

ANANTHA NARAYANAN SURESH BABU

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Google Scholar

EDUCATION

PhD, Massachusetts Institute of Technology

2023 - Present

Major: Mechanical Engineering & Computation, GPA: 5.00/5.00

Advisor: Prof. Pierre Lermusiaux

SM, Massachusetts Institute of Technology

2021 - 2023

Major: Mechanical Engineering, GPA: 5.00/5.00

Thesis: Stochastic Sea Ice Modeling with the Dynamically Orthogonal Equations

B. Tech (with Hons.), Indian Institute of Technology (IIT) Madras

2016 - 2020

Major: Mechanical Engineering, GPA: 9.56/10.00

RESEARCH INTERESTS

Scientific machine learning, Stochastic modeling, Bayesian learning, Model learning, Sea ice dynamics, Fluid & ocean dynamics

RESEARCH EXPERIENCE

Scientific deep learning and neural closure modeling for fluid and ocean flows

Massachusetts Institute of Technology

Graduate Research Project | Advisor: Prof. Pierre Lermusiaux

2022 - Ongoing

- Implemented neural operator-based models for predicting fluid and real oceanic flows in the Atlantic and Massachusetts Bay.
- Currently working on developing physics-inspired deep neural architectures & neural closure models for 2D turbulent geophysical flows and submesoscale ocean processes.

Stochastic modeling and Bayesian learning for sea ice dynamics

Massachusetts Institute of Technology

Graduate Research Project | Advisor: Prof. Pierre Lermusiaux

2021 - Ongoing

- Derived and implemented new dynamically orthogonal equations and schemes for stochastic sea ice field modeling and uncertainty quantification.
- Currently implementing Bayesian model learning to learn and discover sea ice parameters, external forcing, model formulations, new rheologies, and their probability distributions.

Analysis based construction of a hyperelastic potential for collagenous tissues

IIT Madras

Undergraduate Thesis | Advisor: Prof. Krishnakannan

Sep 2019 - Jul 2020

- Developed a hyperelastic potential through a priori analysis of constitutive inequalities for intestinal tissues.
- Predicted the stretch limit of deformation and failure envelopes for all modes of deformation.

Constitutive modeling of time-dependent behavior of hydrogels

IIT Madras

Undergraduate Research | Advisor: Prof. Arockiarajan

Dec 2017 - May 2019

- Developed constitutive models for the viscoplastic behavior of freeze-dried and cross-linked hydrogels.

PUBLICATIONS

Narayanan, A., and Lermusiaux, P.F.J. (2024). "Stochastic sea ice modeling with the Dynamically Orthogonal equations: Theory and applications". In preparation.

Narayanan, A., and Lermusiaux, P.F.J. (2024). "Neural closure modeling for 2D fluid dynamical systems and geophysical flows". In preparation.

Lermusiaux, P.F.J., Narayanan, A., et al. (2024). "Review of machine learning methods for partial differential equations in fluid and ocean dynamics". In preparation.

Rajagopal, E., Narayanan, A., Ryu, T., Haley, Jr., Mirabito, C., and Lermusiaux, P.F.J. (2023). "Evaluation of deep learning models towards ocean forecasting". OCEANS '23 IEEE/MTS Gulf Coast, 25-28 September 2023. 10.23919/OCEANS52994.2023.10337380

Narayanan, A., Rajan, A., Pramanik, R., and Arockiarajan, A. (2019). "A thermodynamically-consistent phenomenological viscoplastic model for hydrogels". Materials Research Express, 6(8), 085418. DOI: 10.1088/2053-1591/ab2a49

Pramanik, R., Narayanan, A., Rajan, A., et al. (2019). "Theoretical modeling and experimental characterization of transversely isotropic hydrogels". International Journal of Engineering Science, 144, 103144. DOI: 10.1016/j.ijengsci.2019.103144

Rajan, A., Pramanik, R., Narayanan, A., and Arockiarajan, A. (2019). "Mechanics of viscoelastic buckling in slender hydrogels". Materials Research Express, 6(5), 055320. DOI: 10.1088/2053-1591/ab0691

FELLOWSHIPS & AWARDS

MathWorks Mechanical Engineering Fellowship (2023-2024), (2024-2025), MIT, awarded to graduate students who actively use MathWorks software in their research

Martin A. Abkowitz International Travel Fellowship in Ocean Engineering (2023), MIT, awarded to attend the SIAM Geosciences conference in Bergen, Norway

Homer A. Burnell Presidential Graduate Fellowship (2021), School of Engineering, MIT, awarded to outstanding incoming graduate students at MIT

MITACS Globalink Summer Research Fellowship (2019), awarded to pursue a fully funded 12-week research internship at the University of British Columbia, Vancouver

CONFERENCES

Presentations

"Stochastic modeling & learning for sea ice dynamics", 2024 SIAM Conference on Mathematics of Planet Earth, Portland, Oregon

"Probabilistic modeling & Bayesian learning for coupled sea ice-ocean dynamics", 17th U. S. National Congress on Computational Mechanics, Albuquerque, New Mexico

"Bayesian data assimilation & learning for coupled sea ice-ocean systems", 2023 SIAM Conference on Mathematical & Computational Issues in the Geosciences, Bergen, Norway

Posters

"Probabilistic modeling and Bayesian learning for sea ice dynamics", 2024 Ocean Sciences Meeting, New Orleans, Louisiana

PROFESSIONAL SERVICE

Reviewer - Journal of Physics D: Applied Physics, IOPscience

since 2024

Reviewer - Physica Scripta, IOPscience

since 2024

Reviewer - Ocean Modelling, Elsevier

since 2023