

# NISHANT BHATTA

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## Career Profile

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Ph.D. in Mechanical Engineering specializing in computational model development for diverse applications. Passionate about solving complex engineering challenges through creative solutions and skilled in effectively communicating technical concepts with interdisciplinary teams to drive innovation.

## Selected Experience

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### North Carolina State University

Aug. 2021 – Present

*Graduate Research Assistant*

*Raleigh, NC*

- Designed a multiphase simulation model for centrifugal desaturation to characterize wetting saturation of a virtual nonwoven filter. The simulation results were compared by designing an experimental setup driven by centrifugal force to generate a force-saturation curve for the first time in the study of coalescence filtration.
- Developed an in-house MATLAB code to implement the Pore Morphology Method (PMM) to predict fluid distribution in a porous media. The PMM results were validated with the CFD-based volume-of-fluid (VOF) method, and the FEA-based energy minimization method (EMM). The PMM method was orders of magnitude faster than the conventional CFD methods.
- Designed a novel simulation framework to predict the performance of a coalescing filter by coupling the fluid distribution from the PMM with the discrete phase model (DPM). The proposed PMM-DPM framework successfully predicted the collection efficiency and pressure drop of a liquid-loaded filter and was computationally affordable.
- Developed an electrohydrodynamic model to investigate the effects of droplet deposition on the aerosol capture efficiency of bipolarly charged fibers. The model incorporated electrostatic interactions, fluid dynamics, and aerosol-fiber interactions to predict the collection efficiency of a liquid-loaded charged filter.
- Designed a convolution neural network (CNN) model to predict saturation field in different 2D fibrous geometries. The model accurately predicts the saturation field across the specified range of fiber topologies.

### North Carolina State University

Jan. 2021 – July. 2021

*Graduate Teaching Assistant (Spring '21, Summer '21)*

*Raleigh, NC*

- Designed the syllabus for Mechanical Engineering Laboratory I (MAE 305) for undergraduate students. The course structure includes hands on experience with basic electrical circuits, strain gauge installation, temperature measurement, and fabrication and characterization of composite materials.
- Responsibilities included lecturing and grading the course.

### Advanced College of Engineering and Management

Nov. 2016 – Dec. 2020

*Instructor*

*Lalitpur, Nepal*

- Crafted an engaging curriculum for undergraduate students on Engineering Thermodynamics and Engineering Drawing. Emphasized a project-centric and hands-on learning approach to facilitate comprehensive understanding and practical application of concepts.
- Responsibilities included lecturing and grading the course.

### Innovation, Incubation and Entrepreneurship Center (IIEC)

Apr. 2017 – Mar. 2019

*Graduate Research Assistant*

*Lalitpur, Nepal*

- Devised a model to configure the motion of a concept medical drone flying in complex terrain with unknown weather conditions to deliver medical supplies. The mathematical model was implemented in MATLAB. For control system, PID controller was used for attitude control while PD controller was used for position control.
- Developed analytical model to predict periodic forces in the buckets due to the impingement of jet on a Pelton turbine.
- Designed an analytical framework to predict the transverse vibrations in Pelton turbine when there is mass unbalance in both the Pelton disk and shaft. Analytical predictions were compared with XL Rotor (industrial roto dynamic solver).

### E&T Nepal Pvt. Ltd.

Nov. 2015 – Apr. 2016

*CAD Engineer*

*Bhaktapur, Nepal*

- Worked on Lagrangian-based Smoothed Particle Hydrodynamics (SPH) method as a part of the solver team to improve solver in the company. C++ was used as the programming language.
- Solid modeling and generative shape design in CATIA software was used to design various industrial parts.

## Education

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### North Carolina State University

*PhD in Mechanical Engineering (GPA: 4.0)*

Jan. 2021 – Dec. 2024

Raleigh, NC

### Pulchowk Campus, Tribhuvan University

*M.Sc. in Mechanical Systems and Design Engineering (Score: 86.53 %)*

Apr. 2017 – Apr. 2019

Lalitpur, Nepal

### Pulchowk Campus, Tribhuvan University

*Bachelor of Engineering in Mechanical Engineering (Score: 79.85 %)*

Nov. 2011 – Nov. 2015

Lalitpur, Nepal

## Relevant Coursework

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|------------------------------|----------------------------|--------------------------------|--------------------------------|
| • Two-phase Flow Simulations | • Advanced Fluid Mechanics | • Computational Fluid Dynamics | • Linear/Non-linear Vibrations |
| • Turbulence                 | • Finite Element Analysis  | • Control Systems              | • Non-linear Dynamics          |

## Publications

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### Journal Publications

- **Bhatta, N.**, Gautam, S., Kumar, A., Tafreshi, H. V., & Pourdeyhimi, B. (2024). [Novel quasi-static method to simulate collection efficiency and pressure drop of coalescing filters.](#) *Journal of Aerosol Science*, 106486.
- **Bhatta, N.**, Tafreshi, H. V., & Pourdeyhimi, B. (2024). [Toward formulating coalescence filtration: Characterizing wetting saturation via centrifugal force.](#) *International Journal of Multiphase Flow*, 170, 104641.
- **Bhatta, N.**, Gautam, S., Farhan, N. M., Tafreshi, H. V., & Pourdeyhimi, B. (2024). [Accuracy of the pore morphology method in modeling fluid saturation in 3D fibrous domains.](#) *Industrial & Engineering Chemistry Research*, 63(42), 18147-18159.
- Gautam, S., **Bhatta, N.**, Kumar, A., Tafreshi, H. V., & Pourdeyhimi, B. (2024). [Matlab implementation of pore morphology method for modeling liquid residue in porous media with heterogeneous wettabilities.](#) *Powder Technology*, 120509.
- Kumar, A., Gautam, S., **Bhatta, N.**, Tafreshi, H., & Pourdeyhimi, B. (2024). [Effects of droplet deposition on aerosol capture efficiency of bipolarly charged fibers.](#) *Soft Matter*.
- Rahman, SM., **Bhatta, N.**, Tafreshi, H., & Pourdeyhimi, B. (2024). [Deep Convolutional Neural Network Based Prediction of Fluid Saturation in 2D Fibrous Media via Pore Morphology Method.](#) *Chemical Engineering Science*. (under review)

### Conference Proceedings

- Bhattarai, S., Poudel, K., **Bhatta, N.**, Mahat, S., Bhattarai, S. and Thapa Magar, K.S., 2018. [Modeling and development of baseline guidance navigation and control system for medical delivery uav.](#) In *2018 AIAA Information Systems-AIAA Infotech@ Aerospace* (p. 0508).
- **Bhatta, N.**, Luintel, M.C., Tharu, J.K. and Karki, S., 2019. [Vibration response of Pelton turbine unit under rotating unbalance.](#) In *Proceedings of IOE Graduate Conference* (Vol. 6, pp. 101-107).
- Tharu, J.K., **Bhatta, N.**, Karki, S. and Luintel, M.C., 2019. [Free Vibration Analysis of Simply Supported Pelton Turbine: A Case of Flexible Rotor Bearings.](#) In *Proceedings of IOE Graduate Conference*.

### Book Chapters

- **Bhatta, N.**, Dura, H. B., Tharu, J. K., & Luintel, M. C. (2021). [Analytical Prediction of the Jet Force in Pelton Turbine.](#) In *International Conference on Vibration Engineering and Technology of Machinery* (pp. 115-132). Singapore: Springer Nature Singapore.

## Thesis

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### Dynamic Response of Pelton Turbine Unit under Rotating Unbalance | *Master's thesis* March 2019

- Developed an analytical framework to predict turbine vibrations in the Pelton turbine when there is mass unbalance in both the disk and the shaft.
- Investigated the transverse oscillation behavior of the Pelton turbine unit under the rotating unbalance (both free and forced vibrations).
- Analyzed flow-induced vibrations due to the impact of the water jet on the Pelton buckets.
- Compared the results of the analytical framework with XL rotor (industrially available rotor dynamic solver).

### Numerical Modeling of Multi-rotor Hovercraft System | *Undergraduate Thesis* October 2015

- Developed a mathematical framework to model the motion of a concept medical drone flying in a complex terrain with unknown weather conditions to deliver medical supplies.
- Designed MATLAB Simulink model of the entire control system and sub-systems of the medical drone.
- Created MATLAB scripts to simulate the dynamic behavior of the medical drone.
- Conducted simulations to understand the response of the medical drone under various input conditions, and used that information to stabilize it (feedback control).

## Projects

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### Droplet detachment from fiber in electric field | *SolidWorks, ANSYS Fluent, C++* March 2023

- Created user-defined functions (UDFs) in ANSYS Fluent to simulate the polarization and Coulomb forces acting on a droplet in the presence of an electric field.
- Conducted VOF simulations (with UDFs) to study detachment of droplets from a fiber.

### Multiphase flow solver for channel flow | *Python, MATLAB* March 2023

- Created an incompressible flow solver (from scratch) to solve the Navier-Stokes equation on staggered grids for an open-channel flow problem.
- Implemented level-set method to track the interface of the droplet as it advects across the domain.
- Implemented surface tension as a body force term in the momentum equation.

### Filtration simulation | *SolidWorks, ANSYS Fluent, Mathematica* October 2021

- Created non-overlapping virtual filters in a given simulation domain.
- Used DPM model to track the particles in a flow-field. Pressure Drop and Collection efficiency were calculated.

### Turbulence | *MATLAB* March 2021

- Predicted turbulence statistics from a set of velocity data obtained from large eddy simulation of a turbulent shear layer, for instance, correlation coefficient, PDF, joint PDFs, marginal PDFs, autocorrelations, and integral time-scales.
- Reynolds Averaged Navier Stokes (RANS) turbulence models were employed to study flow along a flat plate. Spalart Allmaras (one-equation model) and k-omega (two-equations model) were used for the study.
- Predicted Taylor length scales and 1-D energy spectra from large eddy simulation (LES) data. Subgrid viscosity calculations were made through different eddy viscosity models.

### Noise-induced Bifurcations | *MATLAB, Mathematica* March 2021

- Gaussian white noise was included in a periodically driven elastic oscillator to form stochastic differential equations.
- Performed Euler-Maruyama simulation for the approximate solution of stochastic differential equations.
- Different parameters for the periodically driven elastic oscillator were varied, and subsequent FFT plots were analyzed to study the dynamics of the oscillator.

## Presentations

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### Presentation

- **Flow-less coalescence filtration experiment: A novel approach to study instantaneous saturation in nonwovens.** Semi-annual IAB conference meeting held at NC State University (*Fall '21 to Spring '24*).
- **PMM-DPM simulation of aerosol droplet filtration using a coalescing filter.** Multiphase Flow Workshop, 2024, held at Morgantown organized by the National Energy Technology Laboratory (NETL).
- **Pore morphology method for modeling liquid intrusion in porous media.** Multiphase Flow Workshop, 2024, held at Morgantown organized by the National Energy Technology Laboratory (NETL).

## Poster Presentation

- **Characterizing wetting saturation using centrifugal force in nonwoven filters.** Semi-annual IAB conference meeting held at NC State University (*Fall '21 to Spring '24*).
- **Modeling centrifugal desaturation in a virtual nonwoven filter.** Research Innovation and Science for Engineered Fabrics (RISE) conference, Raleigh, NC (*Fall '22, Fall '23*).
- **Modeling coalescence filtration.** MAE Symposium (*Spring '22, Spring '23, Spring '24*).

## Technical Skills

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**Programming Languages:** Python, C/C++, MATLAB, Maple, Mathematica

**Design and Modeling:** SolidWorks, CATIA, Design Modeler, SpaceClaim

**Computational Fluid Dynamics (CFD):** ANSYS Fluent (with UDFs), Star-CCM+, FloTherm, Icepak

**Finite Element Analysis (FEA):** Surface Evolver, ANSYS Mechanical, COMSOL

**Multiphase Modeling:** Volume-of-Fluid (VOF) method, Level-set method, GeoDict

**Discrete Element Method:** Altair EDEM, ANSYS Rocky, MFIX

**Machine Learning:** Neural Networks (CNN, DNN, LSTM), Linear and Logistic Regression, Support Vector Machines (SVM), Principal Component Analysis (PCA)

**Experimental:** Goniometer, Porometer, High-speed camera, Raspberry PI, Electrospinning, SEM, TEM, DOE

**Others:** High-Performance Computing (HPC), Data Processing, MS packages, LaTeX, Techplot

## Awards

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1. MAE Symposium Spring 2022 Poster Competition Winner at NC State University
2. MAE Symposium Spring 2024 Poster Competition Winner at NC State University
3. 'Best Technical Award' winner for excellence in technical presentation at The Nonwoven's Institute Industrial Advisory Board Meeting for research on modeling coalescence filtration. (Spring 2024)
4. Induction into Phi Kappa Phi Honor Society for outstanding academic achievements.
5. College of Engineering (COE) travel award Fall 2024.

## Leadership / Extracurricular

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### Nepalese Student Association (NSA)

**Jan. 2022 – Aug. 2023**

*Primary Advisor*

*North Carolina State University*

- Acted as a mediator between NSA and the university.
- Advised the committee to work towards goals that improve and promote community service, academics, and unity.
- Helped the new-coming students settle into life in the US by passing them relevant information.

### Society of Mechanical Engineering Students (SOMES)

**2019**

*Organizing Committee*

*Pulchowk Campus, Nepal*

- Helped to conduct the first-ever national civil-mechanical expo on the campus which was visited by around ten thousand people.
- Managed the logistics for the event and assigned duties to juniors to perform specific tasks.

## References

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**Professor Hooman V. Tafreshi (Email: [hvtafres@ncsu.edu](mailto:hvtafres@ncsu.edu))**

**Professor Behnam Pourdeyhimi (Email: [bpourdey@ncsu.edu](mailto:bpourdey@ncsu.edu))**

**Professor Tiegang Fang (Email: [tfang2@ncsu.edu](mailto:tfang2@ncsu.edu))**