Sambhu H. Karumanchi

Personal Information

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website

Research Interests

Machine Learning, Robotics, and Vision-based Control

Education

University of Illinois Urbana-Champaign, Urbana, IL, USA

Doctor of Philosophy in Mechanical Engineering, 08/2023 - Present
Advisor : Prof. Naira Hovakimyan GPA : **4.0/4**

Master of Science in Aerospace Engineering, 08/2021 - 08/2023
Advisor : Prof. Naira Hovakimyan GPA : **4.0/4**

National Institute of Technology Karnataka, Surathkal, India

Bachelor of Technology in Mechanical Engineering, 08/2016 - 06/2020
Advisor : Prof. Prasad Krishna & Prof. Patricio Vela GPA : **9.35/10**

Publications

[7] Robust Model Based Reinforcement Learning using $\mathcal{L}_1$ Adaptive control
Minjun Sung*, **Sambhu H. Karumanchi***, Aditya Gahlawat, Naira Hovakimyan
International Conference on Learning Representations (**ICLR**), 2024

[6] Empirical Dynamic Programming for Controlled Diffusions
Sambhu H. Karumanchi, Mohamed A. Belabbas, Naira Hovakimyan
IFAC-PapersOnLine, 2023

[5] Autonomous UAV Navigation in Complex Environments using Human Feedback
Sambhu H. Karumanchi, R. Diddigi, KJ Prabuchandran, Shalabh Bhatnagar
IEEE International Conference on Robot and Human Interactive Communication (**RO-MAN**), 2023

[4] Real-time Autonomous Vehicle Navigation under Unknown Dynamics
Shubham Kedia and **Sambhu H. Karumanchi**
IEEE Intelligent Transportation Systems Conference (**ITSC**), 2023

[3] Tackling Airspace Congestion : A Scalable and Robust Framework for End-to-End UAS Traffic Management
Minjun Sung, **Sambhu H. Karumanchi**, Christophe H.M., H. Kim and Naira Hovakimyan
IEEE Intelligent Transportation Systems Conference (**ITSC**), 2023

[2] Integrated Perception and Planning for Autonomous Vehicle Navigation : An Optimization-Based Approach
S. Kedia, Yu Zhao, **Sambhu H. Karumanchi**
IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (**CVPRW**), 2023

[1] Closed-loop benchmarking of stereo visual-inertial SLAM systems : Understanding the impact of drift and latency on tracking accuracy
Y. Zhao, J.S. Smith, **Sambhu H. Karumanchi** and Patricio Vela
IEEE International Conference on Robotics and Automation (**ICRA**), 2020

Awards

- **MechSE Outstanding Scholar Fellowship**, University of Illinois Urbana-Champaign, 2023
- **University Student Research Challenge (USRC)**, NASA, 2022

Selected Projects

Optimal Control using Physics-Informed Neural Networks (PINNs) :

Supervisor : Prof. Matthew West and Prof. Luke Olson

- Trained PINNs to solve the Hamilton-Jacobi-Bellman (HJB) PDE for trajectory optimization in non-linear systems
- Compared the performance of the framework with constrained numerical optimization techniques such as shooting methods and direct transcription

Approximate Dynamic Programming for Dynamic Resource Allocation

Supervisor : Prof. Cedric Langbort

- Considered cost-effective allocation of freights to two different modes of transport - a high capacity long-haul followed by last-mile transport or direct last-minute transport to the destination - when orders randomly arrive at a single origin with shipping requests to different destinations.
- An approximate dynamic program was formulated and solved using the linear programming approach

Physics-Informed Neural Networks for Aerodynamic Design Optimization

Supervisor : Prof. Elle Wroblewski

- Developed a physics-informed neural network model to determine the optimal aerodynamic shape design for the flows modeled using the Navier-Stokes equation.
- The system was modeled as a controlled Partial Differential Equation with the boundary shape of the aerofoil acting as the control.
- The optimization model accommodates generic performance functions such as achieving a target surface pressure distribution or a desired lift-to-drag ratio

Research Experiences

Research Intern Indian Institute of Science, Bangalore, India *07/2020 - 08/2021*

- Worked on preference-based reinforcement learning for UAV obstacle avoidance and autonomous navigation (**RO-MAN 2023**)

Research Intern Georgia Tech, GA, USA *08/2019 - 12/2019*

- Performed closed-loop benchmarking study of various stereo visual-inertial SLAM systems (**ICRA 2020**)

Skills

Programming languages : C, C++, Python, Julia

Libraries : Robot Operating System(ROS), TensorFlow, Pytorch, OpenCV

Softwares : MATLAB, CATIA, LabVIEW.