Malintha Fernando

Ph.D. Candidate

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Research Overview

Toward Scalable, Cooperative Fleet Autonomy: With the dawn of *autonomous mobility*, and *Beyond 5G* networks there is a growing demand for coordinating *connected*, *mobile* robot fleets in stochastic environments. My research aims to answer the question: how to develop *heterogeneous* robot fleet autonomy to achieve *application-specific* group objectives in a *cooperative* and *scalable* manner? I study game theory, graph neural networks and deep multi-agent reinforcement learning to develop fleet autonomy along these dimensions with focus on low-level dynamics.

Education

Indiana University, Bloomington — ***Fall 2017 - Spring 2023***

Ph.D. in Intelligent Systems Engineering
M.S. in Intelligent Systems Engineering — *Fall 2021*
Supervised by: Prof. Martin Swany

Major: Computer Engineering
Minor: Mathematics

University of Moratuwa, Sri Lanka — ***2011 - 2015***

B.Sc.(Hons.) in Information Technology — *December 2015*

Royal College, Sri Lanka — ***2002 - 2010***

GCE Advanced Level (Physical Sciences) — *2010 (Top 5% Nationwide)*
GCE Ordinary Level — *2007 (10 out of 10 'A' Passes)*

Work Experiences

Open Robotics — ***Summer 2019***
Mountain View, California

Software Engineer Intern — *Mentor: Tully Foote*

Contributions: Designed a framework for UAV swarm control supporting trajectory optimization and receding horizon planning (RHP).

***Technologies**: Robot Operating System (ROS), PX4, IBM CPLEX, C++, MATLAB.*

WSO_2 — ***2014, 2016 - 2017***
Colombo, Sri Lanka

Software Engineer — *January 2016 - July 2017*
Software Engineer Intern — *January - June 2014*

Contributions: Enhanced the integration of WSO_2 frameworks with client APIs, web services, and IOT devices. — ***Open Source Committer***

***Technologies**: Java, Web Services, Web Security.*

***Other Technologies**: Python, PyTorch, Ray Reinforcement Learning Library (RLLib), Deep Graph Library (DGL).*

Teaching

Indiana University — ***Associate Instructor***

ENGR-533: Deep Learning Systems — *Fall 2022*

ENGR-210: Cyber-Physical Systems — *Spring 2022, 2023*
ENGR-321: Advanced Cyber-Physical Systems — *Fall 2021*
Co-conducted lectures, designed lecture materials, assignments on linear dynamical systems simulation and control.*

ENGR-210: Cyber-Physical Systems — *Spring 2021*
ENGR-523: Internet of Things — *Spring 2019*
ENGR-511: Machine Learning and Signal Processing — *Fall 2018*
ENGR-599: Autonomous Robotics — *Fall 2017*

** Course materials: Github Link.*

Publications

Malintha Fernando, Ransalu Senanayake, Heeyoul Choi, Martin Swany, "Graph Attention Multi-Agent Fleet Autonomy for Advanced Air Mobility", *Under Review.* [Preprint]

Malintha Fernando, Ransalu Senanayake, Ariful Azad, Martin Swany, "Graphical Games for UAV Swarm Control Under Time-Varying Communication Networks", *Intelligent Aerial Robotics: From Autonomous Micro Aerial Vehicles to Sustainable Urban Air Mobility and Operations, ICRA 2022.*

Malintha Fernando, Ransalu Senanayake, Martin Swany, "CoCo Games: Graphical Game-Theoretic Swarm Control for Communication-Aware Coverage.", *IEEE Robotics and Automation Letters (RA-L), March, 2022*, [Paper][Video][Project Webpage]

Malintha Fernando "Online Flocking Control of UAVs with Mean-Field Approximation.", *International Conference on Robotics and Automation, (ICRA), Xi'an, China, 2021*, [Paper][Video][Code]

Z. Chen, **M. Fernando** and L. Liu, "A Visual Feature based Obstacle Avoidance Method for Autonomous Navigation," *IEEE Applied Imagery Pattern Recognition Workshop, 2019*.

Malintha Fernando, and Lantao Liu. "Formation Control and Navigation of a Quadrotor Swarm." *International Conference on Unmanned Aircraft Systems (ICUAS), Atlanta, Georgia, 2019.* [Video]

Malintha Fernando, and Lantao Liu. "Swarming of Aerial Robots with Markov Random Field Optimization", 2020, [arXiv.]

Fernando Malintha, Cooray A.V.S, Indeewara T.G.H, Fernando S., "Semi-supervised Learning Framework for Knowledge Extraction in Cricket Domain", *ITRU research symposium (2015), University of Moratuwa, Sri Lanka.*

Open Source Contributions

MavSwarm
A Lightweight, ROS-based UAV swarm simulator with low-level control, trajectory optimization, and RHP [70+ Stars on Github]. — ***Primary Contributor***

ROSNS3
A *Network Simulator* (NS-3) bridge for ROS to simulate wireless communication aspects of networked robot systems [Github Link]. — ***Primary Contributor***

Mozilla Firefox
Contributed by bug fixes and feature improvements to the browser core. ***Contributor, 2013-2014***

Talks

IEEE International Conference on Robot & Human Interactive Communication (RO-MAN), August 2022

Invited Talk at University of Sydney - 2022 June

Workshop for Intelligent Aerial Robotics: From Autonomous Micro Aerial Vehicles to Sustainable Urban Air Mobility and Operations, ICRA 2022.

Guest Lecture on "UAV Swarm Simulation and Control", ENGR-321, Indiana University, 2021.

"Online Flocking Control of UAVs with Mean-Field Approximation" ICRA 2021 [Video].

Invited talk at Indiana University Executive AI Summit - 2020.

Guest Lecture on "Trajectory Optimization for UAVs", ENGR-599, Indiana University, 2019.

"Formation Control and Navigation of a Quadrotor Swarm" - ICUAS 2019.

Professional Service

Reviewer

International Journal of Robust and Nonlinear Control

International Conference on Robotics and Automation (ICRA)

International Conference on Intelligent Robots and Systems(IROS)

IEEE Transaction on Robotics (T-RO)

IEEE Robotics and Automation Letters (RA-L)

International Symposium on Multi-Robot and Multi-Agent Systems (MRS)

Learning for Control and Dynamics Conference (L4DC)

Mentor

Undergraduate Research Opportunities in Computing (UROC) Program

Ben Siefers - Neural Network based Autonomous UAV Navigation *2020*

Eric Tatman - Simulating UAV Swarm Dynamics *2020*

Zach Seliger - Trajectory Generation and Control of a Crazyflie Drone *2018*

Volunteering and Leadership

IEEE Indiana University Student Branch *Founder, Vice Chair 2022/23*

IEEE Region 4 (Midwest) Student Activity Committee (SAC) *2019*
***Responsibilities**: Evaluating regional student activity award applications.*

IEEE Region 10 (Asia/Pacific) Student Activity Committee (SAC) *2016*
***Responsibilities**: Evaluating regional student branch activity proposals and allocate funds.*

IEEE Sri Lanka Section Executive Committee *Section Student Representative*
***Responsibilities**: Coordinating the activities of student branches,*
Promoting IEEE activities in Sri Lankan universities. *2015/16*
***Highlights:** Membership numbers increased by 30% during my tenure.*

IEEE Region 10 Student/Young Professional/Women in Engineering Congress *Core Organizer, 2015*
***Responsibilities**: Leading the promotional activities team.*
***Highlights:** The congress attracted 200+ foreign student delegates across the region.*

IEEE University of Moratuwa Student Branch *Vice Chair, 2013/14*
***Highlights**: The student branch won two IEEE Darrel Chong Awards.*

Awards

Luddy Travel Award, Indiana University *2022*

Graduate Student Fellowship, Indiana University *2017 - 2022*

United Nations Development Program (UNDP) Hackathon - Sri Lanka *2016, Second Place*

Google Summer of Code
For contributing to Mozilla Thunderbird's Calendar protocol for updating it to the latest RFC standards. *2014, Mozilla*

Institute of Engineers - Sri Lanka (IESL) Hackathon *2014, First Place*

State Literary Competition (2009), Sri Lanka, *Short Stories Division* *2009, Finalist*

References

Prof. Martin Swany
Chair, Dept. Intelligent Systems Engineering
Indiana University
Bloomington, IN, 47401

Dr. Ransalu Senanayake
Dept. Computer Science
Stanford University
Stanford, CA, 94305

Prof. Ariful Azad
Dept. Intelligent Systems Engineering
Indiana University
Bloomington, IN, 47401

Prof. Minje Kim
Dept. Intelligent Systems Engineering
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