Junhyoung Ha

Senior Researcher

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Personal Data

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Summary

I am currently a senior researcher in the Center for Healthcare Robotics, AI & and Robotics Institute at Korea Institute of Science and Technology (KIST) and a professor in the Division of AI and Robot, KIST School at the University of Science and Technology (UST). I was a deep learning researcher in Saige Research, a startup company in Seoul, researching image classification, novelty detection, and image generation using generative adversarial networks. Before, I worked as a postdoctoral researcher at Boston Children's Hospital, Harvard Medical School, mainly working on modeling and control of surgical robots. I received my B.S. and Ph.D. in mechanical engineering from Seoul National University, Seoul, South Korea, under the supervision of Prof. Frank C. Park. My research interest covers classic robotics (including nonlinear control, robot dynamics, and motion planning), medical robotics, optimization, computer vision, medical imaging, and deep learning. Current ongoing research includes motion control for snake-like continuum robots, 3D/2D registration between X-ray and CT, and 3D image reconstruction from 2D images.

Research Profile

Google scholar: https://scholar.google.com/citations?user=zEOSVeUAAAAJ&hl=en&oi=ao

Research Interests

Optimization. Robot control. Stochastic system. Computer vision. Medical Imaging. Deep Learning.

Experience

Dec 2019-Current — *Senior Researcher*,
Center for Healthcare Robotics, Department of AI & Robot,
Korea Institute of Science and Technology (KIST)

Currently working on robot control, robot-vision, and medical image analysis, including

- robot control and motion planning for semi-autonomous micro surgery,
- visual servoing based robot manipulator control for eye-in-hand object tracking system,
- real time 6-DOF object localization on X-ray images.

Related capabilities include robot control, motion planning, and computer vision.

May 2019-Oct 2019 — *Deep Learning Researcher*,
Saige Research, Seoul

Worked on AI assisted defect detection, including

- development of neural networks for anomaly detection in presence of normal dataset only,
- development of generative adversarial networks (GANs) for synthesizing detect dataset.

Related capabilities include statistical analysis, deep learning, and GAN.

Sep 2015-Aug 2018 | *Postdoctoral Research Fellow*,
Boston Children's Hospital, Harvard Medical School

Worked on

- control, design, and stability analysis of concentric tube robots and other catheter-type robots,
- design and mechanical analysis of tracheal stents and development of delivery/removal systems with corresponding procedures.
- management of in-vivo clinical study: arranging and protocolizing in-vivo animal studies.

Used/developed capabilities include analysis skills using elastic rod mechanics, optimal control theory, and vector space optimization (plus hands-on skills such as modeling and machining clinical devices).

Oct 2009-Apr 2011 | *Quant Programmer*,
Capital Markets and Portfolio Research

Developed an automatic trading system by implementing mathematical models for pricing derivatives (mostly options) and establishing own trading strategies. Used/developed capabilities include stochastic system, statistics and financial market analysis and pricing.

Education

Aug 2015 **Ph.D.** in Mechanical Engineering,
Seoul National University, Korea

Feb 2008 **B.S.** in Mechanical and Aerospace Engineering,
Seoul National University, Korea

Capabilities

Strong mathematical & theoretical background	The capability includes optimization, optimal control, multibody robot kinematics & dynamics, motion planning, differential geometry, stochastic system, parameter calibration, filter theory, classic machine learning theory, and modern deep learning theory.
System modeling	The capability refers to modeling static or dynamic systems in mathematical models. A necessary skill here is to cast the systems into mathematically analyzable models by applying appropriate assumptions and existing frameworks.
Programming skills	The capability includes C++, C#, MATLAB, and Python programmings.

Publications

Journal papers

1. Y. Li, J. Peine, M. Mencattelli, J. Wang, **J. Ha**, P. E. Dupont, "A Soft Robotic Balloon Endoscope for Airway Procedures." *Soft Robotics* (2021).

2. A. Yun, and **J. Ha**, "A geometric tracking of rank-1 manipulability for singularity-robust collision avoidance." *Intelligent Service Robotics* 14.2 (2021):

3. A. Mondal, **J. Ha**, V. Y. Jo, F. Y. Wu, A. K. Kaza, and P. E. Dupont, "Preclinical evaluation of a pediatric airway stent for tracheobronchomalacia." *The Journal of Thoracic and Cardiovascular Surgery*, 161.1 (2021): e51-e60.271-284.

4. A. Yun, D. Moon, **J. Ha**, S. Kang, and W. Lee, "ModMan: an advanced reconfigurable manipulator system with genderless connector and automatic kinematic modeling algorithm." *IEEE Robotics and Automation Letters* 5.3 (2020): 4225-4232.

5. **J. Ha**, A. Mondal, Z. Zhao, A. K. Kaza and P. E. Dupont, " Pediatric Airway Stent Designed to Facilitate Mucus Transport and Atraumatic Removal," *Biomedical Engineering, IEEE Transactions on*, 2019

6. **J. Ha**, G. Fagogenis and P. E. Dupont, "Modeling Tube Clearance and Friction in Concentric Tube Robot Kinematics," *Robotics, IEEE Transactions on*, 2018

7. **J. Ha** and P. E. Dupont, "Designing Stable Concentric Tube Robots Using Piecewise Straight Tubes," *Robotics and Automation Letters, IEEE*, vol. 2, no. 1, pp. 298–304, 2017

8. **J. Ha**, F. C. Park, and P. E. Dupont, "Optimizing Tube Precurvature to Enhance the Elastic Stability of Concentric Tube Robots," *Robotics, IEEE Transactions on*, vol. 33, no. 1, pp. 22–37, 2017

9. **J. Ha**, F. C. Park, and P. E. Dupont, "Elastic stability of concentric tube robots subject to external loads," *Biomedical Engineering, IEEE Transactions on*, vol. 63, no. 6, pp. 1116–1128, 2016

10. **J. Ha**, D. Kang and F. C. Park, "A Stochastic Global Optimization Algorithm for the Two-Frame Sensor Calibration Problem," *Industrial Electronics, IEEE Transaction on*, vol. 63, no. 4, pp. 2434–2446, 2016

11. Y. B. Kim, **J. Ha**, H. Kang, P. Y. Kim, J. Park, and F. C. Park, "Dynamically optimal trajectories for earthmoving excavators," *Automation in Construction*, vol. 35, pp. 568–578, 2013.

Conference papers

1. **J. Ha**, and S. Kim, "Fast Replanning Multi-Heuristic A*," *International Conference on Robotics and Automation (ICRA)*, 2021.

2. S. Lim, **J. Ha**, and D. Lee, "3D Pose and Curvature Estimation of Bendable Interventional Device using Single-view X-ray Image," in Proceedings of the 2020 42nd Annual International Conference of the *IEEE Engineering in Medicine and Biology Society (EMBC),*, pp. 2404–2407, Montreal, QC, Canada, 2020.

3. **J. Ha**, S. Kim, Y. Baik, D. Lee, W. Lee, and S. Suh, "Artificial neural network enabling clinically meaningful biological image data generation," in Proceedings of the 2020 42nd Annual International Conference of the *IEEE Engineering in Medicine and Biology Society (EMBC),* pp. 2404–2407, Montreal, QC, Canada, 2020.

4. J. Wang, **J. Ha** and P. E. Dupont, "Steering a Multi-armed Robotic Sheath Using Eccentric Precurved Tubes ," *International Conference on Robotics and Automation (ICRA)*, 2019.

5. **J. Ha** and P. E. Dupont, "Incorporating tube-to-tube clearances in the kinematics of concentric tube rob," *International Conference on Robotics and Automation (ICRA)*, 2017.

6. C. Jang, **J. Ha**, P. E. Dupont, and F. C. Park, "Achieving elastic stability of concentric tube robots through optimization of tube precurvature," *International Conference on Intelligent Robots and Systems (IROS)*, 2016.

7. **J. Ha**, F. C. Park, and P. E. Dupont, "Achieving elastic stability of concentric tube robots through optimization of tube precurvature," *International Conference on Intelligent Robots and Systems (IROS)*, 2014.

8. B. Kim, **J. Ha** ,F. C. Park, and P. E. Dupont, "Optimizing Curvature Sensor Placement for Fast, Accurate Shape Sensing of Continuum Robots," *International Conference on Robotics and Automation (ICRA)*, 2014.

References Available on Request

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