Yaejin Moon

ACADEMIC APPOINTMENTS

Assistant Professor	Syracuse University, Department of Exercise Science	Jan 2023 - Present

EDUCATION

Post-Doctoral Research Fellow	Northwestern University (Shirley Ryan AbilityLab), Chicago	Aug 2018 - May 2021
Ph.D., Kinesiology	The University of Illinois, Urbana-Champaign	Aug 2013- May 2018
M.S., Kinesiology	The University of Illinois, Urbana-Champaign	Aug 2011- May 2013
B.S., Sport Science in Physical education (*summa cum laude)*	Seoul National University, Seoul, Korea	Mar 2006- Aug 2010

RESEARCH INTERESTS

1) Investigate effective clinical intervention to improve locomotion and balance function in people with neurological disorders and older adults.
2) Understand neurophysiological and biomechanical mechanisms underlying altered motor efficiency after neurological disorders or aging.
3) Validate accuracy and feasibility of state-of-art technology in measuring balance and gait characteristics in people with and without movement disorders.

RESEARCH EXPERIENCE

Post-Doctoral Fellow (2018-2021) – Northwestern University (Shirley Ryan AbilityLab), Chicago, IL, USA (P.I.: Arun Jayaraman)

Project: Investigating the feasibility of applying electrical stimulation on the spinal cord for gait recovery in stroke and other neurological populations.

I led an interdisciplinary team of engineers and clinicians to investigate the feasibility of applying a novel neuro-stimulator (transcutaneous spinal stimulation) for gait recovery in the clinical population (stroke & spinal cord injury survivors). I managed multiple aspects of the project, including design, development, execution, and implementation of scientific research and development in collaboration with a research team. The work received the National Institutes of Health R01 grant by scoring top 1% (Impact score: 10). Main roles included:

- Contributed to NIH R01 grant application by collecting, analyzing, reporting preliminary data, and writing the approach section (received impact score: 10, percentage: 1%).
- Worked closely with clinical populations (stroke & spinal cord injury survivors) by interacting with the research participants during training and assessment.
- Implemented experiment and intervention procedures based on theories of neuromechanics and biomechanics research techniques. Used neurophysiological measures (i.e., spinal motor evoked potential), motion capture, video analysis, inertial sensors, metabolic assessment, surface electromyography, and participant self-reported measures.
- Developed standard process of gait training combined with neuro-stimulator such as determining progressive gait training protocol and optimal stimulation setting.
- Mentored five undergraduate/post-bachelor research interns.
- Published two papers in peer-reviewed journals and presented data to public conferences.
- Lead the project team by creating long- and short-term plans, setting targets for milestones, adhering to deadlines, delegating tasks to the team members, and monitoring the progress.
- Applied statistical methods to investigate the effects of the rehabilitation technique and dimensionality-reduction method to identify the primary motor outcome of data sets.
- Communicated closely with the executive leaders to keep the project aligned with their goals by having a biweekly meeting

Research Fellow/Graduate student in Kinesiology (2011-2018) - The University of Illinois Urbana-Champaign, Urbana, IL, USA (P.I.: Dr. Jacob Sosnoff)

Fall-related injury assessment: I led human performance studies to evaluate fall risk and design fall prevention intervention. I measured fall impact severity by performing advanced signal processing of kinetic (force plate) and kinematic (motion capture, IMU) data collected during head and hip impact. I also quantified fall risk by measuring biomechanical measures of balance ability, including displacement of the center of pressure (COP) of standing posture and virtual-time-to-contact of COP to stability boundary of an individual.

Wearable sensor validation: I led a validation study to examine the accuracy and precision of a novel inertial sensor in measuring gait and balance metrics by comparing it to contemporary research-grade measurement devices. I designed the experiment of collecting multiple sensors simultaneously, developed an algorithm to process signals to analyze gait and balance function, and applied a statistical model to validate the system.

Shoulder injury risk assessment: I analyzed the joint loads acting on the shoulder during wheelchair propulsion as a function of shoulder pain. I performed inverse dynamic analysis to estimate 3-D and resultant shoulder joint forces using subject anthropometrics, SMARTwheels that measure three-dimensional forces/torques, and motion capture.

Systematic review and meta-analysis: I systematically reviewed and quantitatively synthesized (via meta-analysis) existing literature related to gait performance and fall risk. The review papers provided comprehensive information on the heterogeneous relationship between gait and

neurological conditions and the contribution of body configuration during a fall on reducing injury risk.

TEACHING EXPERIENCE

Instructor
- Fall prevention research: Stay active, save lives, Osher center for lifelong learning, Champaign, IL, USA (Sep-Oct. 2016)
  o Instructed classes for 90 minutes of 8 sessions introducing knowledge to manage fall risk to 22 senior citizens enrolled in the course.
  o Created novel course contents to discuss attitudes and beliefs about falls, risk factors, and evidence-based fall prevention programs.

Teaching Assistant
- Biomechanics of human movement, Kinesiology and Community Health department, the University of Illinois at Urbana-Champaign, Urbana, IL, USA (Sep-Dec. 2016 & Jan-May, 2017)
  o Guided 30 students in developing a biomechanical concept to solve problems through lab activities.
  o Creatively communicated with students to encourage them to ask biomechanics-related questions in areas of their future careers.
  o Listed as "Teachers Ranked as Excellent" evaluated by the Center for Innovation in Teaching & Learning of UIUC.

Mentoring
- Mentored five undergraduate/post-bachelor research interns, Shirley Ryan AbilityLab, Chicago, IL. (Aug.2018 - May.2021)
  o Published a research article with two research interns
  o Drafted recommendation letters for applying to graduate programs and scholarships.
  o Facilitated one-on-one specialized help for three interns to be admitted into a doctoral program

- Illinois Scholars Undergraduate Research Program, the University of Illinois at Urbana Champaign, IL, (Sep. -Dec. 2012)

Physical Education Class Instructor
- Fall prevention exercise training for persons with multiple sclerosis (2015-2016)
- Cognitive-motor interference training to reduce fall risk with people with multiple sclerosis (2014-2015)
- All Day Care Service of Ministry of Education, Seoul Kyungdong Kindergarten, Seoul, Korea, Oct. (2010- 2011)
- Physical education class, Seoul National University Girls' Middle School, Seoul, Korea (May.2009)
- SNU Children Motor Development Class, Seoul National University, Seoul, Korea (Mar. 2006-Jun. 2009)

- Physical education class for children with disabilities, Seoul National University, Seoul, Korea (Mar. 2009-Jun.2010)
- Summer camp for children with disabilities, Seoul National University, Seoul, Korea (Jun. 2008)
- Ski camp for children with disabilities, Seoul National University, Seoul, Korea (Jan. 2008)

EXTRAMURAL GRANT ACTIVITY

National Institute of Child Health and Human Development (NICHD), R01 / **"Locomotor function following transcutaneous electrical spinal cord stimulation in individuals with hemiplegic stroke"** *Role: Main Post-Doc contributor* (wrote the approach section & collected/analyzed/ described preliminary data), PI: Arun Jayaraman. <u>Funded (Impact score: 10, Percentile: 1%);</u> $2,754,576 (07/01/2021 – 06/03/2026)

SCHOLARSHIPS AND AWARDS

- *Annual Sarah Baskin Award - Collaboration Award*, Shirley Ryan AbilityLab, Chicago, IL, 2020
- *Carol L. Chittenden Fellowship in Kinesiology and Community Health*, Champaign, IL, USA, 2018
- *Paul D. Doolen Graduate Scholar for the Biological-Biomedical Sciences*, University of Illinois System, Chicago, IL, 2018
- *Robert L. Sprague Thesis Award*, Kinesiology and Community Health department, the University of Illinois at Urbana-Champaign, 2017
- *T. K. Cureton Physical Fitness Research Award*, Kinesiology and Community Health department, the University of Illinois at Urbana-Champaign, 2016
- *Seoul National University Alumni Scholarship*, Chicago, IL, USA, 2015
- *3rd place in student paper competition in M.S. level*, World Congress of Biomechanics, Boston, MA, USA, 2014
- *YoungNak Scholarship*, YoungNak Foundation, Los Angeles, CA, USA, 2014
- *Jong Scholarship*, Jong Foundation, Chicago, IL, USA, 2014
- *Award for Excellent Report in Liberal Subjects*, Academic Writing Lab, Seoul National University, Seoul, Korea, 2007
- *Merit-based Scholarship*, Department of Physical education, Seoul National University, 2006~2010

MEDIA PRESS

Martial-Arts Move May Lessen Impact of a Fall on Hip, Wall Street Journal, Oct 3. 2016 (https://www.wsj.com/articles/martial-arts-move-may-lessen-impact-of-a-fall-on-hip-1475506572#:~:text=Martial%2Darts%20rolling%2C%20which%20involves,the%20ground%2C%20the%20researchers%20suggested.)

PEER REVIEW PUBLICATIONS:

(Google Scholar: https://scholar.google.com/citations?user=w2iHj6MAAAAJ&hl=en)

1. Jayaraman C, Embry KR, Mummidisetty CK, **Yaejin Moon**, Giffhorn M, Prokup S, Lim B, Lee J, Lee Y, Lee M, Jayaraman A. (2022) Modular hip exoskeleton improves walking function and reduces sedentary time in community-dwelling older adults. J Neuroeng Rehabil. 19(1):144. *Published*

2. Lonini, L., **Yaejin Moon,** Embry, K., Cotton, R. C., McKenzie, K., Jenz, S., Jayaraman, A. (2022) Video-Based Pose Estimation for Gait Analysis in Stroke Survivors during Clinical Assessments: A Proof-of-Concept Study, *Digital Biomarkers*, 6:9-18. *Published*

3. Kim, M.*, **Yaejin Moon*,** Hunt, J. McKenzie, K. A., Horin, A., McGuire, M., Kim, K., Hargrove, L. J., & Jayaraman, A. (2021). A Novel Technique to Reject Artifact Components for Surface EMG Signals Recorded During Walking With Transcutaneous Spinal Cord Stimulation: A Pilot Study. Front Hum Neurosci. 2021 Jun 3;15:660583. *Published*

4. **Yaejin Moon,** Zuleger, T., Lamberti, M., Bansal, A., Mummidisetty, C. K., McKenzie, K. A., Yingling, L., Madhavan, S., Roth, E. J., Lieber, R. L., & Jayaraman, A. (2021). Characterization of Motor-Evoked Responses Obtained with Transcutaneous Electrical Spinal Stimulation from the Lower-Limb Muscles after Stroke. Brain sciences, 11(3), 289. *Published*

5. Wood, T. A., **Yaejin Moon**, Sun, R., Bishnoi, A., & Sosnoff, J. J. (2019). Age-Related Differences in Head Impact during Experimentally Induced Sideways Falls. *BioMed Research International*, *2019*. *Published*

6. **Yaejin Moon**, Bishnoi, A., Sun, R., Shin, J. C., & Sosnoff, J. J. (2019). Preliminary investigation of teaching older adults the tuck-and-roll strategy: can older adults learn to fall with reduced impact severity. *Journal of biomechanics*, *83*, 291-297. *Published*

7. Hsieh, K. L., **Yaejin Moon**, Ramkrishnan, V., Ratnam, R., & Sosnoff, J. J. (2018). Validating Virtual Time to Contact With Home Based Technology in Young and Older Adults. *Journal of Applied Biomechanics*, 1-21. doi: 10.1123/jab.2018-0088 *Published*

8. Sun, R., **Yaejin Moon**, McGinnis, R. S., Seagers, K., Motl, R. W., Sheth, N., Wright, J. A., Ghaffari R., Patel, S., and Sosnoff, J. J.. Assessment of Postural Sway in Individuals with Multiple Sclerosis Using a Novel Wearable Inertial Sensor." *Digital Biomarkers* 2, no. 1 (2018): 1-10. *Published*

9. McGinnis, Ryan S., Nikhil Mahadevan**, Yaejin Moon**, Kirsten Seagers, Nirav Sheth, John A. Wright Jr, Steven DiCristofaro et al. "A machine learning approach for gait speed estimation using skin-mounted wearable sensors: From healthy controls to individuals with multiple sclerosis." *PloS one* 12, no. 6 (2017): e0178366. *Published*

10. **Yaejin Moon,** McGinnis, R. S., Seagers, K., Motl, R. W., Sheth, N., Wright, J. A., Ghaffari R. & Sosnoff, J. J. "Monitoring gait in multiple sclerosis with novel wearable motion sensors." *PloS one* 12, no. 2 (2017): e0171346., *Published*

11. Roeing, Kathleen L., **Yaejin Moon**, and Jacob J. Sosnoff. "Unplanned gait termination in individuals with multiple sclerosis." *Gait & posture* 53 (2017): 168-172.*Published*

12. **Yaejin Moon,** and Jacob J. Sosnoff. "Safe landing strategies during a fall: Systematic review and meta-analysis." *Archives of physical medicine and rehabilitation* 98, no. 4 (2017): 783-794., *Published*

13. **Yaejin Moon,** Sung, J., An, R., Hernandez, M. E. & Sosnoff, J. J. 2016. Gait variability in people with neurological disorders: A systematic review and meta-analysis. Human Movement Science, 47, 197-208. *Published*

14. Jayaraman, C., **Yaejin Moon** & Sosnoff, J. J. (2016). Shoulder pain and time dependent structure in wheelchair propulsion variability. *Engineering & Physics.* 2016; *Published*

15. **Yaejin Moon,** Wadja, D. A. & Sosnoff, J. J. Stride time variability and fall risk in persons with Multiple Sclerosis. *Multiple Sclerosis International. 2015; Published*

16. Sosnoff, J.J., Rice, I., Hsiao-Wecksler, E.T., Hsu, I.M.K., Jayaraman, C., **Yaejin Moon.** Variability in Wheelchair Propulsion: A New Window into an Old Problem. *Frontiers in Bioengineering and Biotechnology.* 2015;3. *Published*

17. Wajda, D., **Yaejin Moon**, Motl, R. W. & Sosnoff, J. J. (2015). Preliminary investigation of gait initiation and falls in multiple sclerosis. *Arch Phys Med Rehabil, 96*(6), 1098-1102., *Published*

18. Sosnoff, J. J., **Yaejin Moon**, Wajda, D. A., Finlayson, M. L., McAuley, E., Peterson, E. W., ... & Motl, R. W., (2014). Fall risk and incidence reduction in high risk individuals with multiple sclerosis: A pilot randomized control trial. *Clinical Rehabilitation*, 0269215514564899, *Published*

19. Jayaraman, C., **Yaejin Moon**, Rice, I. M., Hsiao Wecksler, E. T., Beck, C. L., & Sosnoff, J. J. (2014). Shoulder Pain and Cycle to Cycle Kinematic Spatial Variability during Recovery Phase in Manual Wheelchair Users: A Pilot Investigation. *PLoS ONE, 9*(3), 1-7. *Published*

20. **Yaejin Moon.,** Jayaraman, C. C., Hsu, I. K., Rice, I. M., Hsiao-Wecksler, E. T., & Sosnoff, J. J. (2013). Variability of peak shoulder force during wheelchair propulsion in manual wheelchair users with and without shoulder pain. *Clinical Biomechanics*, *28*(9/10), 967-972. *Published*

CONFERENCE POSTERS/PRESENTATIONS

Yaejin Moon, C. Jayaraman, I.M.K Hsu, I.M, Rice, E.T. Hsiao-Wecksler, J.J. Sosnoff. (Sep 2013). Variability of peak shoulder force during wheelchair propulsion as a function of shoulder pain. American Society of Biomechanics, Omaha, Nebraska. *Poster*

Yaejin Moon, D. Wajda, J. Sung, R. W. Motl, J. J. Sosnoff (Oct 2013) Center of pressure trajectory of footfalls in multiple sclerosis. 3rd International Symposium on Gait and Balance in Multiple Sclerosis: Selecting the Right Measures, St Louis, Illinois. *Poster*

J. Sung, **Yaejin Moon**, D. A. Wajda, S. Balantrapu, R.W. Motl, J.J. Sosnoff (October 2013). Physiological Factors of Gait Variability in Persons with Multiple Sclerosis. 3rd International Symposium on Gait and Balance in Multiple Sclerosis, St. Louis, Missouri. *Poster*

Yaejin Moon, C. Jayaraman, E.T. Hsiao-Wecksler, J.J. Sosnoff. (July 2014). Variability structure in hand-rim peak force during manual wheelchair propulsion: A pilot study. World Congress Biomechanics, Boston, Massachusetts (*Awarded 3rd place in student paper competition*) *Poster*

Yaejin Moon, J.J. Sosnoff. (Nov 2016). Safe landing strategies during a fall: Systematic review and meta-analysis, American Congress of Rehabilitation Medicine, Chicago, Illinois *Poster*

Yaejin Moon, R.S. McGinnins, K. Seagers, R.W. Motl, N. Sheth, J.A. Wright Jr., R. Ghaffari, J.J. Sosnoff. (Nov 2016). Monitoring gait in Multiple Sclerosis with novel wearable motion sensors, American Congress of Rehabilitation Medicine, Chicago, Illinois *Poster*

Yaejin Moon, K.L. Roeing, V. Ramkrishnan, R. Ratnam, N. Sheth, J.J. Sosnoff. (Nov 2016). Fall Risk Assessment: The potential for home-based technology, American Congress of Rehabilitation Medicine, Chicago, Illinois *Poster*

Yaejin Moon, Taylor Zuleger, Martina Lambert, AshirBansal, Kelly McKenzie, Lindsey Yingling & Arun Jayaraman (Aug 2019). Changes in Spinal Excitability Following Stroke, Movement & Rehabilitation Sciences Training Day, Chicago, Illinois *Poster*

Yaejin Moon, Kelly A. McKenzie, Lindsey Yingling, Elliot J. Roth, Richard L. Lieber, Arun Jayaraman (Oct 2020). Noninvasive spinal stimulation improves gait in long-term stroke survivors, American Congress of Rehabilitation Medicine, Virtual annual conference *Poster*

Yaejin Moon, C. Jayaraman, I.M, Rice, & J.J. Sosnoff. (Sep 5, 2014). Variability in Wheelchair Propulsion: A New Window into an Old Problem. Academy of Spinal Cord Injury Professionals, St. Louis, Missouri. *Talk*

Yaejin Moon, J. J. Sosnoff, K. Roeing, Y. Amouyal, V. Ramkrishnan & R. Ratnam. (Sep 14, 2015). Fall Risk Assessment: The potential for home-based technology. 2nd Health Care Engineering Systems Symposium, Champaign, Illinois. *Talk*

Yaejin Moon & J. J. Sosnoff (Apr 2018). Teaching Older Adults How to Fall Safely. Colloquium in Kinesiology and Community Health Department, Champaign, Illinois. *Talk*

Yaejin Moon & J. J. Sosnoff (Sep 2018). Preliminary Investigation on Teaching Older Adults How to Fall Safely. NET External Expert Research Seminar, Chicago, Illinois. _Talk_

TECHNICAL SKILLS

- **Software**
  - **Programing (MATLAB)** – develop MATLAB codes to analyze biomechanical and neurophysiological data to quantify movement characteristics of a population with neurological disease.
  - **Statistics (SPSS, Stata, SAS)** conduct rigorous statistical analysis with quantitative and qualitative data to examine the effect of clinical interventions and conduct meta-analysis.
  - **Graphic editor (Adobe Illustrator, OriginPro)** - create a schematic diagram and scientific graphs
  - **Microsoft Office (Word, Excel, Powerpoint)**

- **Human Performance Data Collection**
  - **Motion Capture System (VICON)** – collect kinematic data of human subjects to analyze movement characteristics.
  - **Video analysis system**
    - DeepLabCut – utilizes a deep-learning-based human pose estimation tool that automatically detects body landmarks to estimate human kinematics from single camera videos.
    - Kinovea – use video analysis software to explore joint kinematics and motion analysis.
  - **Electromyography (EMG) System**
    - Delsys Trigno™ wireless system – acquire EMG data to measure muscle activity during maximum voluntary muscle contraction and walking.
    - Powerlab - acquire EMG data for motor evoked responses for stimulation studies.
  - **ForcePlate**
    - Bertec triaxial force plate – collect center of pressure data to measure balance ability.
    - C-Mill - utilize a force plate embedded treadmill system to acquire real-time data of gait parameters and record kinetic measurements during walking.
  - **Instrumented Walkway System (Gaitrite, Zeno)** – Utilize an automated gait analysis tool to collect spatiotemporal gait parameters and calculate gait symmetry.
  - **Portable Telemetry System (Cosmed K4B^2)** – collect cardiorespiratory response during walking to measure energy efficiency.
  - **Inertial Measurement Systems (Xsens MVN Awinda, MC10 BioStamp, Actigraph)** – collect the full range of 3D human motion and collect real-world home and community physical activity (e.g., step count)

RELEVANT COURSEWORK

Motor control
Motor Learning & Control, Dr. Sosnoff

Biomechanics
Whole-body Musculoskeletal Biomechanics, Dr. Hsiao-Wecksler
Neurobiomechanics, Dr. Hernandez

Neuropsychology
Human Performance & Energy psychology, Dr.Morrow
Advances in psychobiology – Dr. Juraska, Dr. Rhodes, Dr. Liang, Dr. Galvez

Statistics
Kinesiology Research Methods, Dr. Weimo Zhu
Applied statistics 1, Dr. Don Bullock
Applied statistics 2, Dr. Don Bullock
Meta-analysis and systematic review, Dr. An

PROFESSIONAL MEMBERSHIP

American Biomechanics Society
American Congress of Rehabilitation Medicine

PROFESSIONAL ENGAGEMENT

Reviewer for Clinical Rehabilitation
Reviewer for Gait and Posture
Reviewer for BioMed Research International
Reviewer for Frontiers in Neuroscience
Reviewer for Sensors