Seong Ho Yeon

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Interests

Bionics
Lower limb active prosthesis
Optimal control of dynamic mechatronics system
Human-in-the-loop control system with robotic augmentation
Embedded and real-time neural interface

Education

Massachusetts Institute of Technology *Sep. 2019 - Present*
Biomechatronics Group, MIT Media Lab Cambridge, MA
Doctor of Philosophy in Media Arts and Sciences

Massachusetts Institute of Technology *Sep. 2017 - Aug. 2019*
Biomechatronics Group, MIT Media Lab Cambridge, MA
Master of Science in Media Arts and Sciences

Georgia Tech ECE - KAIST EE Dual B.S. Program

Georgia Institute of Technology *Jan. 2015 - Dec. 2016*
Bachelor of Science in Electrical Engineering Atlanta, GA
GPA 4.0/4.0, **Highest Honor**

Korea Advanced Institute of Science and Technology *Mar. 2011 - Dec. 2016*
Bachelor of Science in Electrical Engineering Daejeon, Korea
GPA 4.02/4.30, **Summa Cum Laude**

Research Experiences

Biomechatronics Group, MIT Media Lab *Sep. 2017 - Present*
Graduate Research Assistant (Advisor : Dr. Hugh M. Herr)

- Leading a project to construct synthetic closed-loop control method targeting peripheral nervous system and lower-limb musculature envisioning restoration of the limb function from limb-loss or paralysis
- Developing a hardware and embedded system for magnetomicrometry framework : new, disruptive, and minimally invasive neural interface modality to measure the states of muscles in real-time for control of advanced prosthetic systems
- Developed an embedded electromyography(EMG) processor system, including hardware, firmware, and graphic-user-interface software, for generic lower limb active prosthesis system research
- Developed hardware and software pipeline for for utilizing deep neural network architecture in high band-width control loop for generic lower limb active prosthesis system research

Laboratory for GT Neuroengineering (GT Neuro), Georgia Tech *Aug. 2015 - Dec. 2016*
Undergraduate Research Assistant (Advisor : Dr. Stephen P. Deweerth)

- Proposed, designed, and developed portable and wireless transcutaneous electrical nerve stimulation (TENS) system for diabetic peripheral neuropathy (DPN) patient
- The TENS system is developed in order to prevent aggravation of DPN complications by regenerating sensory feedback from the foot using electrical stimulation through tibial nerve and sural nerve at the ankle level
- The result of the first stimulator prototype has been presented at IEEE EMBC' 16 as a poster
- Designed active prosthesis prototype for cat with bio-mechanical neuro interface integration capability using microcontroller for research of cutaneous sensory feedback system

Communication Systems Laboratory, KAIST *May. 2015 - Aug. 2016*
Undergraduate Research Assistant (Advisor : Dr. SeongHwan Cho)

- Designed and developed a low cost, portable, and real-time sleep apnea diagnosis system with measurement capabilities of ECG, airflow, skin conductance, and bio-impedance based respiration
- The developed system has been presented in IEEE ISOCC '15 as an oral presentation
- Prototyped portable and real-time gait analysis system measuring foot pressure distribution

Nano Integrated Circuit Expertise Laboratory, KAIST *Jun. 2014 - Aug. 2016*
Undergraduate Research Assistant (Advisor : Dr. Sang Guk Lee)

- Collaborated with other graduate students to develop a Flash ADC for a car radar application
- Contributed to design and simulate a digital block layout of a 6-bit 1-GS/s Flash ADC

Industrial Experience

Hyundai Motor Company *May. 2020 - Jul. 2020*
Control Engineering Intern, Robot Platform Team, Robotics Lab

- Conducted research on closed-loop control simulation of dynamic and mobile robots including a 6-DoF manipulator and a mobile quadruped robot
- Conducted research on implementation of a control system and algorithm of 6-DoF medical lower-limb exoskeleton, H-MEX2, for assisting and restoring ambulatory activity of a paraplegic person

NAVER LABS *Jan. 2017 - Jul. 2017*
Robotics Engineering Intern, Robotics Team

- Conducted research in designing software architectures to effectively integrate deep neural network components, including supervised learning based classifier and reinforcement learning based motion planner, on small-sized personal mobile robot without cloud computation environments
- *Capstone Design*, senior design course of KAIST MechE, was formulated based on the conducted research
- Contributed in developing embedded high-power motor driver system, from circuit design to MCU firmware design, for BLDC motors and DC motors

Mobile Communications Business, Samsung Electronics *Jun. 2016 - Aug. 2016*
H/W Engineering Intern, Innovative Solution part, Flagship R&D Team

- Proposed the concept of next-generation optical heart rate monitor (HRM) sensor with auto-calibration feature to compensate individual differences of people to achieve higher robustness of the system
- Analyzed and researched cutting-edge optical bio-sensor solution with flexibility and wireless feature
- Participated in ideation and development of varied next-generation disruptive sensor solutions for mobile products such as environment sensors or bio-sensors

Journal Publications

C. R. Taylor, S. S. Srinivasan, **S. H. Yeon**, M. K. O'Donnell, T. J. Roberts, and H. M. Herr, "Magnetomicrometry," *Science Robotics*, 2021. *Accepted, To be published.*

S. H. Yeon, T. Shu, H. Song, T. H. Hsieh, J. Qiao, E. A. Rogers. S. G. Arango, E. Israel, L. E. Freed, and H. M. Herr, "Acquisition of Surface EMG Using Flexible and Low-Profile Electrodes for Lower Extremity Neuroprosthetic Control," *IEEE Transactions on Medical Robotics and Bionics (TMRB)*, 2021. *Accepted, To be published.*

E. Rogers, M. Carney, **S. H. Yeon**, T. Clites, D. Solav, and H. Herr, "An Ankle-Foot Prosthesis for Rock Climbing Augmentation," *IEEE Transactions on Neural Systems & Rehabilitation Engineering (TNRSE)*, Feb. 2021, vol.29, pp. 41-51.

Conference Publications

S. H. Yeon and H. M. Herr, "Rejecting Impulse Artifacts from Surface EMG Signals using Real-time Cumulative Histogram Filtering," *2021 Annual International Conference of the IEEE Engineering in Medicine and Biology (EMBC)*, Nov. 2021. *Accepted. To Appear.*

S. H. Yeon*, H. Song*, and H. M. Herr, "Spatiotemporally Synchronized Surface EMG and Ultrasonography Measurement Using a Flexible and Low-Profile EMG Electrode," *2021 Annual International Conference of the IEEE Engineering in Medicine and Biology (EMBC)*, Nov. 2021. *Accepted. To Appear.* (*Equally Contributed.)

S. H. Yeon, and T. Shu, E. A. Rogers, H. Song, T. Hsieh, L. E. Freed, and H. M. Herr, "Flexible Dry Electrodes for EMG Acquisition within Lower Extremity Prosthetic Sockets," *2020 8th IEEE International Conference on Biomedical Robotics and Biomechatronics (Biorob)*, May. 2020, pp. 1088-1095. *Nominated as a best student paper award candidate.*

G. Ryou*, Y. Sim*, **S. H. Yeon***, and S. Seok, "Applying Asynchronous Deep Classification Network and Gaming Reinforcement Learning-Based Motion Planner to a Mobile Robot," *IEEE International Conference on Robotics and Automation (ICRA)*, May. 2018, pp. 6268-6275. (*Equally Contributed.)

S. H. Yeon*, D. Kim*, G. Ryou*, and Y. Sim*, "System Design for Autonomous Table Tennis Ball Collecting Robot," *2017 International Conference on Control, Automation and Systems (ICCAS)*, Oct. 2017, pp. 909-914. (*Equally contributed.)

S. H. Yeon, B. Saravanabhavan, A. D. Filippo, H. Park, and S. DeWeerth, "A Portable and Wireless Transcutaneous Electrical Nerve Stimulation System to Generate a Pressure Sensation on the Foot," *2016 Annual International Conference of the IEEE Engineering in Medicine and Biology (EMBC)*, Aug. 2016. (Research Poster Paper)

J. Lee, **S. H. Yeon**, and S. Cho, "All electrical and real-time ECG, respiration, airflow, and skin conductance monitoring system," *Proc. International SoC Design Conference (ISOCC)*, 2015, pp. 111-112.

Patents

H. M. Herr, C. R. Taylor, S. H. Yeon, and M. T. Nawrot, "Magnetomicrometric Advances in Robotic Control", U.S. Patent Application 63/104,942., filed October 23, 2020.

H. M. Herr and S. H. Yeon. "Electromyography Sensor", U.S. Patent Application 16/661,283., filed October 23, 2019.

D. Kim, G. Ryou, Y. Sim, S. H. Yeon, and S. Seok, "Pickup Robot", KR. Patent 1,020,867,820,000., issued March 3, 2020.

Y. Sim, G. Ryou, S. H. Yeon, and S. Seok, "Pipe Assembly", KR. Patent 1,020,236,210,000., issued September 16, 2019.

Y. Sim, G. Ryou, S. H. Yeon, and S. Seok, "Controlling Mobile Robot Based on Reinforcement Learning using Game Environment Abstraction", KR. Patent 1,019,744,470,000., issued April 25, 2019.

Y. Sim, G. Ryou, S. H. Yeon, and S. Seok, "Controlling Mobile Robot Base On Asynchronous Target Classification," KR. Patent 1,019,744,480,000., issued April 25, 2019.

D. Kim, G. Ryou, Y. Sim, S. H. Yeon, and S. Seok, "Method of Controlling Pickup Robot", KR. Patent 1,019,702,950,000., issued April 12, 2019.

Live and Media Demonstration

"Engineering Stories", Engineering Design Workshop, Permanent Exhibition of Museum of Science, Boston, Presenting engineering stories with neurally controlled rock climbing ankle prosthesis system, Virtual exhibition access : https://virtualexhibits.mos.org/edw-engineering-stories/

"Using A.I. to build a better human - The Age of A.I. Season 1 Episode 3", Youtube Original, Dec. 2019, Demonstrating neurally controlled rock climbing ankle prosthesis system, Web access : https://www.youtube.com/watch?v=lrv8ga02VNg

"This MIT Engineer Built His Own Bionic Leg", Bloomberg Documentary, Dec. 2019. Demonstrating neurally controlled ankle prosthesis system, Web access : https://www.youtube.com/watch?v=kaFiwC1xh2Y

Hugh M. Herr, "How we'll become cyborgs and extend human potential", TED : Ideas Worth Spreading, Apr. 2018, Demonstrating neurally controlled ankle prosthesis systems (dynamic powered ankle and quasi-passive rock climbinb ankle), Introduced as a member of "Team Cyborg" at MIT, Web access : https://www.ted.com/talks/hugh_herr_how_we_ll_become_cyborgs_and_extend_human_potential/up-next?language=en

"Augmented", STAT Documentary, To be released, Demonstrated neurally controlled rock climbing ankle prosthesis system, Web access : https://www.youtube.com/watch?v=y_lA1N3La38
https://www.statnews.com/2018/05/30/pioneering-amputation-surgery-prosthetic-foot/

Teaching Experiences

Circuit Analysis *Spring 2016, Fall 2016*
ECE 2040, Georgia Institute of Technology
Tutor

Calculus II *Fall 2014*
MAS 102, Korea Advanced Institute of Science and Technology
Tutor

Topics in Philosophy (Pragmatism) *Fall 2014*
HSS 301, Korea Advanced Institute of Science and Technology
Teaching Assistant

Leadership Experiences

KAIST Basketball Team *Mar. 2014 - Dec. 2014*

Captain

- Competed on the 3rd AEARU Inter-University Basketball Tournament in Japan 2014
- KAIST athletic representative at the 13th KAIST-POSTECH Science War in 2014

Republic of Korea Air Force *Oct. 2011 - Oct. 2013*

Component Maintenance Squadron, R.O.K. 15th Special Activity Wing

Avionics Technician, Maintenance Operation and PAE Management Assistant (Sergeant)

- Administrated and coordinated maintenance scheduling for 270 military technical personnel to ensure appropriate maintenance turnaround for the C-130 Hercules, KT-1, and Hawker 800 aircrafts
- Successfully contrived, implemented and managed a military inventory program for the entire division
- Maintained and repaired autopilot components of Lockheed C-130 Hercules aircraft

Honors and Awards

Kwanjeong Scholarship, Kwanjeong Educational Foundation *Fall. 2019 - Current*

Roger P. Webb. ECE Senior Scholar Award, Georgia Tech *May. 2017*

President's Undergraduate Research Award (PURA), Georgia Tech *Summer 2016, Fall 2016*

Faculty Honors, Georgia Tech *All semesters in 2016, 2017*

National Academic Excellence Scholarship, Korea Student Aid Foundation *Spring 2011 - Fall 2016*

KAIST Presidential Fellowship, KAIST *Spring 2015 - Fall 2016*