

Saad Akhtar

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Research Interests

Heat and mass transfer; Transport Phenomena; Mathematical modeling; Computational Fluid Dynamics; Finite Element Method, Multiscale modeling, Deep learning for engineering, Optimization analysis, Additive manufacturing

Research Experience

🏛 **Postdoctoral Fellow, Dept. of Mathematics & Industrial Engineering, Polytechnique Montréal** 📅 (Sep 2021 – Present)

- Devising a state-of-the-art topology optimization framework for conformal cooling channels adapted for additive manufacturing of moulds and dies
- Developing a novel conjugate heat transfer model to couple with an optimization routine in Python
- Coordinating with different stake holders from McGill University, METALTec industrial consortium and the National Research Council, Canada to meet the research objectives of an inter-sectoral, multidisciplinary project

🏛 **Part-time research assistant, Bioresource, Department, McGill University** 📅 (Jan 2021 – Dec 2021)

- Devised a novel Convolutional Neural Network (CNN) model using Tensor Flow library in Python to estimate piezoelectric properties
- Conducted structural optimization of the piezoelectric materials using Deep Neural Network (DNN)

🏛 **Graduate Research Intern, Construction Research Center, National Research Council, Canada** 📅 (Jan 2021 – Aug 2021)

- Implemented a mathematical framework in Python, based on reaction-diffusion-advection transport equation, to study the effect of indoor ventilation patterns on bio-contaminant spread
- Conceived a reduced order computational and statistical framework to quantify the effect of ventilation, breathing rate, and quanta emission on the risk of probable infection due to COVID-19 exposure in the indoor environments
- Coordinated a state-of-the art literature review on experimental and numerical studies investigating airborne transmission in COVID-19 spread

🏛 **Ph.D. Research, Dept. of Mining & Materials Engineering, McGill University** 📅 (Oct 2015 – August 2021)

- Developed a computational platform in Python that optimizes the operating conditions of the spray freezing system such as nozzle type, spray flow rate, air temperature, and air flow rate to maximize the heat transfer
- Devised a novel crystal growth model to incorporate realistic kinetics and curvature effects and optimized the thermo-physical and kinetic parameters
- Successfully fulfilled complementary research projects to the lab in the fields of artificial ground freezing, spray freezing for mine heating, and sub-surface ventilation in ultra-deep underground mines within grant timelines
- Actively spearheaded research grant proposals worth in excess of CAD 350,000 and supervised 7 graduate and undergraduate students
- Published over 18 scientific papers in reputed, peer-reviewed journals and conference proceedings
- Organized, coordinated, and attended several academic seminars, hackathons, & workshops to promulgate scientific discourse

 **Research Assistant, Dept. of Mechanical Engineering, Masdar Institute, UAE**  (2013 – 2015)

- Devised mathematical models for reaction kinetics and turbulence-reaction coupling in micro-combustors for thermo-photovoltaic (TPV) applications
- Developed and validated a computational reaction model for lean blow out limit in turbulent premixed combustion using Flamelet Generated Manifold (FGM) approach
- Collaborated with Creative Power Solutions AG to gather the experimental and numerical data for verification and validation of the model
- Published 3 first-author peer-reviewed scientific papers in the prestigious journal, *Applied Energy*

Relevant Research Skills

- Advanced proficiency in Matlab and Python for data analysis & visualization, implementing numerical solutions to the PDEs, and coding optimization algorithms for physical models
- Experienced with several libraries in Python such as Tensor flow, Keras (machine learning), NLOpt (optimization), Pandas, Seaborn, Numpy, Sklearn, Matplotlib (data analysis and visualization), Fipy (phase field method)
- Expert in implementing Monte-Carlo methods in MATLAB/Python to perform sensitivity analysis for different thermochemical applications
- Proficient in advanced data analysis techniques and deep learning methods (CNN and DNN) for engineering systems
- Experienced in working on collaborative projects with the industry and writing proposals and grant applications
- Intermediate proficiency in using github and gitlab for addressing issues on the code execution, reviewing pull requests, and pushing and committing changes to the code.
- Skilled in Wolfram Language to solve Partial Differential Equations (PDEs) in Mathematica
- Intermediate proficiency in Finite Volume and Finite Element softwares (Fluent, Comsol, and CFX)
- Expert in L^AT_EX for typesetting, organizing documents, and preparing research publications

Other Skills and Training

- *Machine Learning*: Taken several workshops and participated in hackathons organized by Physics and Computer Science departments at McGill University. Skilled in applying supervised learning algorithms (Classification and Regression) and Convolutional Neural Networks (CNN) for optimizing process parameters.
- *Finite Volume and Finite Element Solvers*: 7 years of experience in geometrical modeling, meshing, scripting, and implementing finite volume and finite element techniques in ANSYS Workbench, Fluent, Comsol, and StarCCM

Awards & Honors

2022	IVADO Postdoctoral Fellowship (CAD 70,000)
2022	NSERC Postdoctoral Fellowship (CAD 90,000)
2021	Best Student Paper Award at the 18 th North American Mine Ventilation Symposium
2021	FRQNT Postdoctoral Research Grant, <i>Quebec Government</i> (CAD 90,000)
2018	FRQNT Doctoral Grant, <i>Quebec Government</i> (CAD 84,000)
2015-2018	McGill Engineering Doctoral Award (CAD 96,000)
2018	Departmental Research Excellence Award, <i>McGill University</i> (CAD 2,500)
2017	Graduate Research Enhancement & Travel Award, <i>McGill University</i>
2017	Departmental Research Excellence Award, <i>McGill University</i> (CAD 2,500)
2015	Clean Combustion Research Centre (CCRC) Travel Fellowship, <i>KAUST</i>
2015	Scholar Athlete of the Year, <i>Masdar Institute</i>
2015	Certificate of Excellence for Outstanding Academic Performance, <i>Masdar Institute</i>
2013	Graduate Research Assistantship, <i>Masdar Institute</i> (\$ 72,000)
2013	International Renewable Energy Agency (IRENA) Scholarship
2008-2012	Dean's Honor Roll, <i>GIK Institute</i>

Education

 **McGill University, Canada**  (2015 – 2021)

Ph.D. Mining & Materials Engineering (*CGPA: 4.0*)

Thesis Title: Analytical and numerical investigation of spray freezing for mine heating (**Supervisor: Professor Agus Sasmito**)

 **Masdar Institute, UAE (In cooperation with MIT)**  (2013 – 2015)

MSc. Mechanical Engineering (*CGPA: 4.0*)

Thesis Title: Numerical investigation of flame structure and blow out limit for turbulent lean premixed methane-air flames under gas turbine conditions (**Supervisor: Professor Tariq Shamim**)

 **GIK Institute of Engineering Sciences, Pakistan**  (2008 – 2012)

B.S. Mechanical Engineering: Graduated with distinction (*Top 2%*)

Teaching Experience

 **Tutor & Grader, McGill University and Masdar Institute**  (2013 – 2020)

- Graduate tutor for the courses of Calculus I and Calculus II for two years (2018 and 2019)
- Delivered guest lectures for the graduate course of *Advanced sub-surface mine ventilation and Air-Conditioning* for a class strength of 15 graduate students
- Prepared course portfolio, conducted weekly tutorial sessions for 30 graduate students and graded midterm and finals exams as teaching assistant for the graduate course of Advanced Thermodynamics at Masdar Institute

 **Mentor/Supervisor, McGill University**  (2017 – 2020)

- Mentoring two junior Ph.D. students in asymptotic analysis, non-equilibrium thermodynamics, implementing optimization algorithms and mathematical modeling of phase-change processes in industrial applications (2019 – Present)
- Supervised 4 undergraduate research interns from Tunisia, France, and Canada from 2018 - 2020
- Conducted weekly meetings and trained the research interns in applying boundary value problems for PDEs to thermo-fluidic applications, High-Performance-Computing, and numerical methods

 **Tutor & Laboratory Instructor, GIK Institute (Full time)**  (2012 – 2013)

- Designed and graded weekly assignments, mid-term, and final exams for undergraduate thermodynamics and fluid mechanics courses
- Prepared and delivered weekly tutorials for these courses with a class strength of more than 70 students
- Developed instructor's manual and student worksheets, and supervised over 140 undergraduate student to conduct experiments related to fluid mechanics, heat transfer, HVAC
- Designed new experiments to demonstrate practical concepts related to phase change heat transfer and fluid flow

Professional Services and Leadership

Reviewer for Academic Journals  (2018 – Present)

- Contributed to the peer review process in scientific scholarship by reviewing pre-prints for the leading academic journals in the field
- Reviewed a total in excess of 10 journal manuscripts for the *International Journal of Heat and Mass Transfer*, *Applied Energy*, *Engineering Applications in Computational Fluid Mechanics*, *International Journal of Energy Research*, and *Applied Thermal Engineering*

Campus and Academic Leadership (2015 – 2019)

- Safety officer of the McGill Mine Multiphysics laboratory at the Mining and Materials Engineering Department
- Organizer, creator & lead presenter of the High Performance Computing workshop at McGill University (2019) attended by over 20 participants from 10 different countries
- Volunteer organizer for *Supporting Active Learning & Technological Innovation in Studies of Education (SALTISE)* conference attended by more than 520 attendees
- Student leader and organizer for the 7th International Applied Energy Conference, Abu Dhabi attended by more than 1500 academics from more than 50 countries
- Delivered workshops on using campus library resources and gave orientation presentations to the incoming graduate students at McGill University

Media Talks and Scientific Outreach

- Invited by the [Canadian Broadcasting Corporation \(CBC\)](#) to talk about my research on cough dynamics
- The research on cough dynamics was also covered by other news agencies and popular science media including [CTV News](#), [Science Daily](#), [Helsinki Times](#), and [McGill Newsroom](#)
- Invited by the McGill University Post Graduate Student Society's podcast titled "Graduate students and where to find them" to discuss my doctoral research
- Invited as the sole student representative for a university-wide panel talk organized by Teaching and Learning Services (TLS) at McGill University to share my FRQNT doctoral grant experience

Professional Affiliations

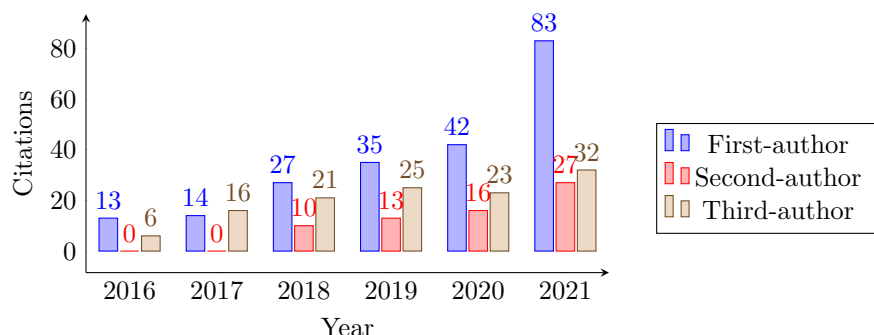
American Society of Mechanical Engineers (ASME)	 (2013 – Present)
Canadian Institute of Mining (CIM)	 (2015 – 2020)
Pakistan Engineering Council (PEC)	 (2012 – Present)
GIKI Mathematical Society (GMS)	 (2009 – 2012)

Referees

Dr. Agus Sasmito Doctoral thesis supervisor  agus.sasmito@mcgill.ca  (514) 398-3788  Associate Professor, Mining & Materials Engineering Dept., McGill University	Dr. Mitra Bahri Supervisor  mitra.bahri@nrc-cnrc.gc.ca  (514) 931-3478  Research Officer, Indoor Air Quality group, National Research Council, Canada	Dr. Tariq Shamim MSc. thesis supervisor  tshamim@niu.edu  (815) 753-9964  Professor & Chair, Mechanical Engineering Dept., Northern Illinois University
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Citation Indices (Google Scholar)

- **Total citations:** 416
- **h index:** 8
- **i10 index:** 6



Journal Publications

Refereed Journal Publications

- 2022 17. M. Xu, Y. Gao, F. Fu, **S. Akhtar**, B. Chaedir, and A. P. Sasmito. Experimental and unified mathematical frameworks of the temperature transition of water-ice phase change cold thermal energy storage. *International Journal of Heat and Mass Transfer (In Press)*, 2022
- 2021 16. J. Muthusamy, S. Haq, S. Akhtar, M. A. Alzoubi, T. Shamim, and J. Alvarado. Implication of coughing dynamics on safe social distancing in an indoor environment—a numerical perspective. *Building and Environment*, 206:108280, 2021. doi:[10.1016/j.buildenv.2021.108280](https://doi.org/10.1016/j.buildenv.2021.108280)
15. M. Xu, **S. Akhtar**, A. Zueter, V. Auger, M. Alzoubi, L. Sushama, and A. P. Sasmito. Modeling outward solidification in a hollow cylinder for phase change materials: Asymptotic analysis. *Applied Mathematics and Computations*, 2021. doi:[10.1016/j.amc.2021.126343](https://doi.org/10.1016/j.amc.2021.126343)
14. **S. Akhtar**, M. Xu, and A. Sasmito. A novel crystal growth model with non-linear interface kinetics and curvature effects: Sensitivity analysis and optimization. *Crystal Growth & Design*, 2021. doi:[10.1021/acs.cgd.0c01652](https://doi.org/10.1021/acs.cgd.0c01652)
13. **S. Akhtar**, M. Xu, and A. P. Sasmito. Development and validation of an asymptotic solution for a two-phase Stefan problem in a droplet subjected to convective boundary condition. *International Journal of Thermal Sciences*, 164:106923, 2021. doi:[10.1016/j.ijthermalsci.2021.106923](https://doi.org/10.1016/j.ijthermalsci.2021.106923)
- 2020 12. **S. Akhtar**, M. Xu, and A. P. Sasmito. Development and validation of a semi-analytical framework for droplet freezing with heterogeneous nucleation and non-linear interface kinetics. *International Journal of Heat and Mass Transfer*, page 120734, 2020. doi:[10.1016/j.ijheatmasstransfer.2020.120734](https://doi.org/10.1016/j.ijheatmasstransfer.2020.120734)
11. M. Xu, **S. Akhtar**, A. Zueter, V. Auger, M. A. Alzoubi, and A. P. Sasmito. Development of Analytical Solution for a Two-Phase Stefan Problem in Artificial Ground Freezing Using Singular Perturbation Theory. *Journal of Heat Transfer*, 142(12), 09 2020. doi:[10.1115/1.4048137](https://doi.org/10.1115/1.4048137). 122401
- 2018 10. **S. Akhtar**, S. Piffaretti, and T. Shamim. Numerical investigation of flame structure and blowout limit for lean premixed turbulent methane-air flames under high pressure conditions. *Applied Energy*, 228:21–32, 2018. doi:[10.1016/j.apenergy.2018.06.055](https://doi.org/10.1016/j.apenergy.2018.06.055)
- 2017 9. **S. Akhtar**, M. Kumral, and A. P. Sasmito. Correlating variability of the leakage characteristics with the hydraulic performance of an auxiliary ventilation system. *Building and Environment*, 121:200–214, 2017. doi:[10.1016/j.buildenv.2017.05.029](https://doi.org/10.1016/j.buildenv.2017.05.029)
8. L. Yuezé, **S. Akhtar**, A. P. Sasmito, and J. C. Kurnia. Prediction of air flow, methane, and coal dust dispersion in a room and pillar mining face. *International Journal of Mining Science and Technology*, 27(4):657–662, 2017. doi:[10.1016/j.ijmst.2017.05.019](https://doi.org/10.1016/j.ijmst.2017.05.019)
7. **S. Akhtar**, M. N. Khan, J. C. Kurnia, and T. Shamim. Investigation of energy conversion and flame stability in a curved micro-combustor for thermo-photovoltaic (TPV) applications. *Applied Energy*, 192:134–145, 2017. doi:[10.1016/j.apenergy.2017.01.097](https://doi.org/10.1016/j.apenergy.2017.01.097)
6. M. A. Alzoubi, **S. Akhtar**, M. Fong, and A. P. Sasmito. Characterization of an open-loop seasonal thermal energy storage system. In *Energy Procedia*, volume 142, pages 3401–3406. Elsevier, 2017. doi:[10.1016/j.egypro.2017.12.477](https://doi.org/10.1016/j.egypro.2017.12.477)

- 2016 5. J. C. Kurnia, S. V. Jangam, **S. Akhtar**, A. P. Sasmito, and A. S. Mujumdar. Advances in biofuel production from oil palm and palm oil processing wastes: a review. *Biofuel Research Journal*, 3(1):332–346, 2016. doi:[10.18331/BRJ2016.3.1.3](https://doi.org/10.18331/BRJ2016.3.1.3)
- 2015 4. **S. Akhtar**, J. C. Kurnia, and T. Shamim. A three-dimensional computational model of H₂-air premixed combustion in non-circular micro-channels for a thermo-photovoltaic (TPV) application. *Applied Energy*, 152:47–57, 2015. doi:[10.1016/j.apenergy.2015.04.068](https://doi.org/10.1016/j.apenergy.2015.04.068)
3. **S. Akhtar**, T. S. Khan, S. Ilyas, and M. S. Alshehhi. Feasibility and basic design of solar integrated absorption refrigeration for an industry. In *Energy Procedia*. Elsevier BV, 2015. doi:[10.1016/j.egypro.2015.07.441](https://doi.org/10.1016/j.egypro.2015.07.441)
2. **S. Akhtar**, M. N. Khan, J. C. Kurnia, and T. Shamim. Numerical investigation of H₂-air premixed combustion in a curved micro-combustor for thermo-photovoltaic (tpv) applications. In *Energy Procedia*, volume 75, pages 3060–3065. Elsevier, 2015. doi:[10.1016/j.egypro.2015.07.626](https://doi.org/10.1016/j.egypro.2015.07.626)
1. J. C. Kurnia, A. P. Sasmito, **S. Akhtar**, T. Shamim, and A. S. Mujumdar. Numerical investigation of heat transfer performance of various coiled square tubes for heat exchanger application. In *Energy Procedia*, volume 75, pages 3168–3173. Elsevier, 2015. doi:[10.1016/j.egypro.2015.07.655](https://doi.org/10.1016/j.egypro.2015.07.655)

Conference Proceedings¹

- 2021 8. M. Xu, **S. Akhtar**, and A. P. Sasmito. A heterogeneous nucleation model for supercooled water and sucrose solution droplets under ultra-cold environments. In *ASME International Mechanical Engineering Congress and Exposition (Paper accepted)*, 2021
7. **S. Akhtar**, M. Xu, and A. P. Sasmito. Spray freezing for mine heating - a statistical perspective. In *18th North American Mine Ventilation Symposium (Paper Accepted)*, 2021
- 2020 6. M. Xu, **S. Akhtar**, A. F. Zueter, M. A. Alzoubi, and A. P. Sasmito. Analytical modeling of outward solidification with convective boundary in cylindrical coordinates. In *ASME International Mechanical Engineering Congress and Exposition*, volume 84591, page V011T11A012. American Society of Mechanical Engineers, 2020
- 2019 5. **S. Akhtar**, M. Xu, and A. Sasmito. Verification and validation of droplet freezing for convective boundary condition using matched asymptotic perturbation method and computational fluid dynamics. In *ASME International Mechanical Engineering Congress and Exposition*, volume 59452, page V008T09A053, 2019. doi:[10.1115/IMECE2019-12081](https://doi.org/10.1115/IMECE2019-12081)
4. M. Xu, **S. Akhtar**, M. A. Alzoubi, and A. P. Sasmito. Singular perturbation solution for a two-phase Stefan problem in outward solidification. In *ASME International Mechanical Engineering Congress and Exposition*, volume 59452, page V008T09A050, 2019. doi:[10.1115/IMECE2019-11033](https://doi.org/10.1115/IMECE2019-11033)
- 2018 3. **S. Akhtar**, A. Madiseh, and A. Sasmito. Numerical investigation of a novel phase-change renewable energy system for underground mine heating and cooling. In *12th IIR Conference on Phase-Change Materials and Slurries for Refrigeration and Air Conditioning. Proceedings: Orford, Canada*, volume 2018-May, pages 50–57, 2018. doi:[10.18462/iir.pcm.2018.0007](https://doi.org/10.18462/iir.pcm.2018.0007)
- 2016 2. Y. Lu, **S. Akhtar**, A. Sasmito, and J. C. Kurnia. Numerical study of simultaneous methane and coal dust dispersion in a room and pillar mining face. In *3rd International Symposium on Mine Safety Science and Engineering*, pages 605–610, 2016. URL <https://isms2016.proceedings.mcgill.ca/article/view/178>

¹Underlined entries represent the conferences I delivered the presentations in as well.

- 2015 1. **S. Akhtar**, J. C. Kurnia, M. Khan, and T. Shamim. A three-dimensional computational model of H₂-air premixed combustion in a circular micro-channel for thermo-photovoltaic (tpv) application. In *AIP Conference Proceedings*, volume 1648, page 850098. AIP Publishing LLC, 2015. doi:doi.org/10.1063/1.4913153

Conference Presentations (Abstract Only)

- 2018 5. M. Xu, **S. Akhtar**, M. Alzoubi, and A. P. Sasmito. Development and verification of two-phase stefan problem using perturbation method for artificial ground freezing. Presented in the 27th *Canadian Congress of Applied Mechanics*, Sherbrooke, QC, Canada
- 2017 4. **S. Akhtar**, A. Madiseh, and A. P. Sasmito. Numerical Investigation of Spray Freezing- A Renewable Phase-Change Air Heating System. Presented in the *ASME Power and Energy conference*, Charlotte, North Carolina
3. M. Fong, **S. Akhtar**, and A. P. Sasmito. Numerical Investigation and Optimization Study of a Novel Seasonal Energy Storage System for Air-Conditioning Application". Presented in the *ASME Power and Energy conference*, Charlotte, North Carolina
- 2015 2. **S. Akhtar**, and T. Shamim. Numerical prediction of turbulent premixed flames near lean blowout limit for a gas turbine combustor. Poster presented in the *High Pressure High Reynolds Combustion (HPHRC) workshop*, Clean Combustion Research Centre (CCRC), KAUST, KSA
- 2012 1. T.S. Khan, **S. Akhtar**, and S. Ilyas. A review of solar cooling technologies. Presented in the *1st International Energy Conference* at TETRAPAK, Lahore, Pakistan