Mishal Thapa, Ph.D.

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Current research and future ambition

I am a Research Engineer at the Remote Sensing Center, where I lead various projects related to aerospace engineering with a focus on aerodynamics and structures. I am also associated with the Stochastic Mechanics and Optimization Laboratory, where I research algorithms related to uncertainty quantification, optimization, sensitivity analysis, machine/deep learning, etc.
To summarize, I am inquisitive and passionate about computational sciences and their applications to engineering problems. And my long-term goal is to contribute to the paradigm shift from a deterministic to a probabilistic design approach.

Academic/Research Interests

Uncertainty Quantification, Stochastic Optimization, Surrogate Modeling, Machine/Deep Learning, Sensitivity Analysis, Reliability, Data-Driven Modeling, Composite Structures (both computational and experimental), Wind energy (aerodynamics and structures), Aerodynamics, Self-Healing Composites, Finite Element Analysis, Computational Fluid Dynamics Simulation, Stochastic Processes, Multi-fidelity modeling.

Education

01/2020 – 12/2020 **Post-doctoral Research Associate, The University of Arizona**
Research Title: *Uncertainty Quantification and Design Optimization under Uncertainty of Composite Wind Turbines*
Advisor: *Dr. Samy Missoum*

01/2015 – 08/2019 **Ph. D., Aerospace Engineering and Mechanics, The University of Alabama, (GPA: 4.0/4.0)**
Dissertation Title: *Efficient Algorithms for Uncertainty Quantification using Polynomial Chaos Expansion and its Applications to Composite Structures.*
Advisor: *Dr. Sameer B. Mulani*

01/2015 – 12/2017 **M.S., Aerospace Engineering and Mechanics, The University of Alabama, (GPA: 4.0/4.0)**
Research Topics: *Uncertainty Quantification, Optimization, Composite Structures*
Advisor: *Dr. Sameer B. Mulani*

2008 – 2012 **B. Eng., Aeronautical Engineering, NUAA, China, (GPA: 4.1/5.0)**
Thesis Title Topics: *Conceptual Design and Analysis of Morphing Wing Aircraft*
Advisor: *Dr. Feng Xu*

2006 – 2008 **High School, Sagarmatha Higher Secondary School, Nepal (Grade: Distinction 78.0 %)**

Skills and Abilities

Engineering/ CAE Software	SolidWorks, CATIA, MSC NASTRAN/PATRAN, ANSYS (Mechanical and Fluent)/APDL, XFOIL, ABAQUS, Microsoft Office, AutoCAD.

Skills and Abilities (continued)

Programming/ Packages	**MATLAB, Python/PyTorch, MATHEMATICA**, C++, FORTRAN, Latex, GitHub, Linux (Basic)
Languages	English (fluent); Hindi (fluent); Chinese (medium); Nepali (native).
Interpersonal skills	Able to work independently or in a diverse team; Excellent leadership skills; Excellent work ethic; Highly motivated and inquisitive researcher.

Standardized test scores

GRE (Graduate Record Examination) score	327/340 - (Quantitative Reasoning: 168/170; Verbal Reasoning: 159/170)

Awards and Achievements

2018-2019	Graduate Council Fellowship, The University of Alabama.
2019	Graduate Student Conference Travel Funding
2010-2011	Full Attendance Award
2009-2010	Second Prize Scholarship of Undergraduate International Students Scholarship
	Honor of Excellent Performance
2008-2009	Second Prize Scholarship of Undergraduate International Students Scholarship
2008	Top 5 in the State, High School Examination
	Excellence in Math Award (Topper), High School Examination

Academic Honors Fraternities by Invitation

- The Honor Society of Phi Kappa Phi
- Golden Key International Honour Society

Academic Service as a Reviewer for Refereed Journals and Conferences

- AIAA Journal
- Structural and Multidisciplinary Optimization
- Applied Mathematical Modeling
- Thin-Walled Structures
- Smart Materials and Structures
- Journal of Composites Science
- Materials
- Fluids
- Engineering Analysis with Boundary Elements
- Wing Energy Science
- 2nd International Conference on Numerical Modeling in Engineering 2019
- International Mechanical Engineering Congress & Exposition IMECE 2020 (ASME)

Professional Memberships/ Involvements

- American Institute of Aeronautics and Astronautics **(Professional Member)**
- American Society for Composites
- American Society of Mechanical Engineers

- Judge at The Undergraduate Research and Creative Activity Conference, The University of Alabama, Tuscaloosa, 2019

Research Publications

Journal Articles

1. S. Gupta, A. Paudel, **M. Thapa**, S. B. Mulani, and R. W. Walters, "Adaptive sampling-based artificial neural network for surrogate modeling," *Aerospace Science and Technology (Accepted)*, 2023.
2. L. M. Santos, A. Lang, **M. Thapa**, *et al.*, "A root-mean-square intersection method for identification of vortex center," (*Manuscript in Preparation for Submission to Experimental Thermal and Fluid Science*), 2023.
3. **M. Thapa**, S. B. Mulani, A. Paudel, S. Gupta, and R. W. Walters, "Classifier-based adaptive basis selection for high-dimensional polynomial chaos," (*Manuscript in Preparation for submission to Computer Methods in Applied Mechanics and Engineering)*, 2023.
4. A. Paudel, S. Gupta, **M. Thapa**, S. B. Mulani, and R. W. Walters, "Higher-order taylor series expansion with efficient sensitivity estimation for uncertainty analysis," *Aerospace Science and Technology*, vol. 126, p. 107 574, 2022.
5. **M. Thapa** and S. Missoum, "Stochastic optimization of a horizontal-axis composite wind turbine blade," *Structural and Multidisciplinary Optimization*, vol. 65, no. 2, pp. 1–18, 2022.
6. **M. Thapa** and S. Missoum, "Uncertainty quantification and global sensitivity analysis of composite wind turbine blades," *Reliability Engineering and Sytem Safety*, vol. 222, p. 108 354, 2022.
7. **M. Thapa**, A. Paudel, S. B. Mulani, and R. W. Walters, "Uncertainty quantification and global sensitivity analysis for progressive failure of fiber reinforced composites," *Structural and Multidisciplinary Optimization*, vol. 63, no. 1, pp. 245–265, 2020.
8. **M. Thapa**, S. B. Mulani, and R. W. Walters, "Adaptive weighted least-squares polynomial chaos expansion with basis adaptivity and sequential adaptive sampling," *Computer Methods in Applied Mechanics and Engineering*, vol. 360, p. 112 759, 2019.
9. **M. Thapa**, S. B. Mulani, and R. W. Walters, "Stochastic multi-scale modeling of carbon fiber reinforced composite laminates with polynomial chaos expansion," *Composite Structures,*, vol. 2013, pp. 82–97, 2019.
10. J. Bodiuzzaman, **M. Thapa**, S. B. Mulani, and S. Roy, "Repeatable self-healing of thermosetting fiber reinforced polymer composites with thermoplastic healant," *Smart Materials and Structures*, vol. 28, no. 2, p. 025 037, 2018.
11. **M. Thapa**, S. B. Mulani, and R. W. Walters, "A new non-intrusive polynomial chaos using higher order sensitivities," *Computer Methods in Applied Mechanics and Engineering*, vol. 328, pp. 594–611, 2018.

Conference Proceedings

1. A. Paudel, S. Gupta, **M. Thapa**, S. B. Mulani, and R. W. Walters, "Uncertain buckling analysis of composite cylinders with initial geometric imperfection," in *: 2023 AIAA SciTech Forum, National-Harbor, Maryland, (Accepted)*, Jan. 2023.
2. N. Rowshan, S. Gupta, A. Paudel, **M. Thapa**, S. B. Mulani, and R. W. Walters, "New method of antithetic sampling for higher dimensionality," in *: 2023 AIAA SciTech Forum, National-Harbor, Maryland, (Accepted)*, Jan. 2023.
3. **M. Thapa**, S. B. Mulani, A. Paudel, S. Gupta, and R. W. Walters, "Adaptive sparse polynomial chaos based on a classifier and sequential sampling," in *: 2023 AIAA SciTech Forum, National-Harbor, Maryland, (Accepted)*, Jan. 2023.

4. S. Gupta, A. Paudel, **M. Thapa**, S. B. Mulani, and R. W. Walters, "Adaptive sampling-based artificial neural network for surrogate modeling," in *:AIAA SCITECH 2022 Forum*, 2022, p. 0805.

5. S. Gupta, A. Paudel, **M. Thapa**, S. B. Mulani, and R. W. Walters, "Efficient decoupled approach for robust design optimization," in *:AIAA AVIATION 2021 FORUM*, Aug. 2021, p. 3044.

6. A. Paudel, S. Gupta, **M. Thapa**, S. B. Mulani, and R. W. Walters, "Regularized solution to underdetermined system in polynomial chaos for uncertainty quantification," in *: 4th National Conference on Multidisciplinary, Design, Analysis, and Optimization, Virtual Conference*, Oct. 2021.

7. **M. Thapa**, A. Paudel, S. Gupta, *et al.*, "Aero-structural design and analysis of pylons for a 16-element airborne radar antenna array," in *: 26th International Symposium on Polar Sciences (ISPS2021)*, Sep. 2021.

8. A. Paudel, **M. Thapa**, S. Gupta, S. B. Mulani, and R. W. Walters, "Higher-order taylor series expansion with efficient sensitivity estimation for uncertainty analysis," in *: AIAA AVIATION 2020 FORUM*, 2020, p. 3164.

9. **M. Thapa** and S. Missoum, "Design of composite wind turbine blades under uncertainties," in *:2nd annual Arizona Postdoctoral Research Conference, September 2020.*, Sep. 2020.

10. **M. Thapa** and S. Missoum, "High-dimensional uncertainty quantification and global sensitivity analysis of a composite wind turbine blade," in *:ASC 35th Annual Technical Conference, Virtual Conference: American Society of Composites*, Sep. 2020.

11. **M. Thapa** and S. Missoum, "Stochastic optimization of a horizontal-axis composite wind turbine blade," in *:ASME International Mechanical Engineering Congress and Exposition*, vol. 84669, American Society of Mechanical Engineers, Sep. 2020, V014T14A026.

12. **M. Thapa**, A. Paudel, S. B. Mulani, and R. W. Walters, "Global sensitivity analysis for stochastic responses of fiber reinforced composites with polynomial chaos," in *: 2020 AIAA SciTech Forum, Orlando Florida*, Jan. 2020.

13. N. Vishe, J. Bodiuzzaman, **M. Thapa**, S. B. Mulani, and S. Roy, "Healing of mode-i fatigue crack in fiber reinforced composites using thermoplastic healants," in *: 2020 AIAA SciTech Forum, Orlando Florida*, 2020, p. 2104.

14. J. Bodiuzzaman, **M. Thapa**, S. B. Mulani, and S. Roy, "Experimental characterization of shape memory polymer enhanced thermoplastic self-healing carbon/epoxy composites," in *: AIAA Science and Technology Forum and Exposition*, 2019, p. 1112.

15. **M. Thapa**, J. Bodiuzzaman, N. Vishe, S. B. Mulani, and S. Roy, "A comparative numerical and experimental study of mode-i interlaminar fracture of self-healing composites using cohesive zone modeling," in *: ASC 34th Annual Technical Conference, Atlanta, Georgia*, 2019.

16. **M. Thapa**, A. Paudel, S. B. Mulani, and R. W. Walters, "Efficient adaptive sparse polynomial chaos expansion with l1-minimization and sequential sampling," in *: AIAA Science and Technology Forum and Exposition 2019*, 2019, p. 1226.

17. **M. Thapa**, A. Paudel, S. B. Mulani, and R. W. Walters, "Stochastic progressive failure analysis of fiber-reinforced composite laminate," in *: 2019 AIAA Aviation and Aeronautics Forum and Exposition, Dallas, Texas, June 17-21*, 2019, p. 3553.

18. J. Bodiuzzaman, **M. Thapa**, S. B. Mulani, and S. Roy, "Repeatability of non-autonomous self-healing with thermoplastic healing agent in fiber reinforced thermoset composite," in *: ASC 33rd Annual Technical Conference, Seattle, Washington*, Sep. 2018.

19. M. W. Fister, **M. Thapa**, and S. B. Sameer B. Mulani, "Adaptive higher-order integration method and its applications in uncertainty quantification," in *: 2018 AIAA Non-Deterministic Approaches Conference, AIAA Science and Technology Forum and Exposition 2018, Kissimmee, Florida*, Jan. 2018, p. 1408.

20 **M. Thapa**, S. B. Mulani, and R. W. Walters, "Variance-based adaptive sparse polynomial chaos with adaptive sampling," in *: 2018 AIAA Non-Deterministic Approaches Conference, AIAA Science and Technology Forum and Exposition 2018, Kissimmee, Florida*, Jan. 2018, p. 2168.

21 **M. Thapa**, S. B. Mulani, and R. W. Walters, "Multi-scale uncertainty quantification of fiber reinforced composites using polynomial chaos decomposition," in *:American Society for Composites 31st Technical Conference and ASTM Committee D30 Meeting, Williamsburg, Virginia, D.C, 2203*, 2016.

22 **M. Thapa**, S. B. Mulani, and R. W. Walters, "Polynomial chaos decomposition with differentiation operation," in *:17th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, Washington, D.C.*, 2016, p. 4288.

Books and Chapters

1 **M. Thapa**, J. Bodiuzzaman, S. B. Mulani, and S. Roy, *Development of Intelligent and Predictive Self-Healing Composite Structures Using Dynamic Data-Driven Applications Systems*, In: Handbook of Dynamic Data-Driven Applications Systems, 2nd Edition. Springer, Cham, 2022, vol. 1.

2 **M. Thapa**, S. B. Mulani, and R. W. Walters, *Polynomial Chaos for Uncertainty Quantification: Past, Present, and Future*, In: Uncertainty Quantification: Advances in Research and Applications. Nova Publishers, 2019.

3 **M. Thapa**, J. Bodiuzzaman, S. B. Mulani, and S. Roy, *Intelligent Self-Healing Composite Structure Using Predictive Self-Healing and Dynamic Data-Driven Application System*, In: Handbook of Dynamic Data-Driven Applications Systems. Springer, 2018.

Research Experience/Inner College Training

01/2020-12/2020	**Postdoctoral Research Associate** (Uncertainty Quantification, Stochastic Optimization, Wind Energy)
2018-2019	**Research Assistant** (Uncertainty Quantification; Self-Healing Composites Structures)
Fall 2017	**Research Assistant** (Self-Healing Composites Structures)
Summer 2017	**Research Assistant** (Adaptive Sparse Polynomial Chaos Expansion; Adaptive Higher-Order Integration Method and its Applications in Uncertainty Quantification Structural Sizing and Analysis of the UWB Antenna Assemblies for Basler BT-67)
Summer 2016	**Research Assistant** (Polynomial Chaos Decomposition with Differentiation)
2012-2013	**Researcher** Research and Development of UAV at Design Empire Pvt. Ltd
2012	**Researcher** Bachelor Graduation Thesis NUAA (Design and Optimization of Morphing Wing Aircraft)
	Researcher The Design and Fabrication of Blended Wing Body Electric-Powered Unmanned Air Vehicle (Part of the team, NUAA)

Teaching/Advising Experience

Teaching

Fall 2022	Guest Lecture for Stochastic Mechanics Topics covered: Global Sensitivity Analysis, Sparse PCE using regularized l1-minimization- Orthogonal Matching Pursuit, Data-driven arbitrary PCE
Spring 2017	Instructor (Lab of Mechanics of Materials)
Fall 2016	Instructor (Lab of Mechanics of Materials)
Spring 2016	Teaching Assistant (Mechanics of Materials)

Teaching/Advising Experience (continued)

Fall 2015	Teaching Assistant (Statics)
Summer 2015	Teaching Assistant (Dynamics)
Spring 2015	Teaching Assistant (Dynamics)

Advising

I have advised several graduate students jointly with Dr. Sameer B. Mulani at the Stochastic Mechanics and Optimization Laboratory (SMO Lab at UA). The topics covered are uncertainty quantification, stochastic optimization, machine learning, finite element analysis, computational fluid dynamics simulations, and so on.

- **Dr. Achyut Paudel (2018-2022)**
  Ph.D. Dissertation Title: Efficiency Improvements For Uncertainty Quantification And Applications To Composite Structures
  Research topics: Uncertainty Quantification, Finite Element Analysis.
- **Subham Gupta (Ph.D. Candidate, 2019-2024)**
  Research topics: Robust Optimization, Machine Learning/Neural Networks, Curvilinear Composites.
- **Nadiya Rowshan (Ph.D. Student, 2022-2026)**
  Research topics: Sampling Methods, Uncertainty Quantification.
- **Omar Abdullah O Taha (Masters Student, 2021-2022)**
  Research topics: Computational Fluid Dynamics Simulation of NACA Airfoils, Multifidelity Modeling for the Aerodynamic Responses of Twin-Otter Aircraft.

Professional Experience

- **Senior Research Personnel-Aeronautics and Engineering Mechanics, The Remote Sensing Center, The University of Alabama (01/2021-Present)**
  Major Responsibilities
  - Perform aerodynamic analysis of radar antenna array structures
  - Perform structural design and finite-element analysis of structures being developed at the Remote Sensing Center
  - Collaborate with faculties from different disciplines on multi-disciplinary projects
  - Perform research on uncertainty quantification, optimization, and machine learning; and implement it for engineering design improvement
  - Mentor and train graduate and undergraduate students
- **Postdoctoral Research Associate, AME, University of Arizona (01/2020-12/2020)**
  Major Responsibilities/Outcomes
  - Developed a fully parametric composite wind turbine blade finite element model
  - Developed a framework for stochastic optimization of composite wind turbine blades considering the aero-structural aspects
  - Perform research on uncertainty quantification, optimization, global sensitivity analysis
  - Provide guidance to graduate students
  - Identify potential sources for grant funding
  - **Published two journal papers, two conference papers, and one poster based on my one-year post-doc research**
- **Graduate Research/Teaching Assistant, AEM, University of Alabama (2015-2019)**

Major Responsibilities

- Performed research on Uncertainty Quantification/Optimization and published several journals, book chapters, and conference papers
- Carried out design and structural analysis of the UWB-Radar Assembly, Mill Cross Radar (for Antarctica Mission), VHF Duol-Pol Antenna Panel, and Composite Stiffened Panel for the Fuselage Section of an Aircraft
- Mentored junior members with CAD modeling and FEA analysis

- **Design and Research Engineer, Design Empire Pvt. Ltd, Nepal (11/2012-07/2014)**
  Major Responsibilities
  - Identify the user's requirement for the product to be developed
  - Designed the products using CATIA
  - Carried out structural analysis with NASTRAN/PATRAN
  - Research and development of UAV

Grants/Funding

- **Airborne Ultra-Wideband Radars for Polar Research: A19-0250-003;**
  Budget: $397,309.00; (co-PI 15% share)
  Our team at The University of Alabama (UA) Remote Sensing Center proposed the development of an ultra-wideband (UWB) radar designed with the largest possible antenna array for airborne sounding and imaging of ice sheets to the Korean Polar Research Institute (KOPRI). This radar will allow measuring the ice thickness for generating 3-D topography of the ice bed for selected areas and mapping air-snow and snow-ice interfaces to estimate the snow thickness on sea ice.

References

Available on Request