

# Seungmoon Song

Assistant Professor at Northeastern University

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## Faculty Appointment

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

## Education

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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

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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



- 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 Groot. 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	Jul 2018
<ul style="list-style-type: none"> <li>• EPFL, Switzerland</li> <li>• University of Tübingen, Germany</li> <li>• University of Stuttgart, Germany</li> <li>• Heidelberg University, Germany</li> <li>• TU Darmstadt, Germany</li> <li>• KU Leuven, Belgium</li> <li>• University of Twente, Netherlands</li> </ul>	
Universities and research institutes in Korea	Jul 2017
<ul style="list-style-type: none"> <li>• Seoul National University</li> <li>• Korea Institute of Industrial Technology</li> <li>• Pohang University of Science and Technology</li> <li>• Korea Institute of Machinery and Materials</li> <li>• Inha University</li> </ul>	
Universities and companies in Korea	Nov 2015
<ul style="list-style-type: none"> <li>• Chung-Ang University</li> <li>• Samsung Advanced Institute of Technology</li> <li>• KAIST</li> <li>• ROBOTIS</li> <li>• Seoul National University</li> </ul>	
The 10th Workshop on Humanoid Soccer Robots at IEEE Humanoids	Nov 3, 2015

## Grant

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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**

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Instructor	<p><b>Northeastern University</b> (Spring 2022)  <b>ME4555 – System analysis and control</b>          Senior-level, 4 credits, 29 students</p>
Teaching Assistant	<p><b>Carnegie Mellon University</b> (Fall 2013)  <b>16868 - Biomechanics and motor control of legged locomotion</b>          Instructor: Hartmut Geyer, Ph.D.          Graduate-level, 12 units, 21 students          Lectured three classes, designed class projects, assisted students,          and graded assignments</p>
Mentoring	<p><b>Northeastern University</b> (2022 – present)          6 Master’s students</p> <p><b>Stanford University</b> (2018 – 2021)          4 Ph.D. and 1 Master’s students</p> <p><b>Carnegie Mellon University</b> (2014 – 2019)          4 Master’s and 2 undergraduate students</p>

## **Honors & Awards**

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

**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

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Organizer	<p><b>NeurIPS 2019: Learn to Move competition</b>            Role: lead organizer            Theme: Deep reinforcement learning for human movement            Participation: 323 teams            Members: Łukasz Kidziński, Scott Delp, Sergey Levine, et al.</p>
Organizer	<p><b>NeurIPS 2022: MyoChallenge</b>            Role: co-organizer            Theme: Learning contact-rich manipulation for musculoskeletal hands            Members: Vittorio Caggiano, Vikash Kumar, Massimo Sartori, et al.</p>
Associate editor	IEEE BioRob 2022
Ad-hoc reviewer	<p><b>Journals</b>            ACM Transactions on Graphics            Advances in Mechanical Engineering            Bioinspiration &amp; Biomimetics            Frontiers in Bioengineering and Biotechnology            Gait &amp; Posture            Human Movement Science            IEEE Robotics and Automation Letters            IEEE Transactions on Neural Systems &amp; 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</p> <p><b>Conferences</b>            IEEE BioRob            IEEE Humanoids            IEEE ICRA            IEEE IROS            NeurIPS (competition track)            SIGCHI</p>

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