Date: June 19, 2018

JSPS US ALUMNI ASSOCIATION SEMINAR PROGRAM

REPORT

Organizer (Awardee)

Name: Matthew J. Major, PhD

Position & Affiliation: Assistant Professor at Northwestern University Department of Physical Medicine and Rehabilitation, & Research Health Scientist at the Jesse Brown VA Medical Center Research and Development Service, Chicago IL

1. TITLE OF SEMINAR

Neuromechanics of Rehabilitation for Lower Limb Loss

2. DATE(S)

June 11, 2018

3. VENUE & CITY, STATE

Baldwin Auditorium, Northwestern University, Chicago IL

4. TARGETED RESEARCH AREAS

(1) Neuromechanics (2) Rehabilitation (3) Limb Loss

5. NUMBERS OF PARTICIPANTS

TOTAL: 65 (registered + unregistered) persons including 2 US Alumni Association members

-US: 59 persons

-FROM OVERSEAS: 6 person(s) including 5 person(s) from Japan

Northwestern University Prosthetics-Orthotics Center
680 North Lake Shore Drive Voice: 312.503.5700
Suite1100 Facsimile: 312.503.5760
Chicago, Illinois 60611 www.nupoc.northwestern.edu

Executive Summary

The *Neuromechanics of Rehabilitation for Lower Limb Loss Symposium* was held on June 11th, 2018, at Northwestern University, Chicago IL. Lower limb loss is an impairment that constrains mobility and negatively affects quality of life. The detrimental impact that lower limb loss has on balance, maneuverability, and energy expenditure creates significant restrictions to activity participation. Groundbreaking research in the science of neuromechanics is yielding knowledge about how combinations of bionic prostheses, novel physical therapies, and human adaptability can maximize the quality of life for these patients. Neuromechanics is a multidisciplinary science that combines concepts from biomechanics, motor control, and neurophysiology to study human movement. The symposium aims were to: 1) Introduce members of the rehabilitation scientific and clinical communities to various approaches to conducting neuromechanics research on lower limb loss; and 2) Create a dialogue on how neuromechanics research can enhance limb loss rehabilitation and identify target areas for future research. The symposium also showcased neuromechanics research being conducted in Japan, and described the longstanding history and ongoing mechanisms of support by the Japanese Society of Promotion of science (JSPS) for collaborative research between scientists in the United States (US) and Japan. The Northwestern University Prosthetics-Orthotics Center (NUPOC) served as the host for this symposium, and is a leading research and education center with a record of pioneering research on prosthetics and rehabilitation.

The symposium featured presentations from six renowned rehabilitation scientists in the US and Japan, a lively and engaging panel discussion, a poster session with eleven displays, and an informal networking event following the concluding remarks. Overall, the symposium was a great success and received excellent feedback from attendees, many of whom requested that the symposium be repeated annually. A considerable number of symposium attendees were from overseas (e.g., Taiwan, India, Korea, Puerto Rico, Slovakia, and China), but live and work in the US. Attendees represented all stages of academics (students, fellows, faculty, and clinicians) and were from many institutions across the US, including: Northwestern University, University of Illinois-Chicago, Harvard-MIT, University of Wisconsin-Madison, University of Nebraska-Omaha, Shirley Ryan AbilityLab, Rosalind Franklin University, University of Michigan-Ann Arbor, and University of Texas-Dallas. Attendees represented diverse research and clinical professions, including: prosthetists/orthotists, therapists, bioengineers, and rehabilitation specialists. The symposium emphasized how neuromechanics research can be applied to different aspects of the rehabilitation process of persons with lower limb loss, and NUPOC is supporting an online forum for ongoing discussion amongst attendees on future research initiatives.

Topics Discussed with Outcomes & Future Challenges

The *Neuromechanics of Rehabilitation for Lower Limb Loss Symposium* was designed to exchange ideas on how the interdisciplinary science of neuromechanics can be applied to the rehabilitation process for individuals with lower limb loss. Speakers addressed this focus from the following perspectives:

1. Mechanical impedance in human neuromotor control and wearable robotic systems;

Northwestern University Prosthetics-Orthotics Center
680 North Lake Shore Drive Voice: 312.503.5700
Suite1100 Facsimile: 312.503.5760
Chicago, Illinois 60611 www.nupoc.northwestern.edu

2. Epidemiology of falls among persons with lower limb loss;
3. The effects of fear of falling on balance and gait of lower limb prosthesis users;
4. Locomotor strategies of lower limb prosthesis users in the presence of walking disturbances;
5. Neuromechanics of lower limb prosthesis users during non-steady-state locomotion;
6. Rehabilitation of highly active prosthesis users with application to competitive sport.

The symposium successfully highlighted the contribution of neuromechanics science to advancing lower limb loss rehabilitation. Considerations on how physical and cognitive factors influence rehabilitation outcomes can effectively address the holistic needs of lower limb prosthetics patients. The panel members recognized that a considerable amount of rehabilitation research to date has been focused on biomechanics and that more work is needed to better integrate concepts of motor control and neurophysiology to elevate the quality of evidence-based practice. The current challenge for scientists conducting neuromechanics research is to successfully facilitate continuation of an interdisciplinary approach to the problem of enhancing the rehabilitation process. Opportunities to continue this dialogue and explore research collaboration, including an on-line follow-up forum and open-access *Proceedings* (forthcoming), have been created and hosted by NUPOC.

A list of presenters and the symposium *Proceedings* can be found by visiting this website:

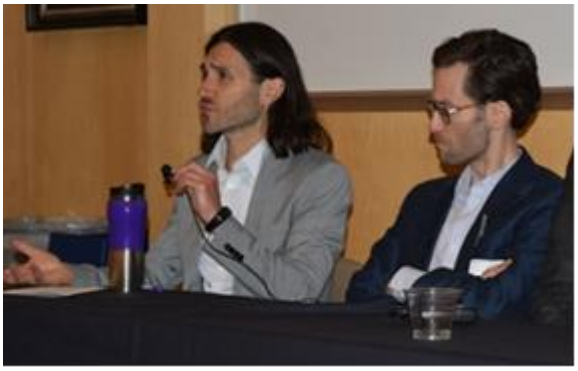
http://nupoc.northwestern.edu/education/continuing-ed/neuromechanics-rehabilitation.html

List of Scientific Posters

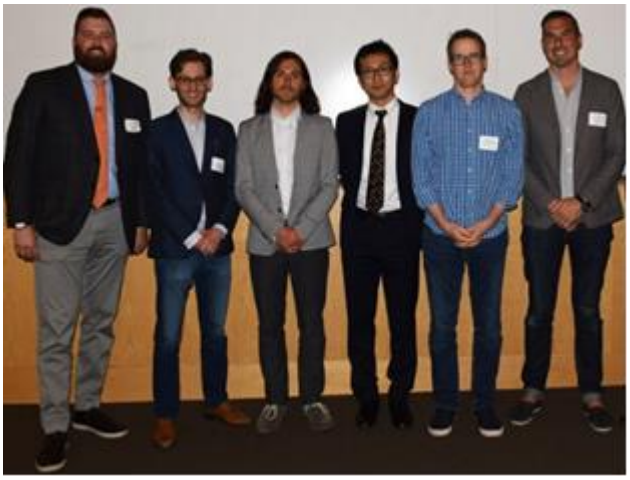
- Greene M, Adamczyk P. *Joint Effects of a Quasi-Passive Two Degree of Freedom Prosthetic Ankle.*
- Hisano G, Hashizume S, Murai A, Kobayashi Y, Nakashima M, Hobara H. *Factors Affecting Knee Buckling Risk during Walking in Unilateral Transfemoral Amputees.*
- Kaluf B, Duncan A, Shoemaker E, Martin T, DiGioia C, *et al. Comparative Effectiveness of Microprocessor Controlled and Carbon Fiber Energy Storing and Returning Prosthetic Feet in Persons with Unilateral Transtibial Amputation: Full Study*.
- Krausz N, Hargrove L. *Powered Prosthesis Control and Intent Recognition Based on Novel Computer Vision Algorithms.*
- Li W, Pickle N, Fey N. *Time Evolution of Frontal-Plane Dynamic Balance during Locomotor Transitions of Altered Anticipation and Complexity.*
- Major M, Shirvaikar T, Stine R, Gard S. *Effects of Wearing an Upper Limb Prosthesis on Standing Balance.*
- Olesnavage K, Arelekatti M, Prost V, Petalina N, Johnson B, Winter A. *Design of a Low Cost, Mass-Manufacturable Prosthetic Leg for Persons with Amputations in India.*
- Pickle N, Silverman A, Wilken J, Fey N. *Segmental Contributions to Sagittal-Plane Whole-Body Angular Momentum When Using Powered Compared to Passive Ankle-Foot Prostheses on Ramps.*
- Shepherd M, Rouse E. *Energy Storage and Return in Prosthetic Feet Is Not Maximal at the Preferred Stiffness.*
- Shorter A, Rouse E. *Type of Gait Alters Ankle Joint Mechanical Impedance.*
- Takahashi K, Hashizume S, Namiki Y, Hobara H. *Mechanical Power and Work Profiles during Sprinting in Transfemoral Amputees.*

Northwestern University Prosthetics-Orthotics Center
680 North Lake Shore Drive Voice: 312.503.5700
Suite1100 Facsimile: 312.503.5760
Chicago, Illinois 60611 www.nupoc.northwestern.edu

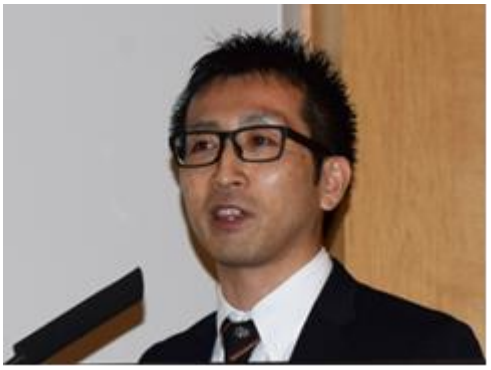
The symposium was well attended by rehabilitation specialists throughout the US.



Dr. Major responds to audience questions during the panel discussion.



Presenters from left to right: Nicholas Fey, PhD, Noah Rosenblatt, PhD, Matthew Major, PhD, Hiroaki Hobara, PhD, Andrew Sawers, PhD, CPO, and Elliott Rouse, PhD.



Distinguished featured speaker, Hiroaki Hobara, PhD, presented *Active Amputees: Biomechanics of Running-Specific Prostheses*.

Mr. Koki Kawano, JSPS representative, presented *Research Collaborations with Japan*.

Northwestern University
Prosthetics-Orthotics Center

The Neuromechanics of Rehabilitation for Lower Limb Loss Symposium 2018

Monday, June 11, 2018
8:30 a.m. - 4:00 p.m.

Baldwin Auditorium
Robert H. Lurie Medical Research Center
303 East Superior
Chicago, IL 60611

NUPOC Tel: 312.503.5700
www.nupoc.northwestern.edu

THE NEUROMECHANICS OF REHABILITATION FOR LOWER LIMB LOSS SYMPOSIUM 2018

CONTINENTAL BREAKFAST
8:30 - 9:00 a.m.

PRESENTATIONS

9:00-9:10 a.m. **Matthew J. Major, PhD**
Assistant Professor, Physical Medicine & Rehabilitation
Northwestern University, Chicago, IL
Welcome, symposium overview, aims, and introductions

9:10-9:35 a.m. **Elliott Rouse, PhD**
Assistant Professor, Department of Mechanical Engineering
University of Michigan, Ann Arbor, MI
The Role of Mechanical Impedance in Human Neuromotor Control and Wearable Robotic Systems

9:35-10:00 a.m. **Andrew Sawers, CPO, PhD**
Assistant Professor, Department of Kinesiology
University of Illinois, Chicago, IL
Falls among Lower Limb Prosthesis Users: Refocusing through an Epidemiological Lens

MORNING REFRESHER
10:00 a.m. - 10:10 a.m.

10:10-10:35 a.m. **Matthew Major, PhD**
Assistant Professor, Physical Medicine & Rehabilitation
Northwestern University, Chicago, IL
How a priori *Knowledge of a Perturbation Impacts Proactive and Reactive Locomotor Strategies of Below-Knee Prosthesis Users*

10:35-11:00 a.m. **Noah Rosenblatt, PhD**
Assistant Professor, Podiatric Surgery & Applied Biomechanics
Rosalind Franklin University, North Chicago, IL
The Effects of Fear of Falling on Balance and Gait: Lessons from Intact Adults and Implications for Prosthetic Design and Rehabilitation

11:00-11:25 a.m. **Nicholas Fey, PhD**
Assistant Professor, Mechanical Engineering; Joint–Bio-engineering
University of Texas-Dallas, Dallas, TX
Assessing the Neuromechanical Response of Individuals with Major Lower-Limb Loss during Steady and Non-Steady-State Locomotion

11:25 a.m.-12:10 p.m. **Hiroaki Hobara, PhD**
Senior Researcher, National Institute of Advanced Industrial Science and Technology
Tokyo & Tsukuba, Japan
Active Amputees: Biomechanics of Running-Specific Prostheses

12:10-12:30 p.m. **Mr. Koki Kawano**
International Program Representative, JSPS Office Washington, D.C.
JSPS Information Session

LUNCHEON
BALDWIN AUDITORIUM FOYER
12:30 noon - 13:30 p.m.

13:30-14:30 p.m. **Drs. Hobara, Rouse, Major, Fey, Sawers and Rosenblatt**
Panel Discussion

14:30- 15:00 p.m. **Dr. Major** and **Dr. Garrick**
Closing Remarks

AFTERNOON REFRESHER
15:00 - 16:00 p.m.

NETWORKING OPPORTUNITY
16:30-18:00 p.m.

Symposium registrants are invited to gather for an unhosted, post-symposium mixer. Dinner and drinks are at your own expense. All are welcome!

D4 Irish Pub
345 E Ohio Street
Chicago, IL 60611
(312) 624-8385

NORTHWESTERN
UNIVERSITY

Northwestern Medicine®
Feinberg School of Medicine

JSPS

ACKNOWLEDGEMENTS

The *Neuromechanics of Rehabilitation for Lower Limb Loss Symposium 2018* would not have been possible without the sponsorship and support of the Northwestern University Prosthetics-Orthotics Center (NUPOC), Department of PM&R, Feinberg School of Medicine; and the Japan Society for the Promotion of Science (JSPS). We appreciate the symposium speakers, researchers who submitted posters, and registrants who contributed valuable content and spurred discussions.

The views and opinions expressed in the symposium presentations, posters and discussions are those of the authors and do not necessarily reflect the position or policy of any of the supporting institutions.

Photographs were taken with the permission of the symposium participants.

Matthew J. Major, PhD
R. J. Garrick, PhD

Northwestern University Prosthetics-Orthotics Center (NUPOC)
680 North Lake Shore Drive, Suite 1100
Chicago, IL 60611
TEL: 312-503-5700
FAX: 312-503-5760
nupoc.northwestern.edu/