Seungmoon Song

Assistant Professor at Northeastern University
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Faculty Appointment

Assistant Professor   **Northeastern University** (Jan 2022 – present)
Mechanical and Industrial Engineering

Education

Postdoctoral Fellow   **Stanford University** (Jun 2018 – Dec 2021)
Mechanical Engineering
Supervisor: Steven H. Collins, Ph.D.

Carnegie Mellon University (Jun 2017 – May 2018)
Robotics Institute
Supervisor: Christopher Atkeson, Ph.D.

M.S., Ph.D.   **Carnegie Mellon University** (Aug 2010 – May 2017)
Robotics Institute
Advisor: Hartmut Geyer, Ph.D.

M.S.   **Virginia Tech** (Aug 2008 – Aug 2010)
Electrical and Computer Engineering
Advisor: Dennis Hong, Ph.D.

B.E., *summa cum laude*   **ICU (*KAIST)** (Feb 2004 – Feb 2008)
Electrical and Communications Engineering
Research advisor: Jeongsuk Ha, Ph.D.
* ICU was Korea's IT-specialized university that merged with KAIST in 2009.

Other Research Experience

Lab Associate   **Disney Research**, Pittsburgh, PA (May – Aug 2014)
(summer intern)   Robotics
Supervisor: Katsu Yamane, Ph.D. and Joohyung Kim, Ph.D.
Research: Develop and control animation-like bipedal robot
Keywords: bipedal robot design, 3D printing, trajectory optimization

Student Intern   **ETRI**, S. Korea (Jan – Mar 2008)
                              Robot AI server team
                              Supervisor: Hyungsun Kim, Ph.D.
                              Task: Review real-time robot-motion-control interface programs

Publications

Papers, videos, and other supporting materials are available at: http://seungmoon.com
Counts: 8 articles, 12 proceedings, 10 abstracts, 2 patents
Citation numbers (from Google Scholar): 560 citations, h-index: 13

Journal articles

J8.   GM Bryan, PW Franks, **S Song**, R Reyes, MP O'Donovan, KN Gregorczyk & SH Collins. Optimized hip-knee-ankle exoskeleton assistance reduces the metabolic cost of walking with worn loads. *Journal of NeuroEngineering and Rehabilitation*. 2021.

J7.   GM Bryan, PW Franks, **S Song**, AS Voloshina, R Reyes, MP O'Donovan, KN Gregorczyk & SH Collins. Optimized hip-knee-ankle exoskeleton assistance at a range of walking speeds. *Journal of NeuroEngineering and Rehabilitation*. 2021.

J6.   **S Song**, Ł Kidziński, XB Peng, C Ong, J Hicks, S Levine, CG Atkeson, & SL Delp. Deep reinforcement learning for modeling human locomotion in neuromechanical simulation. *Journal of NeuroEngineering and Rehabilitation*. 2021.

J5.   **S Song** & SH Collins. Optimizing exoskeleton assistance for faster self-selected walking speed. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*. 2021.

J4.   **S Song**, H Choi, & SH Collins. Using force data to self-pace an instrumented treadmill and measure self-selected walking speed. *Journal of NeuroEngineering and Rehabilitation*. 2020.

J3.   **S Song** & H Geyer. Predictive neuromechanical simulations indicate why walking performance declines with aging. *The Journal of Physiology*. 2018.

J2.   **S Song** & H Geyer. Evaluation of a neuromechanical walking control model using disturbance experiments. *Frontiers in Computational Neuroscience*. 2017.

J1.   **S Song** & H Geyer. A neural circuitry that emphasizes spinal feedback generates diverse behaviours of human locomotion. *The Journal of Physiology*. 2015.

Conference proceedings (peer-reviewed)

C12.   A Rai, R Antonova, **S Song**, W Martin, H Geyer, & CG Atkeson. Bayesian optimization using domain knowledge on the ATRIAS biped. *IEEE ICRA*, 2018.

C11.　**S Song**. Towards a hierarchical neuromuscular control model with reflex-based spinal control – a study with a simple running model. *International Symposium on Advanced Intelligent Systems*, 2015.

C10.　**S Song** & H Geyer. Regulating speed in a neuromuscular human running model. *IEEE Humanoids*, 2015.

C9.　Z Batts, **S Song**, & H Geyer. Toward a virtual neuromuscular control for robust walking in bipedal robots. *IEEE IROS*, 2015.

C8.　**S Song**, J Kim, & K Yamane. Development of a bipedal robot that walks like an animation character. *IEEE ICRA*, 2015.

C7.　**S Song**, R Desai, & H Geyer. Integration of an adaptive swing control into a neuromuscular human walking model. *IEEE EMBC*, 2013.

C6.　**S Song** & H Geyer. Generalization of a muscle-reflex control model to 3D walking. *IEEE EMBC*, 2013.

C5.　**S Song**, C LaMontagna, SH Collins, & H Geyer. The effect of foot compliance encoded in the windlass mechanism on the energetics of human walking. *IEEE EMBC*, 2013.

C4.　**S Song** & H Geyer. Regulating speed and generating large transitions in a neuromuscular human walking model. *IEEE ICRA*, 2012.

C3.　**S Song** & H Geyer. The energetic cost of adaptive feet in walking. *IEEE ROBIO*, 2011.

C2.　**S Song**, Y Ryoo, & D Hong. Development of an omnidirectional walking engine for full-sized lightweight humanoid robots. *ASME IDETC*, 2011.

C1.　**S Song**, D Hwang, S Seo, & J Ha. Linear-Time Encodable Rate-Compatible Punctured LDPC Codes with Low Error Floors. *IEEE VTC*, 2008.

Conference abstracts (selected)

A10.　**S Song**, H Choi, K Poggensee, CG Atkeson, & SH Collins. Human-in-the-loop optimization of ankle-exoskeleton assistance for faster preferred walking speed: a preliminary study. *Dynamic Walking*, 2019.

A9.　**S Song**, Ł Kidziński, R Khidorka, C Ong, S Mohanty, J Hicks, J Ku, S Carroll, S Levine, M Salathé, CG Atkeson, SH Collins & S Delp. Learn to Move: a competition to bridge biomechanics, neuroscience, robotics, and machine learning to model human motor control. *Dynamic Walking*, 2019.

A8.　**S Song**, H Geyer, SH Collins, & CG Atkeson. Towards predictive neuromechanical simulations for pathological gait and assistive devices. *World Congress of Biomechanics*, 2018.

A7.　A Falisse, G Serrancoli, C Dembia, **S Song**, I Jonkers, & F De Groote. Computationally efficient predictive muscle-driven simulations of 3D walking. *World Congress of Biomechanics*, 2018.

A6.   **S Song**, Y Aucie, & G Torres-Oviedo. Can split-belt treadmill walking be explained with a reflex-based model. *Neuroscience*, 2017.

A5.   **S Song** & H Geyer. Modeling and exploring elderly walking with neuromechanical simulations. *Dynamic Walking*, 2017.

A4.   **S Song** & H Geyer. A spinal reflex based neuromuscular model of human locomotion investigated against unexpected disturbances. *Neuroscience*, 2016.

A3.   **S Song** & H Geyer. Testing a neuromuscular locomotion control model against human experiments. *Dynamic Walking*, 2016.

A2.   **S Song** & H Geyer. Using a neuromuscular model of human locomotion to control bipedal robots. *Dynamic Walking*, 2015.

A1.   **S Song** & H Geyer. Robust 3D locomotion models using primarily reflex control. *Dynamic Walking*, 2013.

Patents

P2.   J Kim, K Yamane, & **S Song**, Method for developing and controlling a robot to have movements matching an animation character, United States Patent 9427868, 2016.

P1.   J Nam, J An, D Hwang, J Ha, & **S Song**, Apparatus and method for encoding low density parity check code, Korean patent 10-0999272-00-00, 2010.

Other technical writings

T3.   **S Song**. Understanding the control of human locomotion through simulation and its application to robotic assistive devices. MATERIC (Korean research information center), February, 2016.

T2.   **S Song**. Robotic lower-limb prosthetics related technical issues – 2. Control algorithm. ROBOT (monthly Korean magazine), May 2013.

T1.   **S Song**. Robotic lower-limb prosthetics related technical issues – 1. Hardware. ROBOT (monthly Korean magazine) April 2013.

Invited Talks

ASCC 2022 Workshop on Control of Soft Wearable Robots	May 7, 2022
BioRob 2020 Workshop on Community-Based Rehabilitation Research using Wearable Devices	Nov 29, 2020
University of Delaware (Mechanical Engineering Department Seminar)	Sep 25, 2020

WearRAcon (Breakout session speaker)   Mar 31, 2020

NeurIPS Deep RL workshop   Dec 14, 2019

Universities in Europe   Jul 2018
- EPFL, Switzerland
- University of Tübingen, Germany
- University of Stuttgart, Germany
- Heidelberg University, Germany
- TU Darmstadt, Germany
- KU Leuven, Belgium
- University of Twente, Netherlands

Universities and research institutes in Korea   Jul 2017
- Seoul National University
- Korea Institute of Industrial Technology
- Pohang University of Science and Technology
- Korea Institute of Machinery and Materials
- Inha University

Universities and companies in Korea   Nov 2015
- Chung-Ang University
- Samsung Advanced Institute of Technology
- KAIST
- ROBOTIS
- Seoul National University

The 10th Workshop on Humanoid Soccer Robots at IEEE Humanoids   Nov 3, 2015

Grant

Principal Investigator ($1.0M)	**NIH K99AG065524**, $1.0M (2020 – present) Simulation framework to develop ankle exoskeleton gait assistance for older adults K99: $238,100 over 2 years; R00: $747,000 over 3 years

Teaching Experience

Instructor	**Northeastern University** (Spring 2022) ME4555 – **System analysis and control** Senior-level, 4 credits, 29 students
Teaching Assistant	**Carnegie Mellon University** (Fall 2013) 16868 - **Biomechanics and motor control of legged locomotion** Instructor: Hartmut Geyer, Ph.D.

Graduate-level, 12 units, 21 students
Lectured three classes, designed class projects, assisted students, and graded assignments

Mentoring   **Northeastern University** (2022 – present)
6 Master's students

Stanford University (2018 – 2021)
4 Ph.D. and 1 Master's students

Carnegie Mellon University (2014 – 2019)
4 Master's and 2 undergraduate students

Honors & Awards

Honor   **Summa cum Laude**, ICU (2008)

Competitions   **RoboCup** (2010)
3rd place, adult-size humanoid league
4th place, kid-size humanoid league

Radio & Wireless Engineering Prototypes, Radio Education and Research Center, S. Korea
Finalist, Building Power Control System (2005)
Finalist, Ubiquitous Medical Information System (2006)

Scholarship   **Richard King Mellon Foundation Presidential Fellowship in the Life Sciences at Carnegie Mellon University** (2016-2017)

Ford Engineering Scholarship, Golden Key International Honour Society (2010)

Science and Engineering National Scholarship, Korea Science and Engineering Foundation, S. Korea (2006)

Academic Excellence Scholarship, ICU, S. Korea (2004 – 2006)

Full-tuition scholarship, Ministry of Information and Communication, S. Korea (2004 – 2007)

Academic Service

Organizer   **NeurIPS 2019: Learn to Move competition** (2019)
Role: lead organizer
Theme: Deep reinforcement learning for human movement

Participation: 323 teams
Members: Łukasz Kidziński, Scott Delp, Sergey Levine, et al.

Associate editor   IEEE BioRob 2022

Ad-hoc reviewer   **Journals**
ACM Transactions on Graphics
Advances in Mechanical Engineering
Bioinspiration & Biomimetics
Gait & Posture
Human Movement Science
IEEE Robotics and Automation Letters
IEEE Transactions on Neural Systems & Rehabilitation Engineering
IEEE Transactions on Robotics
Journal of Biomechanics
Journal of Neural Engineering
Journal of the Royal Society Interface
PLOS Computational Biology
Scientific Reports
Science Robotics

Conferences
IEEE BioRob
IEEE Humanoids
IEEE ICRA
IEEE IROS
NeurIPS (competition track)
SIGCHI
SIGGRAPH
SIGGRAPH Asia
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