

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 into KAIST in 2009.

Scholarly Contributions

Papers, videos, and other materials are available at: <http://seungmoon.com> and <https://neumove.org/>.
Counts: 13 journal articles, 20 peer-reviewed conference papers, 2 patents
(From Google Scholar) Citations: 1409; h-index: 17

Journal articles

- J13 P Shetty, J Menezes, **S Song**, A Young, M Shepherd. Ankle exoskeleton control via data-driven gait estimation for walking, running, and inclines. *IEEE Robotics and Automation Letters*. 2025.
- J12 V Firouzi, A Seyfarth, **S Song**, O von Stryk, & MA Sharbafi, Biomechanical models in the lower-limb exoskeletons development: A review. *Journal of NeuroEngineering and Rehabilitation*. 2025.
- J11 A Dziewaltowski, AM Gonabadi, P Antonellis, **S Song**, & P Malcolm, Perturbation-based estimation of within-stride cycle metabolic cost. *Journal of NeuroEngineering and Rehabilitation*. 2024.
- J10 JGA Cashaback, JL Allen, AHY Chou, DJ Lin, M Mangalam, MA Price, NK Secerovic, **S Song**, H Zhang, HL Miller, NSF DARE—transforming modeling in neurorehabilitation: a patient-in-the-loop framework, *Journal of NeuroEngineering and Rehabilitation*. 2024.
- J9 A Lakmazaheri*, **S Song***, BB Vuong, B Biskner, DM Kado, & SH Collins. Optimizing exoskeleton assistance to improve walking speed and energy economy for older adults. *Journal of NeuroEngineering and Rehabilitation*. 2024.
- 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.

Peer-reviewed conference papers

C20 CK Tan, et al., & **S Song**. MyoAssist 0.1: MyoSuite for Dexterity and Agility in Bionic Humans. *IEEE ICORR*, 2025.

C19 M Liu, D Zhang, Y Chen, T Gong, H Kainz, **S Song**, & J Lee. MedVis Suite: A Framework for MRI Visualization and U-Net-Based Bone Segmentation with In-Depth Evaluation. *ICBBB*, 2025.

C18 V Caggiano* G Durandau* C Wang* CK Tan*, P Schumacher*, et al., & V Kumar. Myochallenge 2023: Towards human-level dexterity and agility. *OpenReview.net*. 2024.

C17 V Ton, D Solav, & **S Song**. Impact of sole designs of offloading AFO on gait dynamics: a predictive neuromechanical simulation study. *IEEE BioRob*, 2024.

C16 GM Bryan, PW Franks, **S Song**, & SH Collins. Pilot comparison of customized and generalized hip-knee-ankle exoskeleton torque profiles. *IEEE ICRA*, 2024.

C15 D Vasu, **S Song**, H Kainz, J Lee, MRI Segmentation of Musculoskeletal Components Using U-Net: Preliminary Results, *ICBBB*, 2024.

C14 V Caggiano, et al., & V Kumar. MyoChallenge 2024: Physiological Dexterity and Agility in Bionic Humans. *NeurIPS 2024 Competition Track*. 2024.

C13 V Caggiano*, G Durandau*, et al., & V Kumar. MyoChallenge 2022: Learning contact-rich manipulation using a musculoskeletal hand. *Proceedings of Machine Learning Research*, 2023.

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)

- A17 V Ton, **S Song**. Comprehensive analysis of neuromechanical control models of human walking in physics-based simulations. *American Society of Biomechanics*, 2025.
- A16 H Son, **S Song**. Towards general motion tracking in physics-based simulation. *American Society of Biomechanics*, 2025.
- A15 C Robbins, CK Tan, **S Song**. Towards simulation-based exoskeleton control design and optimization. *American Society of Biomechanics*, 2025.
- A14 R Rastogi, M Shepherd, **S Song**. Can virtual neuromuscular exoskeleton torque provide speed-adaptive gait assistance? *American Society of Biomechanics*, 2025.
- A13 C Goyal, CK Tan, **S Song**. Towards a task-agnostic exoskeleton arm assistant using deep reinforcement learning and neuromechanical simulation. *American Society of Biomechanics*, 2024.
- A12 CK Tan, G Durandau, M Sartori, V Kumar, V Caggiano, **S Song**. MyoSuite: A unified neuromechanical simulation platform for human movement research. *American Society of Biomechanics*, 2024.
- A11 **S Song**. Modeling in-the-wild effects of gait assistive devices through neuromechanical simulations and deep reinforcement learning, *NSF DARE Conference*, 2023.
- A10 **S Song**. Toward predictive simulation framework for gait assistive ankle exoskeletons. *Ubiquitous Robotics*, 2022.
- A9 **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.

- A8 **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.
- A7 **S Song**, H Geyer, SH Collins, & CG Atkeson. Towards predictive neuromechanical simulations for pathological gait and assistive devices. *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. *Society for 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. *Society for 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.

Invited Talks (selected)

Physical Therapy Department Seminar, Yonsei University	May 28, 2025
Rehabilitation Sciences Seminar, Boston University	April 18, 2025
Robotics Center Seminar, University of Utah	March 20, 2025
ASB Symposium: Can machine learning drive the next generation of scientific discovery in human movement? (invited talk and panel discussion)	August 7, 2024
Institute of Control, Robotics and Systems (ICROS), 2024 (Invited talk)	July 2, 2024

Meeting with the Robot Expert, Intelligent Robotics Innovation Consortium for Universities (seven universities in Korea)	May 10, 2024
Robotics workshop, Pázmány Péter Catholic University, Hungary	Feb 21, 2024
HRI Colloquium, Tufts University	Oct 6, 2023
Symposium on Robots & AI, Gwangju Institute of Science and Technology	Sep 22, 2023
Summer robot expert international workshop, Hanyang University	Jul 7, 2023
Meeting with the Robot Expert, Intelligent Robotics Innovation Consortium for Universities (seven universities in Korea)	May 19, 2023
AI Robotics Seminar, Seoul National University	April 2, 2023
Mechanical & Aerospace Engineering Special Robotics Seminar, UCLA	March 2, 2023
Boston Action Club	Oct 20, 2022
Universities and research institutes in Korea <ul style="list-style-type: none"> • ETRI • Pukyong National University • Pusan National University • Korea Institute of Science and Technology • Korea University • Seoul National University • Hyundai Motor Research Institute • KAIST 	Jul-Aug 2022
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
Mechanical Engineering Department Seminar, University of Delaware	Sep 25, 2020
Session Speaker, WearRAcon	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	Jul 2017
<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 	
Universities and companies in Korea	Nov 2015
<ul style="list-style-type: none"> • 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

(Co-)PI 08/2025–07/2029	NIH/NIA RF1 AG096055 Contact PI: GS Sawicki Identifying multi-scale mechanisms for age-related increase in metabolic cost of walking
Contact-PI 07/2023–09/2024	Northeastern TIER 1 Personalizing musculoskeletal model through deep learning and MRI processing
(Sole-)PI 04/2020–03/2026	NIH K99/R00 AG065524 Simulation framework to develop ankle exoskeleton gait assistance for older adults

Teaching and Mentoring

Instructor Northeastern University	ME5374: Neuromechanical Simulation of Human Movement Graduate-level, 4 credits Fall 2025: 17 students
	ME4555: System analysis and control Senior-level, 4 credits Spring 2025: 56 students Spring 2024: 51 students Spring 2023: 46 students Spring 2022: 29 students
Teaching Assistant Carnegie Mellon University	16868: Biomechanics and motor control of legged locomotion Instructor: Hartmut Geyer, Ph.D.

Fall 2013	Graduate-level, 12 units, 21 students Lectured three classes, designed class projects, assisted students, and graded assignments
Mentoring	<p>Northeastern University (2022-present) Current: 4 PhD, 3 MS students, and 3 undergraduate students Alumni: 2 Postdocs, 7 MS students, 3 visiting students</p> <p>Stanford University (2018-2021) 4 PhD and 1 MS students</p> <p>Carnegie Mellon University (2014-2019) 4 MS and 2 undergraduate students</p>
NeuMove study groups and research interns Study materials provided to students, with research opportunities following successful completion	<p>Total count since 2023: 44 - 28 MS and 16 undergraduate students</p> <p>Study groups: - MyoAssist (2025-present) - Gait assistive exoskeletons (2024-present) - Reflex-based model (2023-present) - Deep RL for neuromechanical simulations (2023-present)</p>

Honors & Awards

Honor	<p>NSF DARE2023 Fellow (2023)</p> <p>Richard King Mellon Foundation Presidential Fellowship in the Life Sciences at Carnegie Mellon University (2016-2017)</p> <p>Summa cum Laude, ICU (2008)</p>
Competitions	<p>RoboCup (2010) 3rd place, adult-size humanoid league 4th place, kid-size humanoid league</p> <p>Radio & Wireless Engineering Prototypes, Radio Education and Research Center, S. Korea Finalist, Ubiquitous Medical Information System (2006) Finalist, Building Power Control System (2005)</p>
Scholarship	<p>Ford Engineering Scholarship, Golden Key International Honour Society (2010)</p> <p>Science and Engineering National Scholarship, Korea Science and Engineering Foundation, S. Korea (2006)</p>

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

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

Academic Activities

MyoSuite (2022-present)
(open-source project)

Description: A suite of musculoskeletal models and task environments, enabling the simulation of diverse motor control behaviors within the MuJoCo simulator

Over 107K downloads on PyPI

Leadership team: V Caggiano (MyoLab), V Kumar (MyoLab), G Durandau (McGill U), M Sartori (U Twente), and **S Song**

Academic competition organizations
(count: 5)

NeurIPS 2022-2025: MyoChallenge

Role: Organizer

Theme:

- 2025: Towards Human Athletic Intelligence
 - 2024: Physiological Dexterity and Agility in Bionic Humans
 - 2023: Towards Human-Level Dexterity and Agility
 - 2022: Learning contact-rich manipulation for musculoskeletal hands
- Members: V Caggiano (Meta AI), V Kumar (Meta AI), G Durandau (McGill U), M Sartori (U Twente), et al.

NeurIPS 2019: Learn to Move competition

Role: Lead organizer

Theme: Deep reinforcement learning for human movement

Participation: 323 teams

Members: Ł Kidziński (Stanford), S Delp (Stanford), S Levine (UC Berkeley), XB Peng (UC Berkeley), et al.

Tutorial
(count: 1)

ASB 2025: MyoAssist: Simulating human neuromechanics and assistive devices in MyoSuite

Role: Organizer (with my PhD students C Robbins and H Son)

Workshop organizations
(count: 8)

BioRob 2024: Neuromusculoskeletal Twins – Lab vs. Clinical Reality

Role: Organizer

Together with: KK Peper (TU München), G Durandau (McGill U), D Häufle (Heidelberg U), V Kumar (MyoLab), P Schumacher (Max Planck Inst), V Caggiano (MyoLab)

ICRA 2024: Expanding Frontiers of Sim2Real

Role: Organizer

Together with: V Kumar (MyoLab), N Fey (MIT), G Durandau (McGill U), V Caggiano (MyoLab), P Agrawal (MIT)

MyoSuite Conference 2024, 2025

Role: Organizer

Together with: V Caggiano (MyoLab), et al.

NeurIPS 2022, 2023, 2024: MyoSymposium

Role: Organizer

Together with: V Caggiano (Meta AI), V Kumar (Meta AI), G Durandau (McGill U), M Sartori (U Twente), et al.

ICRA 2023: Neuromechanics meets deep learning

Role: Organizer

Together with: G Durandau (McGill U), H Wang (U Twente), M Sartori (U Twente), V Caggiano (Meta AI), V Kumar (Meta AI)

External mentoring

PhD Thesis Committee

Northeastern University, 3 students (2023-present)

Georgia Tech (2025-present)

Boston University (2023-2025)

University of Stuttgart (2023)

TU Darmstadt (2022-present)

University of Delaware (2021-2024)

MS Thesis Committee

Northeastern University, 2 student (2023-present)

TU Darmstadt (2023-2024)

Research Mentor

Yonsei University, 1 PhD student (2025-present)

Seoul National University, 1 PhD student (2024-present)

Yorktown High School Science Research Program, 1 high school student (2023-2025)

Seoul National University, 2 PhD students (2022-2024)

Stanford Aging and Ethnogeriatrics (SAGE) Center (2022-2023)

Stanford University, 1 PhD student (2022-2023)

University of Nebraska Omaha, 1 PhD student (2021-2024)

Associate editor

IEEE IROS (2025)

IEEE Transactions on Neural Systems and Rehabilitation (2024-2026)

- Special issue: Broadening the Impact of the DARE Conference:

Transformative Opportunities for Modeling in Neurorehabilitation

IEEE Robotics and Automation Letters (2022-present)

IEEE BioRob (2022, 2024)

Ad-hoc reviewer
(IOP trusted reviewer)**Journals**

ACM Transactions on Graphics

Advances in Mechanical Engineering

Bioinspiration & Biomimetics

Engineering

Frontiers in Bioengineering and Biotechnology

Frontiers in Mechanical Engineering

Gait & Posture
Human Movement Science
IEEE Robotics and Automation Letters
IEEE Transactions on Human-Machine Systems
IEEE Transactions on Neural Systems & Rehabilitation Engineering
IEEE Transactions on Robotics
Journal of Biomechanics
Journal of Neural Engineering
Journal of NeuroEngineering and Rehabilitation
Journal of Physiology
Journal of the Royal Society Interface
Mechatronics
PLOS Computational Biology
PLOS ONE
Robotics and Autonomous Systems
Scientific Reports
Science Robotics

Conferences

IEEE BioRob
IEEE Humanoids
IEEE ICORR
IEEE ICRA
IEEE IROS
IEEE ISMR
NeurIPS (competition track)
SIGCHI
SIGGRAPH
SIGGRAPH Asia
UR

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