

HARIKUMAR KANDATH

PERSONAL DATA

DATE OF BIRTH: 19/09/1984
CURRENT POSITION: Assistant Professor
OFFICE ADDRESS: A5-304, International Institute of Information Technology,
Robotics Research Center,
Hyderabad - 500032, Telangana, India.
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RESEARCH INTERESTS

Aerial robotics
Control and coordination of multi-robot systems
Reinforcement learning
Robust control and state estimation
Evolving controllers

RESEARCH EXPERIENCE

<i>July 2019 - Feb 2020</i>	Research Fellow, Engineering Product Design, Singapore University of Technology and Design, Singapore. Objective: Development and testing of autonomous evolving controllers for unmanned air vehicle.
<i>July 2018 - June 2019</i>	Research Fellow, Computational Intelligence Laboratory, School of Computer Science and Engineering, Nanyang Technological University, Singapore. Objective: Modeling, control system design and flight testing of a hybrid vertical takeoff and landing (VTOL) unmanned air vehicle.
<i>July 2016 - June 2018</i>	Research Fellow, ST Engineering - NTU Corporate Laboratory, School of Electrical and Electronic and Engineering, Nanyang Technological University, Singapore. Objective: To develop control and decision making algorithms that address peer-to-peer model of multi-vehicle collaboration with mobility, communication and sensing constraints.
<i>Jan 2016 - March 2016</i>	Research Assistant, Faculty of Science and Technology, University of Macau, Macau, China. Objective: Modeling and control system design for a hovercraft.
<i>Oct 2015 - Dec 2015</i>	IISc Senior Research Associate, Department of Aerospace Engineering, Indian Institute of Science, Bangalore, India. Objective: Flight testing of a fixed wing micro air vehicle.
<i>Jan 2015 - Sep 2015</i>	IISc Junior Research Associate, Department of Aerospace Engineering, Indian Institute of Science, Bangalore, India. Objective: Flight testing of a fixed wing micro air vehicle.

INDUSTRIAL WORK EXPERIENCE

SEP 2008 - DEC 2009 Assistant Systems Engineer at TATA CONSULTANCY SERVICES LIMITED, Mumbai, India.

EDUCATION

JAN 2010 - JULY 2015 Doctor of Philosophy in FLIGHT DYNAMICS & CONTROL, **Indian Institute of Science, Bangalore**, India.
Thesis: "Design and Flight Test of Integrated Guidance and Control of a Fixed Wing Autonomous Micro Air Vehicle" | Advisor: M. Seetharama Bhat.
CGPA: 7/8

JULY 2006 - JULY 2008 Master of Technology in PROCESS CONTROL & INSTRUMENTATION **National Institute of Technology, Tiruchirappalli**, India.
CGPA: 8.69/10

AUG 2002 - JUNE 2006 Bachelor of Technology in ELECTRICAL & ELECTRONICS ENGINEERING **NSS College of Engineering (University of Calicut), Palakkad**, India.
PERCENTAGE: 73.61/100

SCHOLARSHIPS

MARCH 2006 GATE (Graduate Aptitude Test in Engineering) MHRD, Govt. of India.
SUBJECT: Electrical Engineering, RANK: 738/19527.

Jan 2015 - Sep 2015 IISc Junior Research Associate Fellowship,
Indian Institute of Science, Bangalore, India.

Oct 2015 - Dec 2015 IISc Senior Research Associate Fellowship,
Indian Institute of Science, Bangalore, India.

LIST OF JOURNAL PUBLICATIONS (PUBLISHED/ACCEPTED)

- 1) K. Harikumar, J. Senthilnath and S. Sundaram, "Mission Aware motion Planning (MAP) Framework with physical and geographical constraints for a Swarm of Mobile Stations," **IEEE Transactions on Cybernetics**, vol. 50, no. 3, pp. 1209-1219, March, 2020, doi: 10.1109/TCYB.2019.2897027.
- 2) K. Harikumar, J. Senthilnath and S. Sundaram, "Multi-UAV Oxyrrhis Marina-Inspired Search and Dynamic Formation Control for Forest Firefighting," **IEEE Transactions on Automation Science and Engineering**, vol. 16, no. 2, pp. 863-873, April, 2019. doi: 10.1109/TASE.2018.2867614.
- 3) K. Harikumar, Titas Bera, Rajarshi Bardhan, and Suresh Sundaram, "Discrete-time Sliding Mode Observer for the state estimation of a manoeuvring target," **Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering**, vol. 233, no. 7, pp. 847-854, 2019. <https://doi.org/10.1177/0959651819826488>.
- 4) K. Harikumar, Sidhant Dhall and M. Seetharama Bhat, "Design and experimental validation of a Robust output feedback control for the coupled dynamics of a micro air vehicle," **Springer International Journal of Control, Automation and Systems**, vol. 17, no. 1, pp. 155-167, 2019. <http://dx.doi.org/10.1007/s12555-017-0799-2>.
- 5) H. Kandath, J. V. Pushpangathan, T. Bera, S. Dhall, and M. S. Bhat, "Modeling and Closed Loop Flight Testing of a Fixed Wing Micro Air Vehicle," **Micromachines**, vol. 9, no. 3, p. 111, Mar. 2018. doi:10.3390/mi9030111.

6) J. V. Pushpangathan, **H. Kandath** and M. S. Bhat, "75 mm Wingspan Fixed-Wing Nano Air Vehicle with a Novel Aircraft Configuration," *IEEE Access*, vol. 6, pp. 74521-74535, 2018. doi: 10.1109/ACCESS.2018.2883216.

7) Jinraj V. Pushpangathan, M. Seetharama Bhat and **H. Kandath**, "v-Gap Metric-Based Simultaneous Frequency-Shaping Stabilization for Unstable Multi-Input Multi-Output Plants," *AIAA Journal of Guidance Control and Dynamics*, vol. 41, no. 12, pp. 2684-2691. Dec. 2018. <https://doi.org/10.2514/1.G003351>.

8) Jinraj V Pushpangathan, M Seetharama Bhat and **K Harikumar**, "Effects of Gyroscopic Coupling and Counter torque in a Fixed-Wing Nano Air Vehicle," *AIAA Journal of Aircraft*, Vol. 55, No. 1 (2018), pp. 239-250. <https://doi.org/10.2514/1.C034280>.

9) S. Jana, **H. Kandath**, M. Shewale and M. Seetharama Bhat, "Effect of propeller induced flow on the performance of biplane micro air vehicle dynamics," in *Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering*, pp. 716-728, vol. 234, 2019.

10) Jana, S., Shewale, M., Balasubramaniam, S., **Kandath, H.**, and Bhat, M. S., "Design and flight testing of closed-loop simple adaptive control for a biplane micro air vehicle," *Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering*, online, Nov, 2019.

BOOK CHAPTERS

1) **K Harikumar** , Titas Bera, Rajarshi Bardhan and Suresh Sundaram, "Cooperative obstacle avoidance for heterogeneous unmanned systems during search mission," *Robotic Intelligence*, World Scientific, pp. 91-98, May 2019. DOI:10.1142/9789811203480_0011.

2) J. Senthilnath, **K Harikumar** and S. Suresh, "Efficient resource allocation for decentralized heterogeneous system using density estimation approach," *Robotic Intelligence*, World Scientific, pp. 137-143, May 2019. DOI:10.1142/9789811203480_0016.

LIST OF CONFERENCE PUBLICATIONS

1) **K. Harikumar**, T. Bera, R. Bardhan and S. Sundaram, "State Estimation of an Agile Target using Discrete Sliding Mode Observer," *5th IEEE International Conference on Control, Decision and Information Technologies (CoDIT)*, Thessaloniki, 2018, pp. 75-79. doi: 10.1109/CoDIT.2018.8394793.

2) **H. Kandath**, T. Bera, R. Bardhan and S. Sundaram, "Autonomous Navigation and Sensorless Obstacle Avoidance for UGV with Environment Information from UAV," *Second IEEE International Conference on Robotic Computing (IRC)*, Laguna Hills, CA, 2018, pp. 266-269. doi: 10.1109/IRC.2018.00056.

3) **K. Harikumar**, J. Senthilnath and S. Sundaram, "Mutli-agent consensus under communication failure using Actor-Critic Reinforcement Learning," *IEEE Symposium Series on Computational Intelligence (SSCI)*, Bangalore, 2018, pp. 1461-1465. doi: 10.1109/SSCI.2018.8628943.

4) S. Jayavelu, **H. kandath** and S. Sundaram, "Dynamic Area Coverage for Multi-UAV Using Distributed UGVs: A Two-Stage Density Estimation Approach," *Second IEEE International Conference on Robotic Computing (IRC)*, Laguna Hills, CA, 2018, pp. 165-166. doi:

10.1109/IRC.2018.00033.

5) **K. Harikumar**, S. Dhall and M. S. Bhat, "Nonlinear modeling and control of coupled dynamics of a fixed wing micro air vehicle," **IEEE Indian Control Conference (ICC)**, Hyderabad, 2016, pp. 318-323. doi: 10.1109/INDIANCC.2016.7441153.

6) **K. Harikumar** and M. S. Bhat, "Path generation and integrated guidance and control of a micro air vehicle," **IEEE International Conference on Control Applications (CCA)**, Hyderabad, 2013, pp. 1024-1029. doi: 10.1109/CCA.2013.6662886.

7) **H. Kandath**, M. A. Hady, M. Pratama and Ng. Bing Feng, "Robust Evolving Neuro-Fuzzy Control of a Novel Tilt-rotor Vertical Takeoff and Landing Aircraft," **IEEE International Conference on Fuzzy Systems**, New Orleans, USA, June 2019, DOI: 10.1109/FUZZ-IEEE.2019.8858923.

TECHNICAL REPORTS

1) M. Seetharama Bhat, S.N. Omkar, **K. Harikumar**, T. Bera, A. Eobin, S. Dhall and J. Arun, "Development of Autonomous Robust Fixed Wing Micro Air Vehicle", Department of Aerospace Engineering, Indian Institute of Science, Bangalore, Technical Report No: AE/MSB/DRDO-NPMICAV-TR-2012-001, December 2012.

2) M. Seetharama Bhat, S.N. Omkar, **K. Harikumar**, Jinraj V. Pushpangathan, T. Bera, S. Karthik, S. Dhall and A. Eobin, "Development of Autonomous Robust Fixed Wing Micro Air Vehicle", Department of Aerospace Engineering, Indian Institute of Science, Bangalore, Technical Report No: AE/MSB/DRDO-NPMICAV-TR-2013-002, October 2013.

3) M. Seetharama Bhat, S.N. Omkar, **K. Harikumar**, Jinraj V. Pushpangathan, T. Bera, S. Karthik, S. Dhall and Pradyumna M K, "Development of Autonomous Robust Fixed Wing Micro Air Vehicle", Department of Aerospace Engineering, Indian Institute of Science, Bangalore, Technical Report No: AE/MSB/DRDO-NPMICAV-TR-2013-003, December 2013.

4) M. Seetharama Bhat, S.N. Omkar, **K. Harikumar**, T. Bera, Jinraj V. Pushpangathan, S. Jana, S. Dhall and Akhil Thomas, "Development of Autonomous Robust Fixed Wing Micro Air Vehicle", Department of Aerospace Engineering, Indian Institute of Science, Bangalore, Technical Report No: AE/MSB/DRDO-NPMICAV-TR-2014-001, September 2014.

PARTICIPATION IN INTERNATIONAL EVENTS/DEMONSTRATIONS

1) Participated in GoFly challenge organized by Boeing. Objective was to make a autonomous personal flying air vehicle.

2) Participated in the final round of Mohamed Bin Zayed International Robotics Challenge (MBZIRC) held at Abu Dhabi, March 2017. The challenges were

1.1) Vision based tracking and landing of an Unmanned Aerial Vehicle (UAV) on an Unmanned Ground Vehicle (UGV).

1.2) Cooperative pickup and transport of multiple objects using multiple UAVs.

3) Demonstration of convoy protection using multiple UAVs for Singapore Technologies Engineering Ltd., Singapore, February 2017.

4) Demonstration of the flight of autonomous 15 cm wingspan Micro Aerial Vehicle (MAV) for NPMICAV (National program for micro air vehicle), sponsored by ARDB (Aircraft research and development board, Govt. of India), Bangalore, November 2015.

ACADEMIC ACTIVITIES

- 1) Served as chair for the session C7.2, Control Applications (PART 2) for 5th *IEEE International Conference on Control, Decision and Information Technologies (CoDIT)*, Thessaloniki, Greece, April 2018.
- 2) Reviewed a book proposal for Wiley publications (UK) with title - "Gyroscope Theory", Feb. 2018.
- 3) Reviewed manuscripts for many international journals and conferences.