PRERNA PATIL

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RESEARCH INTERESTS

I am currently a postdoctoral researcher at the University of Washington, Seattle advised by Profs. Steve Brunton and Nathan Kutz. Prior to this, I completed my doctorate in the computational modeling and simulation (CMS) program at the University of Pittsburgh, under the mentorship of Prof. Hessam Babaee.

My current research interests are

- ◇ Uncertainty quantification
- ◇ Stochastic PDEs
- ◇ Reduced order modeling
- ◇ Data driven modeling
- ◇ Closure modeling

EDUCATION

University of Pittsburgh *August 2017 - August 2022*
Ph.D in Computational Modeling and Simulation

Brown University *August 2015 - June 2017*
Sc.M in Fluids and Thermal Sciences

Indian Institute of Technology Madras *August 2010 - July 2014*
B.Tech in Aerospace Engineering
Minor: Systems Engineering

PUBLICATIONS

- ◇ Patil, Prerna, and Hessam Babaee. 'Real-time reduced-order modeling of stochastic partial differential equations via time-dependent subspaces.'Journal of Computational Physics 415 (2020): 109511.
- ◇ Patil, Prerna, and Hessam Babaee. "Reduced-Order Modeling with Time-Dependent Bases for PDEs with Stochastic Boundary Conditions." SIAM/ASA Journal on Uncertainty Quantification 11.3 (2023): 727-756.

TECHNICAL STRENGTHS

Coding experience	C/C++, MATLAB, Python, OpenMP, MPI, CUDA
Software & Tools	ICEM-CFD, GridGen, Ansys, Nektar, LATEX, Git

CONFERENCE TALKS

American Physical Society - Division of Fluid Dynamics

- Presented a talk on 'Real-time reduced order modeling of deterministic partial differential equations using time dependent basis'at the at the 75th meeting of the American Physical Society- Division of Fluid Dynamics(APS-DFD) in November 2022 at Indianapolis, Indiana.
- Presented a talk on 'Dynamically bi-orthonormal formulation for stochastic partial differential equations'at the at the 72st meeting of the American Physical Society- Division of Fluid Dynamics(APS-DFD) in November 2019 at Seattle, Washington.
- Presented a talk on 'Reduced order modeling of stochastic bifurcation in naturally convected flows'at the at the 71st meeting of the American Physical Society- Division of Fluid Dynamics(APS-DFD) in November 2018 at Atlanta, Georgia.
- Presented a talk on 'Multi-fidelity modelling for cylinder flow'at the 69th meeting of the American Physical Society- Division of Fluid Dynamics(APS-DFD) in November 2016 at Portland, Oregon.

COURSEWORK

Engineering Courses
Fluid Mechanics
CFD
Reduced Order Modeling
Introduction to Combustion theory
Numerical Solutions of Partial Differential Equations

Other Courses
Introduction to Machine Learning
Deep Learning
Probability and Statistics
Probability Theory
Computational Probability and Statistics

RESEARCH EXPERIENCE

Time delay embedding to uncover unstable periodic orbits and exact coherent structures in chaotic fluid systems
Postdoctoral research

Advisors: Steven Brunton & Nathan Kutz

- Evaluated the use of long-time delay embeddings to capture progressively sophisticated unstable periodic orbits (UPOs) of a chaotic system
- The time delay embeddings obtained for these UPOs can be further used to predict the global characterizations of the dynamics of the attractor including natural measure, fractal dimensions, and Lyapunov exponents.
- Demonstrated that for long time delay embeddings, UPOs disentangle and converge to a discrete Fourier decomposition.

Reduced-order modeling of stochastic partial differential equations via time-dependent subspaces
Doctoral research

Advisor: Hessam Babaee

- Implemented model driven reduced order modeling techniques to solve stochastic PDEs using time-dependent basis. The stochasticity is introduced in the flow using random initial conditions, boundary conditions and/or random parameters.
- Developed new methodology called the dynamic bi-orthonormal (DBO) method for decomposition of the random field. Demonstrated equivalence to the dynamic orthogonal (DO) method and bi-orthogonal (BO) method and exhibited better numerical properties for DBO.
- Using the variational principle the evolution equations were developed for SPDEs with stochastic non-homogeneous boundary conditions. The method was implemented for stochastic Dirichlet, Robin and Neumann boundary conditions.

- ◇ Application of the method include problems in uncertainty quantification, linear sensitivity analysis, passive and reactive species transport and compressible flows.

Time-dependent basis to solve partial differential equations
Doctoral research

Advisor: Hessam Babaee

- ◇ Implemented the time dependent basis to solve deterministic partial differential equations by exploiting the low-dimensional correlations in the flow field
- ◇ The developed technique has been implemented to solve compressible Navier-Stokes equation

Multi-fidelity Modelling for flow over cylinder
Master's Thesis

Advisor: George Karniadakis

- ◇ Implementing multi-fidelity framework to obtain the response surfaces for $C_{P(mean)}$, $C_{L(RMS)}$ and $C_{D(RMS)}$ vs Reynolds Number.
- ◇ Implementing Co-kriging to combine data from 3D DNS simulations(high fidelity) and 2D simulations (low-fidelity) and predict values at new points.
- ◇ This method will effectively reduce the computational cost and time to obtain response surfaces which depend on multiple parameters.

INTERNSHIP EXPERIENCE

Los Alamos National Laboratory June 2017 - August 2017

Parallel Computing Summer Research Internship

- ◇ Shown parallelism in high-performance computing are readily applicable to machine learning algorithms.
- ◇ Demonstrated that the ARock asynchronous algorithm set provides a fast and reliable method for classifying hyper-spectral imaging data.
- ◇ Poster presented at Los Alamos National Laboratory Student Symposium poster session-2017. [Poster pdf]

OTHER ACTIVITIES

- ◇ Obtained Private pilot's license (PPL) from Moore Aviation on July 2022. Trained on a Cessna 172R single engine land aircraft.