Donghoon Baek

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Education

University of Illinois at Urbana-Champaign **Aug. 2021 – Current**
Ph.D. in Mechanical Science and Engineering (Advisor: Prof. Joao Ramos) *Urbana, IL*

Korea Advanced Institute of Science and Technology (KAIST) **Sep. 2017 – Jun. 2019**
M.S. in Robotics Program (Advisor: Prof. Dong-Soo Kwon, GPA: 3.68 / 4.0) *Daejeon, Republic of Korea*

University of Kwangwoon **Feb. 2011– Feb. 2017**
B.S. in Robotics Program (Advisor: Prof. Whang Cho, GPA: 3.81/4.0) *Seoul, Republic of Korea*

Areas of Expertise & Research Interests

Humanoid and Legged Robot Control, Model-based Control and Reinforcement Learning, Sim-to-Real, Parameter Identification and Estimation, Whole-body Loco-Manipulation, Medical Robot Control

Work Experience

ROEN Surgical Inc **Sep. 2020 – Jun 2021**
Research Engineer *Daejeon, Republic of Korea*

- Developed a software program (control, architecture, communication, and GUI) for a flexible surgical robot. (C++, Python, ROS, Tensorflow, Ethercat, Qt, OpenGL, Linux, Multi-Threads)
- Developed a GAN-based surgical instrument segmentation and a vision-based feed-forward controller. (Cycle-GAN, Visual Servoing, Model-based Feed-Foward Control, Kalman Filter)
- Developed a parameter optimization algorithm (PSO, GA, Scipy)
- Improved the control performance of a surgical robot for ureteroscopy using real-time smooth trajectory planning. (Real Time Trajectory Planning with Tele operation)
- Contributed to the development of optimization algorithm to find the optimal port placement for a laparoscopic surgical robot. (Matlab, Simscape)
- Designed and manufactured a flexible surgical robot testbed system considering wire tension control (SolidWorks).

MosQ Inc **Mar 2020 – Aug 2020**
Robotics Engineer *Seoul, Republic of Korea*

- Designed the automated intravenous blood collection robotic system (SolidWorks).
- Developed a control software architecture (GUI, Multi-Threads, Motor Control).

ROEN Surgical Inc **Sep 2019 – Feb 2020**
Research Intern *Daejeon, Republic of Korea*

- Contributed to the development of software to control a flexible surgical robot. (C++, Python, ROS, OpenGL)
- Improved the control performance of a flexible surgical robot using a vision-based hysteresis reduction algorithm.

Korea Army **Oct 2011 – Jul 2013**
Tactical Assistant to a military officer *Yeong-Cheon, Republic of Korea*

Journal Publication

Fast Learning-Based Inertial Parameter Identification of Unknown Object for Model-Based Control of Wheeled Humanoids, D. Baek*, B Peng, S Gupta, J Ramos, In Submission to IEEE Robotics and Automation Letters 2024 (Under Review).

A Study of Shared-Control with Bilateral Feedback for Obstacle Avoidance in Whole-body Telelocomotion of a Wheeled Humanoid, D. Baek*, J. Chang* and J. Ramos, In IEEE Robotics and Automation Letters, 2023.

ViO-Com: Feed-forward compensation using vision-based optimization for high-precision surgical manipulation, D. Baek, Y. -H. Nho and D. -S. Kwon, In IEEE Robotics and Automation Letters, vol. 7, no. 1, pp. 263-270, Jan. 2022, doi: 10.1109/LRA.2021.3123375.

Hysteresis Compensator With Learning-Based Hybrid Joint Angle Estimation for Flexible Surgery Robots, D. Baek, J. -H. Seo, J. Kim and D. -S. Kwon, In IEEE Robotics and Automation Letters, vol. 5, no. 4, pp. 6837-6844, Oct. 2020, doi: 10.1109/LRA.2020.2972821.

Learning-based discrete hysteresis classifier using wire tension and compensator for flexible endoscopic surgery robots, Donggeol Lee, **DongHoon Baek**, Hansoul Kim, Joonhwan Kim, and Dong-Soo Kwon, In International Journal of Precision Engineering and Manufacturing, 2022.

A novel encountered-type master device with precise manipulation for robot-assisted microsurgery, Kim, D.S., Yang, U.J., Cheon, B., **Baek, D.**, and Kwon, D.S., In the International Journal of Medical Robotics and Computer Assisted Surgery, 17(6), e2314.

Shape-Locking Mechanism of Flexible Joint Using Mechanical Latch With Electromagnetic Force, D. G. Chung, J. Kim, **D. Baek**, J. Kim and D. -S. Kwon, In IEEE Robotics and Automation Letters, vol. 4, no. 3, pp. 2661-2668, July 2019, doi: 10.1109/LRA.2019.2897006.

Selected Conference Publication

FSL-LVLM: Friction-Aware Safety Locomotion using Large Vision Language Model in Wheeled Robots, Peng Bo, **Donghoon Baek***, Qijie Wang, Joao Ramos, In Submission to Robotics Conference, 2024. (Under Review)

Real-to-Sim Adaptation via High-Fidelity Simulation to Control a Wheeled-Humanoid Robot with Unknown Dynamics, Donghoon Baek*, Youngwoo Sim, Amartya Purushottam, Saurabh Gupta, Joao Ramos, In IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2024.

FSL-LVLM: Friction-Aware Safety Locomotion using Large Vision Language Model in Wheeled Robots, Bo Peng, **Donghoon Baek**, Qijie Wang, Joao Ramos. (Under Review)

Hands-free Telelocomotion of a Wheeled Humanoid, A Purushottam, Y Jung, K Murphy, **D Baek**, J Ramos, In IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2022.

Hybrid LMC: hybrid learning and model-based control for wheeled humanoid robot via ensemble deep reinforcement learning, D. Baek, A. Purushottam, and J. Ramos, In IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2022.

Hysteresis Compensator with Learning-based Pose Estimation for a Flexible Endoscopic Surgery Robot, Baek, Donghoon, Ju-Hwan Seo, Joonhwan Kim, and Dong-Soo Kwon, In 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 2983-2989. IEEE, 2019.

Effects of Flexible Surgery Robot on Endoscopic Procedure: Preliminary Bench-Top User Test, Joonhwan Kim, Minho Hwang, Dongho Lee, Hansoul Kim, Jeongdo Ahn, Jaemin You, **Baek, Donghoon**, Dong-Soo Kwon, In 2019 28th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN).

Image-based hysteresis compensator for a flexible endoscopic surgery robot, Baek, Donghoon, Ju-Hwan Seo, Joonhwan Kim, Dong-Soo Kwon, In 2019 16th International Conference on Ubiquitous Robots (UR) (*Best Paper Award*).

Path planning for automation of surgery robot based on probabilistic roadmap and reinforcement learning, Baek, Donghoon, Minho Hwang, Hansoul Kim, Dong-Soo Kwon, In 2018 15th International Conference on Ubiquitous Robots (UR)).

Robust trajectory tracking of Master-Slave surgery robot system based on PD with Integral Sliding Mode Control, Hansoul Kim, Minho Hwang, **Donghoon Baek**, and Dong-Soo Kwon, In 2018 15th International Conference on Ubiquitous Robots (UR)).

A flexible endoscopic surgery robot K-FLEX and its feasibility validation in in-vivo animal trial, M. Hwang, J. H. Kim, D. H. Lee, J. Ahn, J. You, **D. Baek**, H. Kim, D. Son, D. S. Kwon, In the 14th Asian Conference on Computer Aided Surgery. (ACCAS 2018) (*Best Paper Award*).

Development of the rescue robot for earthquake zone, DH Baek, YT Kim, HS Kim, SY Lee, HS Lee, TM Hwang, GW Park, JH Back, In the 12th Korea Robotics Society Annual Conference. (KRoC2017) (*Best Student Paper Award*).

Patents

US Patent App. 18/562,175, Surgical tool device having wire hysteresis compensation function and method for controlling same DH Baek, NHO Young-Hoon, DS Kwon,

US Patent App. 17/277,159, Method of determining hysteresis of surgical robot, method of compensating for the same, and endoscopic surgical apparatus Dong Soo Kwon, **Dong Hoon Baek**, Ju Hwan Seo, Joon Hwan Kim, Jeong Do AHN, Han Soul Kim, Jae Min You,

US Patent App. 17/406,834, Asymmetric rolling joint device of surgical instrument DS Kwon, JD Ahn, JH Kim, JM You, HS Kim, DG Lee, Y Yi, **DH Baek**

US Patent 11,433,558, Flexible drive manipulator Dong Soo Kwon, Jae Min You, Joon Hwan Kim, Jeong Do AHN, Han Soul Kim, **Donghoon Baek**, Dong Geol Lee, Ye Sung Yi, Un Je Yan

Projects / Competition

Control of an epiduroscopy robotic system and develop a navigation system **2018 – 2019**

- Developed a software to control an epiduroscopy robotic system.

- Motor control, teleoperation control, Aurora Sensor, GUI.

Mine removal training system using IoT and App **2018**
- Proposed an idea to develop the mine removal training system using IoT and App.

Torque-based control of the smart robotic grasper **2017**
- Developed a safe torque-controller for a robotic grasper to grab unknown objects.
- Control motors using an embeded system.

Developed a rescue robot, ROSA **2016**
- Designed a robotic manipulator and Developed a task-space manipulator controller.
- Dynamixel motor control, Numerical Inverse kinematics, GUI

Awards / Honors

Top 10 Mechanical Technology Award, KFMES, Korea **2019**
- Designed a master device system for a flexible surgical robot.

Best Paper award, the 16th International Conference on Ubiquitous Robots (UR 2019) **2019**
- **Image-based hysteresis compensator for a flexible endoscopic surgery robot,**

Best Application Award and Overall Winner, Hamlyn Surgical Robot Challenge, London, UK **2018**
- Designed a master device system for a flexible surgical robot.

Minister of National Defense Award, Military defense start-up competition, Korea **2018**
- Mine removal training system using IoT and App.

Best Paper award, the 14th Asian Conference on Computer Aided Surgery. (ACCAS 2018) **2018**
- **A flexible endoscopic surgery robot K-FLEX and its feasibility validation in in-vivo animal trial**

Best Paper award, the 12th Korea Robotics Society Annual Conference. (KRoC2017) **2017**
- **Development of the rescue robot for earthquake zone**

Excellent Paper award, University of Kwangwoon, Korea **2016**
- Development of the rescue robot for earthquake zone.

Second Prize, University of Kwangwoon, Korea **2016**
- KwangWoon IT eXibition (KWIX).

Second Prize, International Robot Contest, Korea **2015**
- Mini DARPA Robotics Challenge.

Scholarships for the highest academic results, University of Kwangwoon, Korea **2013–2016**

Robocup final competition, Robocup, Germany **2016**
- Disaster rescue robot.

Robot Demonstration, IEEE-RAS humanoids 2015, Korea **2015**
- Disaster rescue robot.

Programming Experience

Python, C, C++, Matlab, Pytorch, Tensorflow, OpenCV

Reference

Prof. Joao Ramos Assistant Professor in the Mechanical Science and Engineering Electrical & Electrical and Computer Engineering at the University of Illinois at Urbana Champaign, Illinois, United States. Email: jlramos@illinois.edu

Prof. Dong-Soo Kwon
Professor in the School of Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea. Email: kwonds@kaist.ac.kr