aerospace Engineering.	
Team Member, UT Austin Libraries HELIOS team	April 2023 - Aug 2024
To advance Higher Education Leadership Initiative for Open Scholarship (HELIOS). Gave a speech at US White House on Open Science (News , Post , Video). Organizer and Panelist at the First Texas Open Science Summit .	
Panelist at the Open Science Webinar at Navigating the New Arctic Office .	
Panelist at Open Science Event by Intl. Federation of Library Assoc. & Inst. .	
Co-Chair & DEI Team Lead, US Assoc. of Polar Early Career Scientists	Sept 2022 – Present
Fostering climate and DEI-conscious collaborations between academia & polar organizations.	
Board Member, AGU Hydrology Section Student Subcommittee (AGU-H3S)	Jan 2023 – Present
Providing professional development & networking opportunities to early career hydrologists.	
Volunteer, MIT Energy Conference	April 2023 \$900
Helped with organizing the conference in person in Boston.	
Coordinator, Center for Planetary Systems Habitability Student Travel Award	Jan – Apr 2023
Organizing, coordinating and liaising the application process for student travel to LPSC 2023.	
MIT - Houston Energy Innovation Student Fellow	March 2022 – April 2023
Creating energy innovation ecosystem considering the threat of climate change.	
Volunteer / Braindate Lounge Assistant, AGU Fall Meeting 2022	Dec 2022
Facilitated collaborations between researchers and scientists through Braindate at AGU 2022.	
Mentor, American Geophys. Union Earth & Planetary Surface Processes (EPSP)	Oct 2022 – Present
Mentoring graduate students across the world for developing technical and research skills in EPSP. Virtual	
Geoscience Ambassador, Jackson School of Geosciences, UT Austin	Sept 2021 - July 2022
Making geoscience accessible to broader community & promoting interdisciplinary research. Austin, USA	
Session Chair, Society for Industrial & Applied Mathematics Annual Meeting 2021	July 2021
Chaired the “CP15: Machine Learning and Data Mining” Session. Virtual	
President & Senior Advisor, Soc. for Industrial & Applied Math, Austin Chapter	Sept 2020 – Present
Spearheaded several programs & Won Best Graduate Organization at UT Austin Award. Austin, USA	
Mentor, Mentoring365, American Geophysical Union	Aug 2021 – Present
Facilitating an exchange of professional knowledge, skills, and experiences in Earth and space sciences. Virtual	
Mentor, SIAM Applied Mathematics Mentorship	Jan 2021 – Present
Conceptualized the program and mentoring UT students for applied math concepts and prospects. Austin, USA	
Volunteer, Lunar and Planetary Science Conference 2022	March 2021
Managed a virtual and an in-person session and moreover conference logistical tasks. Houston, USA	
Mentor, Sir Syed Global Scholar Award	Jan 2016 – Present
Mentoring top AMU students from humble backgrounds for US grad school applications. Aligarh, India	
Zonal Head & College Head Ambassador, Smilyo Educational Charitable Society	Jan 2014 – Jan 2015
Managed multi-university teams & provided educational resources to not-so-privileged. New Delhi, India	

REVIEWER FOR TECHNICAL JOURNALS

Geoscience: Computational Geoscience, Water Resources Research, Geophysical Research Letters 
, Journal of Geophysical Research - Planets 

Numerical Methods: Journal of Computational Physics, Geoscientific Model Development, Computer and Fluids

SKILLS

Languages: C, C++, Fortran 77/90, Python (SciPy, NumPy, Matplotlib, Pandas, Pytorch, Tkinter, Tensorflow, GUI programming, Webscraping), HTML, MATLAB, Mathematica, Shell Scripting, L^AT_EX, High Performance Computing (SLURM)

General Software: AutoCAD, SolidWorks, ANSYS, Fluent, COMSOL Multiphysics, TecPlot, ParaView, Microsoft Office, Git, Travis CI, Docker




Geoscience Software: Hydrus, VPLANet, QGIS, QGreenland, ENVI, PlanetProfile, PHREEQC, ParFlow





OS: Linux, Windows, Mac


STUDENT MEMBERSHIP







American Geophysical Union
Association of Polar Early Career Scientists
Society for Industrial and Applied Mathematics
American Physical Society

MEDIA COVERAGE

Understanding ice layer formation to estimate sea level rise - UT , AAAS , Phys.org  Sept 2024
For the thesis work on understanding ice layer formation done in collaboration with NASA-JPL.



Little groundwater recharge in ancient Mars aquifer - UT , EurekAlert , AAAS , Phys.org  Feb 2024
For the collaborative work with Eric Hiatt on water on early Mars.

Fulfilling my NASA dream - Sir Syed Global Scholar Award Story of the Month  Aug 2022
On my post-baccalaureate experience towards landing a graduate fellowship at NASA JPL.

Mars may have less water than previously estimated - Multiple news outlets April 2022
UT Austin Website (front cover) ,  & , Phys.org , Times of India , Bailey Universe 

Outstanding Student Presentation Award at AGU 2021 - UT Austin  April 2022
For outstanding student presentation on Rainwater Infiltration in AGU Fall Meeting 2021.

CPSH Travel Grant Sends 11 Students to LPSC - UT Austin  March 2022
For travel grant of \$1,000 from Center for Planetary Systems Habitability to attend LPSC 2022.

Lunar & Planetary Institute Career Devel. Award News - UT Austin , LPI News  Feb 2022
For outstanding first-authored work on fate of water on early Mars submitted at LPSC conference.

How To Stay Productive While in Quarantine - Oden Institute Feature Article  March 2021
For academic & research achievements and service at Oden Institute during quarantine.

OPEN SOURCE SOFTWARES

- [6] **Shadab, M.A.**, Adhikari, S., Rutishauser, A., Grima, C. and Hesse, M.A. (2024). mashadab/ice-layer-formation: v1.0.0. Zenodo. <https://doi.org/10.5281/zenodo.12706191>
- [5] **Shadab, M.A.** and Hesse, M. A., 2024. mashadab/VarSatFlow: v1.0 (v1.0). Zenodo. <https://doi.org/10.5281/zenodo.11398273>
- [4] **Shadab, M.A.**, Hiatt, E., and Hesse, M.A., 2022. mashadab/polubarinova-kochina-solutions: P-k tool v1.1 (v1.1). Zenodo. <https://doi.org/10.5281/zenodo.74786522>
- [3] **Shadab, M.A.**, Luo, D., Shen, Y., Hiatt, E., and Hesse, M.A., 2021. PINNs for Unconfined Groundwater Flow (v1.0). Zenodo. <https://doi.org/10.5281/zenodo.5803542>

- [2] **Shadab, M.A.** and Hesse, M.A., 2022. Gravity driven infiltration with the development of a saturated region (v1.0). Zenodo. DOI: 10.5281/zenodo.6558260. URL: <https://github.com/mashadab/hyperbolic-infiltration-theory>
- [1] **Shadab, M.A.**, 2021. Reservoir-Simulator. Zenodo. DOI: <https://doi.org/10.5281/zenodo.6581752>. URL: <https://github.com/mashadab/Reservoir-Simulator>