Rohit K S S Vuppala

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Ph.D student (RVD Distinguished Graduate Fellow)

Ex-Visiting Researcher (Palo Alto Research Center)

EDUCATION

Oklahoma State University, Stillwater, OK

Ph.D student (Unmanned Aerial Systems track - Aerospace Engineering), 2020-Ongoing

-Realistic wind data generation and wind-field prediction for Safe Wind-Aware navigation of small-UAVs in city spaces.

-Currently adopting Machine Learning and Data-driven methods coupled with Reduced Order Models to use large-scale high fidelity atmospheric data for local wind field prediction.

North Carolina State University, Raleigh, NC

Masters in Mechanical Engineering, 2017-2020

-Line Based Discontinuous Galerkin Methods for Compressible Fluid Flow.

-Developed a high performance, multi-processor computational fluid dynamics code using MPI in Fortran for compressible fluid flows.

National Institute of Technology, Trichy, India

B.Tech(Hons) in Mechanical Engineering. 2013-2017

-Numerical modeling of arc welding of Ti-alloys

-Implemented a novel heat model for simulating the arc welding process to predict the weld bead dimensions and characteristics.

RESEARCH EXPERIENCE

Safe Wind-Aware Navigation for Collaborative Autonomous Aircraft in Low Altitude Airspace

Research Assistant, Oklahoma State University, OK.

Description: The project aims to validate the hypothesis that 'in-time' gust awareness by a pilot or an autopilot, can enhance safety, efficiency and robustness of future autonomous aircraft operations in low altitude airspace.

Responsibilities:

- Currently working on developing a framework in **Python** (PINN, POD-LSTM, CAE) for realistic wind data generation and prediction using Data-driven, Reduced Order Modeling and Machine Learning using high-fidelity CFD data.
- Sub-team lead for generating Atmospheric/Wind CFD data using Large-Eddy Simulation from idealised atmospheric flow solvers like CM1 (Cloud Model 1), PALM (Parallelised Large Eddy Simulation Models) and solvers like OpenFOAM.
- Working in collaboration with Unmanned Systems Research Institute (USRI); Systems, Cognition, and Control Laboratory (SCC); Control, Robotics and Automation Laboratory (CoRAL) at Oklahoma State University as a part of National Robotics Initiative (NRI-NSF).

Machine Learning surrogate models for Patient specific Hemo-dynamic modeling of arterial diseases

Visiting Researcher/Research Internship, Palo Alto Research Center (PARC).

Description: The project aims to validate the hypothesis that physics based Machine Learning models could be used to generate patient specific cardio-vascular models for diagnosis and intervention of cardio-vascular diseases like arterial stenosis and brain aneurysms.

Responsibilities:

- Developed a Physics Informed Neural Network framework to generate data agnostic and data inclusive Machine Learning models for blood flow in stenosis and aneurysms.
- Provides an end-to-end framework for reading in actual patient geometries from 3D scans and generating a surrogate model for blood flow.
- The capabilities include point cloud generation for arbitrary geometries, user specified refinement regions, etc.

Scientist in-loop, Machine Learning accelerated semantic segmentation of volumetric X-ray tomography images

Visiting Researcher/Research Internship, Palo Alto Research Center (PARC).

Description: The project was aimed to validate the hypothesis that Machine Learning methods could be used to accelerate semantic segmentation capabilities for 3D volumetric X-ray tomography images. Worked as part of team, organised by Berkeley Lab and Palo Alto Research Center.

Responsibilities:

- Developed a random forest based ML algorithm to accelerate semantic segmentation with input from human in-loop segmentation of 2D slices.
- Eliminated the need for manual volumetric segmentation, observed a 20x speed up in the total time required for volumetric segmentation.
- Provided an end-to-end framework for reading in the volumetric data from 3D X-Ray tomography scans, take user inputs for segmentation on 2D slice and generate a 3D segmented volume.
- Used Napari(Python) for building 3D viewer and application for the project.

Line-Based Discontinuous Galerkin method for Compressible Fluid Flows

Research Assistant, North Carolina State University, NC. 2018-2020

Description: The project was aimed at developing a higher-order multi-processor capable compressible fluid flow solver based on Line-Discontinuous Galerkin methodology.

Responsibilities:

- Developed a MPI based high-performance CFD solver using Fortran for compressible fluid flow computation.
- Initial results published in a technical paper at AIAA AVIATION 2019 forum.

Response Surface Optimisation of Polymer Electrolyte Membrane Fuel Cell

Research Assistant, McGill University, Montreal, Canada. 2016 Summer

Description: The project was aimed at developing a multi-phase, multi-species, electrochemical, numerical model for validation and optimisation of PEM Fuel Cells from experimental data using ANSYS Fluent.

Responsibilities:

- Validate the experimental data with the numerical model.
- Evaluate parameters like porosity, ionomer tortousity, size of cathode catalyst particle for ideal Voltage-Current characteristics.
- Create a Response Surface (RSM) from Design of Experiments (DoE) for parameter search to obtain optimum results, instead of computationally expensive CFD runs.
- Published the research in 'Molecules', a peer reviewed journal.

SKILLS

- Experience in developing codes and framework for machine learning and data-driven approaches using Tensor Flow (Python).
- Experience with High Performance Computing and developing MPI based applications for large-scale CFD solvers.
- Proficient in programming languages like Fortran, C++, Python, Julia.
- Worked with atmospheric CFD solvers like Cloud Model 1 (CM1), Parallelised Large Eddy Simulation Model (PALM), mesoscale numerical weather prediction solvers like WRF(Beginner).
- Worked with higher-order/hyper-sonic CFD solvers like Nek5000,US3D, Nektar++ and other CFD solvers like OpenFOAM, Fluent, COMSOL.
- Level 1 High Power Rocketry Certified, qualified to fly rocket motors till class I .

ACHIEVEMENTS AND EXTRA-CURRICULAR

- **Roy and Virginia Dorrough Distinguished Graduate Fellow (2022-2023)**, College of Engineering, Architecture and Technology at Oklahoma State University.
- **Vice-President** of the Mechanical and Aerospace Engineering Graduate Student Association at Oklahoma State University.
- Winner for Berkeley Lab(LBL) - Palo Alto Research Center (PARC) joint hackathon for semantic segmentation of volumetric X-Ray tomography of animal cells.
- Received prestigious Graduate Student Travel Award from School of Mechanical and Aerospace Engineering.
- Winner of Quantum Winter Hackathon, a multi-physics based challenge using quantum computing.
- Qiskit IBM summer school graduate on Introductory Quantum Computing and Quantum Machine Learning
- MITACS Globalink 2016 Summer Fellowship, DAAD WISE 2016 Summer Fellowship

ACTIVITIES OF BROADER IMPACT

- Organised ”Intro to scientific machine learning” workshop as part of DataByte series at Edmon Low Library Oklahoma State University. The workshop was open to the general public, students and faculty at Oklahoma State University.
- Adjudicated at Oklahoma State Science and Engineering Fair (OSSEF) as a special judge.
- Mentored undergraduate research students, along with students in under-represented communities, with a publication at a conference.

RESEARCH PUBLICATIONS

- Vuppala, Rohit KSS, and Kursat Kara. ”Deep Learning for Realistic Wind Field Prediction in Various Urban Morphologies for Application to Small Unmanned Aerial Systems.” *AIAA SCITECH 2023 Forum. 2023.*
- Robb, Caleb S., Rohit KSS Vuppala, Ryan C. Paul, and Kursat Kara. ”Flight Dynamics of a Flying Wing Aircraft Featuring the Bell Spanload.” *AIAA SCITECH 2023 Forum, p. 2610. 2023.*
- Creese, A., Vuppala, R. K., Hernandez, S. D., & Rouser, K. P. (2023). ”Engine cycle design and Integration of Component Interfaces of a Micro Turbojet Engine for Additive Manufacturing.” *AIAA SCITECH 2023 Forum (p. 1465).*

- Vuppala, Rohit KSS, and Kursat Kara. "A non-intrusive reduced order model using deep learning for realistic wind data generation for small unmanned aerial systems in urban spaces." *AIP Advances 12.8 (2022): 085020.*
- "Wind Field Prediction in Urban Spaces for small Unmanned Aerial Systems using Convolutional Autoencoders, Rohit KSS Vuppala and Kursat Kara *AIAA AVIATION 2022 Forum. 2022.*"
- "A Novel Approach in Realistic Wind Data Generation for The Safe Operation of Small Unmanned Aerial Systems in Urban Environment, Vuppala, Rohit KSS, and Kursat Kara. *AIAA AVIATION 2021 FORUM. 2021.*"
- "Variance Reduction of Quadcopter Trajectory Tracking under Stochastic Wind Disturbances, Tabassum, Asma, Rohit KSS Vuppala, He Bai, and Kursat Kara." arXiv preprint arXiv:2104.10266 (2021)."
- Vuppala, Rohit KSS, et al. "Optimization of membrane electrode assembly of PEM fuel cell by response surface method." *Molecules 24.17 (2019): 3097.*
- "Higher Order Line-Based Discontinuous Galerkin method for compressible flows" *AIAA AVIATION 2019 Forum, 3211*
- "Furkan Oz, Rohit K. S. S. Vuppala, Kursat Kara and Frank Gaitan. Solving Burgers' Equation with Quantum Computing".
- "Investigation of Airflow around Buildings using Large Eddy Simulations for Unmanned Air Systems Applications.", Landua, T. R., Vuppala, R. K. S. S., and Kara, K. (2022). *In AIAA SCITECH 2022 Forum (p. 1688)*.

PRESENTED TALKS

- Vuppala, Rohit, et al. "Wind Field Prediction in Urban Spaces using Machine Learning based Reduced Order Models for Unmanned Aerial Systems." 103rd AMS Annual Meeting. AMS, 2023.
- Vuppala, Rohit Kameshwara Sampath Sai, and Kursat Kara. "Physics Informed Neural Network model for wind field prediction in urban spaces for small Unmanned Aerial Systems." *APS Division of Fluid Dynamics Meeting Abstracts. 2022.*
- Vuppala, Rohit Kameshwara Sampath Sai, and Kursat Kara. "Realistic Wind Data Generation for Small Unmanned Air Systems in Urban Environment using Convolutional Autoencoders." *APS Division of Fluid Dynamics Meeting Abstracts. 2021.*
- "Data-driven realistic wind data generation for safe operation of Small Unmanned Air Vehicles in urban environment" *Mini-Symposium Reduced Order Modeling in the Age of Data, Southeastern Atlantic Section Conference, Society Of Industrial and Applied Mathematics (SIAM-SAES 2021)*
- "A Machine Learning Approach to Predict Wind Field Data" *40th ASME|AIAA Regional Symposium, Oklahoma State University, April 3, 2021*
- "Large-Eddy Simulation of Atmospheric Boundary-Layer Gusts for Small Unmanned Air Systems, Vuppala, Rohit KSS, and Kursat Kara." *Bulletin of the American Physical Society (2020)*.
- "Realistic Wind Data Generation for Small Unmanned Air Systems in Urban Environment using Convolutional Autoencoders, Vuppala, Rohit KSS, and Kursat Kara. " *Bulletin of the American Physical Society (2021)*.
- "A Machine Learning Approach to Predict Wind Field Data, Vuppala Rohit KSS and Kursat Kara." *40th ASME|AIAA Online Regional Symposium, Oklahoma State University*