NAREN VOHRA

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EDUCATION

Ph.D. candidate, Mathematics, *Oregon State University (OSU).* *2018 – Present*

Advisor: Prof. Malgorzata Peszynska.

Expected *2023*.

Master of Science, Mathematics, *OSU.* *2018 – 2020*

Master of Science, Major in Mathematics, *Indian Institute of Science (IISc),* Bangalore, India. *2017 – 2018*

Bachelor of Science, Major in Mathematics, *IISc.* *2012 – 2017*

PUBLICATIONS

1 L. Bigler, M. Peszynska, and N. Vohra, **Heterogeneous Stefan Problem and Permafrost Models with P0-P0 Finite Elements and Fully Implicit Monolithic Solver**, *Electronic Research Archive, 2022*, 30 (4), 1477–1531. DOI: 10.3934/era.2022078

2 C. Shin, A. Alhammali, L. Bigler, N. Vohra, and M. Peszynska, **Coupled flow and biomass-nutrient growth at pore-scale with permeable biofilm, adaptive singularity and multiple species**. *Mathematical Biosciences and Engineering, 2021*, 18 (3), 2097-2149. DOI: 10.3934/mbe.2021108

AWARDS AND ACHIEVEMENTS

Lightning Talk Award *2022*

Awarded 2^{nd} place at the 2022 Student Lightning Talks, Los Alamos National Laboratory, for talk *Well-balanced Discretizations of Shallow Water Systems on Arbitrary Polygonal Meshes.*

Oregon Lottery Graduate Scholarship *2022*

Awarded by the Graduate School, OSU, for the academic year 2022 – 2023.

Graduate Student Excellence Award *2022*

Department of Mathematics, OSU.

Oberwolfach Leibniz Graduate Students *2022*

Received support from Mathematisches Forschungsinstitut Oberwolfach to attend an Oberwolfach workshop (Id: 2204) in person.

NSF Mathematical Sciences Graduate Internship *2021*

Internship at Los Alamos National Laboratory funded by Oak Ridge National Laboratory during Summer 2021.

Outstanding Performance in Coursework Award *2019, 2021*

Department of Mathematics, OSU.

INSPIRE Fellow *2012–2013, 2015–2016*

Awarded the INSPIRE Fellowship from August 2012 - January 2013 and August 2015 - July 2016 after securing admission into IISc through the AIEEE.

All India Rank 506 in AIEEE *2012*

Secured an All India Rank of 506 in the 2012 All India Engineering Entrance Examination, taken by approximately 1.1 million students across the country.

EXPERIENCE

Research

I am working on analysing different numerical schemes to implement thermo-hydro-mechanical models which are used to simulate energy, flow, and deformation in multiple phase systems. Specifically, I am looking to efficiently and accurately model the freezing and thawing processes in permafrost. Recently, I have worked on the implementation of a mixed finite element formulation of the heterogeneous Stefan problem. I have also worked on the implementation of different formulations of the Biot model which governs the deformation and flow in porous media.

Graduate Research Assistant, OSU *Summer, Fall 2019, Spring, 2020, Fall 2021, Winter 2022*

Support from NSF Grant NSF DMS-1522734 and DMS-1912138 on "Phase transitions in porous media across multiple scales" (PI: Malgorzata Peszynska).

Los Alamos National Laboratory *6/21–8/27/2021, 6/20–8/26/2022*

Worked under the guidance of Dr. Svetlana Tokareva and Dr. Konstantin Lipnikov in the Applied Mathematics and Plasma Physics group of Theoretical Division at Los Alamos National Laboratory (LANL) as a NSF Mathematical Sciences Graduate Internship participant (2021) and as a LANL Graduate Student (2022).

Studied well-balanced, depth positivity preserving numerical schemes for solving the shallow water equations in the numerical framework *Amanzi*, and further studied the coupling of surface flow with subsurface flow and solute transport.

Woodwell Climate Research Center *4/18–6/10/2022*

Worked under the guidance of Prof. Malgorzata Peszynska, Dr. Elchin Jafarov, and Dr. Brendan Rogers on modeling deformation due to permafrost thaw by analyzing the poroelasticity system. Further analyzed the effect of unfrozen water content on the active layer depth settlement.

Technical University of Munich, Germany *1/30–2/4/2022*

Visited Prof. Barbara Wohlmuth's group in the Department of Mathematics at Technical University of Munich.

Ongoing work on permafrost models and the challenges associated with their numerical implementation, with particular emphasis on introducing visco-elasticity to analyse deformation.

Graduate Teaching Assistant, OSU *2018–Present*

Spring 2021: Grader for Advanced Calculus, Probability 3.

Winter 2021: Grader for Models and Methods of Applied Mathematics, Probability 2.

Fall 2020: Differential Calculus.

Winter 2020: Calculus for Management and Social Science.

Spring 2019: Calculus for Management and Social Science.

Winter 2019: Differential Calculus.

Fall 2018: Differential Calculus.

Project Trainee at CAOS, IISc *2016–2018*

Project at Center for Atmospheric and Oceanic Sciences (CAOS) at IISc under the guidance of Prof. Venugopal V. and Dr. Fabrice Papa.

Worked on the analysis of the decadal cycle in Ganges river discharge and its relation to the Indian Monsoon by using time-frequency analysis, particularly the wavelet transform.

Teaching Assistant, IISc *8–12/2017*

Teaching Assistant for the course *Probability and Statistics* taught by Prof. M.K.Ghosh at IISc.

In-charge of clearing doubts of students and grading their exams.

PRESENTATIONS AND CONFERENCES/WORKSHOPS ATTENDED

1 LANL Lightning Talk (oral), *Well-balanced Discretizations of Shallow Water Systems on Arbitrary Polygonal Meshes*, Naren Vohra, Svetlana Tokareva, Konstantin Lipnikov, *8/9/2022*.

2 Woodwell Climate Research Center (oral), *Modeling Subsidence Due To Permafrost Thaw*, Naren Vohra, Malgorzata Peszynska, Elchin Jafarov, Brendan Rogers, *6/2/2022*.

3 SIAM PNW (oral, invited), *Mixed Finite Elements for the Permafrost Model and Steps Towards Thermo-hydro-mechanical Coupling*, Naren Vohra, Malgorzata Peszynska, *5/21/2022*.

4 The Finite Element Circus, University of Florida, *4/8–4/9/2022*

5 Applied Math and Computational Seminar, OSU (oral), *Mixed Finite Elements for the Heterogeneous Stefan Problem and Application to Multiscale Multiphysics Models of Permafrost*, Naren Vohra, Lisa Bigler, Malgorzata Peszynska, *3/11/2022*.

6 Oberwolfach Workshop on "Multiscale Coupled Models for Complex Media: From Analysis to Simulation in Geophysics and Medicine" (Workshop Id: 2204), Mathematisches Forschungsinstitut Oberwolfach, *1/23–1/29/2022*.

7 The Finite Element Circus, Penn State University, *11/5–11/6/2021*.

8 NSF-MSGI Presentation (oral), *Well-balanced Discretizations of Shallow Water Systems on Arbitrary Polygonal Meshes*, Naren Vohra, Svetlana Tokareva, Konstantin Lipnikov, *8/12/2021*.

9 SIAM GS21 (oral), *Accounting for Mass and Volume Conservation in a Coupled Flow-Deformation-Energy Model at Pore-Scale*, Naren Vohra, Malgorzata Peszynska, *6/21–6/24/2021*.

10 SIAM CSE21 (oral), *Coupled Biot and Phase Transition Model at Pore-Scale*, Naren Vohra, Malgorzata Peszynska, *3/1–3/5/2021*.

11 Joint Mathematics Meeting, *1/6–1/9/2021*.

12 InterPore Short Course, *Multiphase Flow in Permeable Media: A Pore-Scale Perspective*, Professor Martin Blunt, Imperial College London, *12/7–12/10/2020*.

13 Second Joint SIAM/ CAIMS Annual Meeting (poster), *Coupling of Flow and Deformation in Porous Media at the Network Scale*, Naren Vohra, Malgorzata Peszynska *7/6–7/17/2020*.

14 Applied Math and Computation Seminar, OSU (oral), *A Multiscale Study of the Biot System and the Stefan Problem*, Naren Vohra, Malgorzata Peszynska, *5/29/2020*.

15 7^{th} Annual Cascade RAIN Meeting (oral), *Coupling of Flow and Deformation in Porous Media at Network Scale*, Naren Vohra, Malgorzata Peszynska, *4/4/2020*.

16 2^{nd} Biennial Meeting of SIAM Pacific Northwest Section, Seattle University, *10/18–10/20/2019*.

17 Mathematical Problems In Industry Workshop, New Jersey Institute of Technology, *Construction of the PDF of fiber size and distribution using finite samples* (project sponsored by Gore Technologies), *6/17–6/21/2019*.

18 Graduate Student Mathematical Modeling Camp, University of Delaware, *Modeling flow and fouling in elastic membrane filters*, *6/12–6/15/2019*.

19 OpenFOAM Workshop, OSU, *6/3–6/4/2019*.

20 6^{th} Annual Cascade RAIN Meeting, University of Washington, Bothell, *4/13/2019*.

SELECTED COURSEWORK

OSU (*2018–Present*)
Real Analysis I, II, III
Abstract Linear Algebra
Partial Differential Equations (PDE) I,II,III
Models and Methods of Applied Mathematics
Variational Methods for PDE
Structural Mechanics
Numerical Analysis I, II, III
Finite Volume and Discontinuous Galerkin Methods

IISc (*2012–2018*)
Functional Analysis
Measure Theory
Introduction to Dynamical Systems Theory
Partial Differential Equations
Fourier Analysis
Probability Models
Homogenization of Partial Differential Equations
Digital Image Processing

Uncertainty Quantification
Linear and Nonlinear Optimization
Finite Elements for PDE

SKILLS

Programming languages

MATLAB (expert), $C++$ (advanced), Python (advanced)

Computing environments and frameworks

Amanzi (Contributor) [https://github.com/amanzi/amanzi], deal.II [https://dealii.org], ParaView, Git, Blender, OpenFOAM

TRAVEL AWARDS

SIAM Pacific Northwest Section Annual Meeting (PNW21), travel award, *2022*.
SIAM Conference on Mathematical & Computational Issues in the Geosciences (GS21), travel award, *2021*.
SIAM Conference on Computational Science and Engineering (CSE21), travel award, *2021*.
Graduate Student Professional Development Award (OSU) for Joint Mathematics Meeting, registration support, *2021*.
Mathematical Problems in Industry, New Jersey Institute of Technology, full support, *2019*.
Graduate Student Mathematical Modeling Camp, University of Delaware, full support, *2019*.
Annual Cascade RAIN Meeting, University of Washington, travel support, *2019*.

SERVICE

OSU Student Chapter SIAM *2019 – Present*

President (elected), *2021 – Present*.
Organized talks by alumni and programming language tutorials for chapter members.
Helped increase number of members by at least 10 so far.

Mathematics Ad Hoc Review Committee *2022 – Present*

Member (invited) of the ad hoc committee to review the current PhD qualifying requirements in the department of mathematics.

Mathematics Graduate Program Ambassador *2022 – Present*

Involved in outreach to potential applicants.