

Seungmoon Song

Assistant Professor at Northeastern University

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<http://seungmoon.com/>

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 into KAIST in 2009.

Other Research Experience

Lab Associate
(summer intern)

Disney Research, Pittsburgh, PA (May – Aug 2014)
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, 11 abstracts, 2 patents

(From Google Scholar) Citations: 597; h-index: 14

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)

- A11 **S Song**. Toward predictive simulation framework for gait assistive ankle exoskeletons. *Ubiquitous Robotics*, 2022.
- 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

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|---|--------------|
| Boston Action Club | Oct 20, 2022 |
| Universities and research institutes in Korea | Jul-Aug 2022 |
| • ETRI | |

- Pukyong National University
- Pusan National University
- Korea Institute of Industrial Technology
- Korea University
- Seoul National University
- Hyundai Motor Research Institute
- KAIST

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 <ul style="list-style-type: none"> • EPFL, Switzerland • University of Tübingen, Germany • University of Stuttgart, Germany • Heidelberg University, Germany • TU Darmstadt, Germany • KU Leuven, Belgium • University of Twente, Netherlands 	Jul 2018
Universities and research institutes in Korea <ul style="list-style-type: none"> • Seoul National University • Korea Institute of Industrial Technology • Pohang University of Science and Technology • Korea Institute of Machinery and Materials • Inha University 	Jul 2017
Universities and companies in Korea <ul style="list-style-type: none"> • Chung-Ang University • Samsung Advanced Institute of Technology • KAIST • ROBOTIS • Seoul National University 	Nov 2015
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) 3 rd place, adult-size humanoid league 4 th 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

Role: lead organizer

Theme: Deep reinforcement learning for human movement

Participation: 323 teams

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

Organizer

NeurIPS 2022: MyoChallenge

Role: co-organizer

Theme: Learning contact-rich manipulation for musculoskeletal hands

Members: Vittorio Caggiano, Vikash Kumar, Massimo Sartori, et al.

Associate editor

IEEE BioRob 2022

Ad-hoc reviewer

Journals

ACM Transactions on Graphics

Advances in Mechanical Engineering

Bioinspiration & Biomimetics

Frontiers in Bioengineering and Biotechnology

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

PLOS ONE

Scientific Reports

Science Robotics

Conferences

IEEE BioRob

IEEE Humanoids

IEEE ICRA

IEEE IROS

NeurIPS (competition track)

SIGCHI

SIGGRAPH
SIGGRAPH Asia
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