Hai-Nguyen (Hann) Nguyen

Ph.D., Mechanical Engineering | Roboticist

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Summary

Demonstrated working history at top research institutions in France, UK, Korea, and Vietnam. Strong research professional in robotics and autonomous systems with works published in top-tier journals/conferences, featured in media and demonstrated in public.

Research-minded programmer, proficient in C++/Python/ROS/PX4 with safety-certified and production-ready code on a variety of MCUs/sensors. Experienced in developing integrated hardware-software prototypes and industry-grade products in fast-paced Dev-Ops environments.

Education

15.09.2012 – 26.02.2018	**Ph.D. Mechanical & Aerospace Engineering**, *Seoul National University*, Korea. Thesis: Dynamics and Control of Quadrotor-based Aerial Manipulation Systems. Committee: Prof. Frank C. Park (chair), Prof. Dongjun Lee (advisor), Prof. Kyujin Cho, Prof. Hyosung Ahn, and Prof. Kyungsoo Kim.
05.09.2003 – 04.07.2008, 15.10.2008 – 13.01.2011	**B.Eng. Mechatronics, M.Sc. Engineering Mechanics**, *Hanoi University of Science and Technology*, Vietnam. Topics: Symbolic models of multibody systems (B.Eng.) and a formalism for multibody systems using null-space of Jacobian matrix (M.Sc.). Advisor: Prof. Van-Phong Dinh.

Research Experience

05.07.2021 – now	**Contract Research Scientist**, *National Centre for Scientific Research (CNRS)*, France

Joined Robotics and InteractionS (RIS) group in LAAS-CNRS. Focus on the development of the foundations necessary to realize advanced aerial manipulation capability with a strong emphasis on *robustness* and *dexterity*. Initiated research projects and related collaborations along this line include:

Robustness aerial physical interaction

○ Developed an integrated framework for autonomous sensor placement with aerial robots [4], presenting a fully contained and accessible sensor placement approach capable of robust interaction with the environment.

○ Co-developed an aerial manipulator with shared compliance [5] with a study on combining mechanical compliance from the design with electronical compliance from the control.

Dexterous aerial manipulation

○ Co-developed a constrained Kalman filter for a cable-suspended aerial multirobot manipulator [2].

○ Developed an algorithm for motion planning of a large-size aerial skeleton system with lock mechanisms.

10.04.2018 – 09.04.2020	**Research Associate**, *Imperial College London*, UK Worked in Aerial Robotics Laboratory (ARL). ○ Developed an autonomous quadrotor system equipped with a winch-tethered magnet that is capable of perching on and sliding along a vertical surface for inspection at close proximity. The first realization of a tethered quadrotor that can hover and perch vertically near infrastructure elements, enabling a variety of surface manipulation and repair tasks. Live demos at EMPA, Switzerland (<u>NEST</u>), at Imperial College, UK (<u>ORCA</u>), at Blyth, UK (<u>ORE Catapult</u>) and to many visitors to ARL during 2019-2020. ○ Developed planning and control algorithms for an aerial grappling robot to perch on a variety of surfaces including tree branches and pipelines (RoboSoft19).
15.09.2012 – 26.02.2018	**Graduate Researcher**, *Seoul National University*, Korea Worked in Interactive & Networked Robotics Laboratory (INRoL). ○ Developed a novel aerial platform (SmQ platform) to overcome the well-known under-actuation issues of multi-rotor drones in aerial operation/manipulation. Provided theoretical framework for its modeling and control, combining high-level Lyapunov control design (to achieve trajectory tracking) with low-level constrained optimization (to comply with physical constraints) (<u>IROS15</u>, <u>TRO18</u>, <u>IEEE Spectrum</u>, <u>Interesting Engineering</u>). Live demo to many experts in robotics visiting INRoL during 2015-2018. ○ Designed a control framework to enable a quadrotor to operate a tool attached on it. Fully characterized the internal dynamics of the spatial quadrotor tool operation, which arises due to the under-actuation of the quadrotor (<u>IROS13</u>, <u>Automatica15</u>).
01.09.2009 – 24.08.2012	**Researcher**, *Vietnam Academy of Science and Technology*, Vietnam Joined Department of Mechatronics, Institute of Mechanics in Sep. 2009 and became permanent researcher from Mar. 2010. Co-developed software/hardware for a 6-DOF manipulator prototype for welding.
01.12. 2007 – 01.07. 2008,	**Intern, Graduate Researcher**, *Hanoi University of Science and Technology*, Vietnam
15.10. 2008 – 01.09. 2009	Studied at Department of Applied Mechanics. Developed an algorithm for generating symbolic models of tree-topology multibody systems (B.Eng. project) and a formalism for multibody systems using null-space of Jacobian matrix (M.Sc. project).

▬▬▬ Industry Experience

23.03.2020 – 28.05.2021	**Senior Robotic Engineer**, *Vimaan Robotics, Inc.*, CA, US (remote) Joined Autonomous Navigation Team in Santa Clara, CA (joined remotely due to the COVID-19 and visa delay). Focus on developing sensor fusion, control and planning algorithms for indoor autonomous robots, ranging from autopilot to mission generation. ○ Developing trajectory generation and motion control for a hybrid ducted-fan/multi-rotor drones. ○ Developed a range-aid feature for vision/inertia based state estimation, implemented on ECL/PX4 firmware and verified with existing flight data. ○ Designed and implemented a route optimization algorithm for multiple aerial vehicles with limited flight time.
01.09.2019 – 01.12.2019	**Robotic Consultant**, *Imperial Consultants (ICON)*, UK Working with Uniper Energy on digitalization. Demonstrate and case study the use of autonomous flying robots for routine inspection and monitoring tasks at the power plants.

▬▬▬ Teaching Experience

May 2022	**Guest Lecturer**, *University of Twente*, Netherlands (1) Control for UAVs (Spring 2022).
Mar. 2020	**Teaching Assistant**, *Business School, Imperial College London*, UK (1) Imperial Leadership in a Technology Driven World Programme (Sberbank).

Mar. 2019	**Guest Lecturer**, *Imperial College London*, UK
	(1) Aircraft Systems Engineering and Unmanned Vehicle Technologies (Spring 2019, Spring 2020).
Mar. 2019– May. 2019	**Coach, UK STEM Ambassador**, *Shepherds Bush Library*, UK (1) Code club (Python).
Sep. 2013 – Jul. 2017	**Teaching Assistant**, *Seoul National University*, Korea (1) Control System I (Spring 2015, Spring 2016, Spring 2017). (2) Control System II (Fall 2013, Fall 2014, Fall 2016). (3) Robot Mechanics (Spring 2014, Spring 2016).

Mentoring Experience

2021-2022	**RIS Group**, *LAAS-CNRS*, France
	Mentoring interns at LAAS: (1) Colomban Le-Falher, "Development of a flexible perching mechanism with integrated sensors for aerial robots", Master thesis, INSA, Strasbourg. (2) Leonardo Mouta Pereira Pinheiro, "Manipulating a cable-suspended object with multiple UAVs and environment contacts in 2D", Engineering thesis, Supaero, Toulouse. (3) Arthur Lotz, "Development of a perching robot", Engineering internship, Estaca.
2018-2020	**Aerial Robotics Lab**, *Imperial College London*, UK
	Mentoring phD student: (1) Brett Stephens, "Interactive control and motion planning strategies for aerial manipulators in industrial environments", PhD student at Imperial College London. *Mentoring master students:* (1) Bojia Mao, "Achieve Aerial Tensile Perching with Learning-Based Control Algorithm", Master thesis. Now Algorithm Engineer at Tencent. (2) Ronglong Ye, "Design and Manufacturing of a Passive Adapted Grapple for UAV Perching System", Master thesis. Now Sales Manager at Woco Group. (3) Alan Slatter, "Agile Tensile Perching withMicro Aerial Vehicles", Master thesis. Now Software Engineer at Amazon. (4) Brett Stephens, "Development of an Autonomously Perching Quadrotor Platform", Master thesis at ETH Zurich (internship at Imperial College). Now PhD candidate at Imperial College London.

Technical Experience

Coding	C++/Python, Matlab/Maple, ROS/PX4, OpenCV/PCL, Git/Docker/Bash/SQL.
Robots	Multi-rotor drones, Manipulators, Underwater robot, Haptic devices, Motion capture systems, ARM-based MCUs.
Sensors	Distance (TFmini, Terabee), Depth camera (Realsense, Terabee), Mono IMU-Camera.
Techniques	Nonlinear control theory, Motion planning, Constrained Optimization, State estimation and Sensor fusion, VIO/SLAM.

Media

2021	Imperial College London.
2020	Imperial College London, Telegraph.
2019	Reuters TV, BBC, Energy Voice, CNBC, Insider UK.
2018	Imperial College London, EMPA.

2017	Interesting Engineering, IEEE Spectrum.
2015	IEEE Spectrum.

Research Funding

Jan. 2020 – Dec. 2020	**Principal Investigator**, *ORCA Partnership Resource Fund, EPSRC (£164K)*, UK Mixed-Reality Enhanced Telepresence for Remote Inspection and Monitoring with Multiple Aerial Robots. (later tranfered to Co-PI before leaving Imperial)

Honors and Awards

2018	Outstanding Contribution in Reviewing, Mechatronics Journal, Elsevier.
2017	Best Video Award, Korea Robotics Society Annual Conference.
2015	Travel Award, IEEE/RSJ International Conference on Intelligent Robots & Systems.
2013 – 2015	Lecture & Research Scholarship, Seoul National University.
2013	Global Scholarship, Seoul National University.
2012 – 2016	BK Scholarship, Brain Korea 21 & 21 Plus Program, Korea Government.
2010, 2011	Exceptional Researcher (Stakhanovite Appellation), Institute of Mechanics.
2003	Merit-based Scholarship, Hanoi University of Science and Technology.
2002	First Prize in Physics, Annual Excellent Student Competition, Haiphong City.
2001	Third Prize in Biology, Annual Excellent Student Competition, Haiphong City.

Academic Services

	Edited and reviewed around **100 articles** since 2014.
Assoc. Editor	Ubiquitous Robots (2020, 2021), IEEE Int'l Conference on Robotics & Automation (2023).
Section Chair	Robotics: Science and Systems (2019).
Review	IEEE Transactions on Robotics, IEEE Robotics and Automation Letters, Mechatronics, Nonlinear Dynamics, IEEE Transactions on Industrial Electronics.
	IEEE Int'l Conference on Robotics & Automation (2015-now), IEEE/RSJ Int'l Conference on Intelligent Robots & Systems (2014-now).

Invited Talks

Dec. 2022	**ICube - Université de Strasbourg**, France Empowering aerial robots with physical interaction capabilities.
Sep. 2022	**Fulbright University**, Vietnam Empowering flying vehicles with physical interaction capabilities: from Control and Design perspectives.
Dec. 2019	**Laboratory for Analysis and Architecture of Systems**, *CNRS*, France Dynamics and Controls of Aerial Robots for Physical Interaction.
Nov. 2018	**2030:A Martian Odyssey**, *Symposium for Extreme Habitats*, UK Aerial Robotics for Infrastructures.
Mar. 2018	**Dept. Applied Mechanics**, *HUST*, Vietnam Introduction of Aerial Manipulation Systems.

Jan. 2018 **Networked Robotic Systems Laboratory**, *NCKU*, Taiwan
Aerial Robotic Systems for Physical Interaction.

Patents

[1] D. J. Lee, **H. Nguyen** and H. Lee, "Aerial robot system based on multi-rotor for mechanical tasks," *Korea Patent No. 10-1614620-0000*, 2016.

Publications

Detailed citation at <u>Google Scholar Profile</u>. Mentored-student authors are underlined.

[1] **H. Nguyen**, <u>B. Stephens</u>, and M. Kovac. Aerial inspection at close proximity: a multi-modal mobility approach. 2023. (in preparation)

[2] D. Sanalitro, **H. Nguyen**, J. Cortes, A. Franchi and S. Lacroix. State Estimation Improvement for a Cable-Suspended Aerial Multirobot Manipulator based on Constrained Kalman Filtering. (in preparation)

[3] F. Hauf, B. B. Kocer, <u>A. Slatter</u>, **H. Nguyen**, O. K. F. Pang, R. Clark, E. Johns, and M. Kovac. Learning Tethered Perching for Aerial Robots. (submitted)

[4] <u>B. Stephens</u>*, **H. Nguyen***, S. Hamaza, and M. Kovac. An integrated framework for autonomous sensor placement with aerial robots. *IEEE/ASME Transactions on Mechatronics (TMech)*, 2022. (* equal contribution)

[5] <u>B. Stephens</u>, L. Orr, B. B. Kocer, **H. Nguyen**, M. Kovac. An Aerial Parallel Manipulator with Shared Compliance. *IEEE Robotics and Automation Letters (RAL)*, 7(2):11902-11909, 2022. (with IROS option)

[6] S. Hamaza, A. Farinha, **H. Nguyen**, and M. Kovac. Sensor Delivery in Forests with Aerial Robots: A New Paradigm to Environmental Monitoring. *IROS Workshop on Perception, Planning and Mobility in Forestry Robotics (WPPMFR)*, 2020. (*Best Paper Award*)

[7] D. Robb, M. Imtiaz Ahmad, C. Tiseo, S. Aracri, A. C. McConnell, V. Page, C. Dondrup, H. M. Taylor, P. Ardon, E. Pairet, L. J. Wilson, T. Semwal, **H. Nguyen**, H. Hastie, and K. Lohan. Robots in the danger zone: exploring public perception through engagement. *ACM/IEEE Int'l Conference on Human-Robot Interaction (HRI)*, 2020.

[8] **H. Nguyen***, R. Siddall*, <u>B. Stephens</u>, A. Navarro-Rubio, M. Kovac. A passively adaptive microspine grapple for robust, controllable perching. *IEEE International Conference on Soft Robotics (RoboSoft)*, 2019. (* equal contribution)

[9] **H. Nguyen**, S. Park, J. Park, and D. J. Lee. A novel robotic platform for aerial manipulation using quadrotors as rotating thrust generators. *IEEE Transactions on Robotics (T-RO)*, 34(2):353-369, 2018.

[10] **H. Nguyen**, C. Ha, and D. J. Lee. Mechanics, control and internal dynamics of quadrotor tool operation. *Automatica*, 61:289-301, 2015.

[11] J. Bak, **H. Nguyen**, S. Park, D. J. Lee, T. Seo, S. Jin, and J. Kim. Positioning control of an underwater robot with tilting thrusters via decomposition of thrust vector.

International Journal of Control, Automation and Systems (IJCAS), 15(5):2283-2291, 2017.

[12] **H. Nguyen**, S. Park, and D. J. Lee. Aerial tool operation system using quadrotors as rotating thrust generators. In *Proc. IEEE/RSJ Int'l Conference on Intelligent Robots & Systems (IROS)*, pp. 1285-1291, 2015.

[13] **H. Nguyen** and D. J. Lee. Hybrid force/motion control and internal dynamics of quadrotors for tool operation. In *Proc. IEEE/RSJ Int'l Conference on Intelligent Robots & Systems (IROS)*, pp. 3458-3464, 2013.

[14] V-P. Dinh and **H. Nguyen**. A new approach using null space of Jacobian matrix in simulation of multibody dynamics. *Studies in Applied Electromagnetics and Mechanics*, 37:44-58, 2012.