

# Raviraj Nataraj, PhD

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## CAREER SUMMARY

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- Professor in biomedical engineering
- Research scientist with concentration in biomechanical control and rehabilitation
- Experience in human motion analysis, sensors, computer simulation, and closed-loop control
- Pursuing a career as investigator in human motor control and developing rehabilitation applications
- Completed Ph.D. in feedback control of standing neural prostheses using functional electrical stimulation (FES) following spinal cord injury (SCI)
- *Postdoctoral research experience:*
  - Studying sensorimotor control of the hand with implications of carpal tunnel syndrome (CTS)
  - Estimating and applying feedback variables for control of leaning standing
  - Creating feedback controllers for walking and exoskeleton applications
  - Investigating user perception and function of multisensory hand prostheses

## CORE EXPERTISE

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- Development and evaluation of three-dimensional biomechanical systems under muscle control for standing, walking, reaching, and grasping
- EMG, force, and video motion data capture and signal analysis
- Creation and deployment of real-time sensor feedback control systems for individuals with neurological disorders
- C Programming, MATLAB/SIMULINK, SIMM, VICON Nexus, LabView

## PROFESSIONAL EXPERIENCE

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### STEVENS INSTITUTE OF TECHNOLOGY, Hoboken, NJ

*Assistant Professor, Aug 2016 – present*

- Tenure-track in Department of Biomedical Engineering
- Director of Movement Control Rehabilitation Laboratory ([www.mocorelab.com](http://www.mocorelab.com))
- RESEARCH FOCUS: Integration of individuals with movement disability to assistive devices and rehabilitation paradigms

### CLEVELAND CLINIC, Cleveland, OH

*Research Associate, Jan 2016 – May 2016*

- Investigating user perception and function of multisensory hand prostheses for more natural control following upper-limb amputation

### CLEVELAND STATE UNIVERSITY, Cleveland, OH

*Postdoctoral Research Associate, Jan 2015 – June 2016*

- Identifying optimal control models for gait with implications for powered exoskeletons augmenting walking performance

### LOUIS STOKES VA MEDICAL CENTER, Cleveland, OH

*Postdoctoral Research Fellow, Jan 2014 – Jan 2015*

- Developing feedback control systems for advanced standing function at leaning postures to augment functional reaching workspace

### CLEVELAND CLINIC, Cleveland, OH

*Postdoctoral Researcher, July 2011 – Dec 2013*

- Investigating functional biomechanics of the hand including implications of carpal tunnel syndrome

- Developing advanced methodology to characterize digit kinematics and kinetics during dexterous grasping
- Examining the effects of visual feedback and compliance on pinching mechanics

**LOUIS STOKES VA MEDICAL CENTER, Cleveland, OH**

*Biomedical Researcher, Jan 2011 – June 2011*

- Technical documentation, scientific writing, data analysis

**CASE WESTERN RESERVE UNIVERSITY, Cleveland, OH**

*PhD Candidate, Jan 2005 – Dec 2010*

- Developed feedback control system for standing balance using functional neuromuscular stimulation following spinal cord injury

**CASE WESTERN RESERVE UNIVERSITY, Cleveland, OH**

*Graduate Student Fellow, Jan 2003 – Dec 2004*

- Investigated artificial neural network prediction of changes in bipedal standing center of pressure from trunk acceleration inputs during three-dimensional perturbations

**STANFORD UNIVERSITY, Palo Alto, CA**

*Graduate Student Fellow, Sept 2001 – Dec 2002*

- Developed computer simulation software for analysis of external forces at tibio-femoral interface of knee implants during gait for Zimmer, Inc. (Warsaw, IN)

**CLEVELAND CLINIC, Cleveland, OH**

*Undergraduate Student Researcher, May 2000 – March 2001*

- Conducted research to characterize structural, mechanical properties of tendon
- Assisting in surgical extraction of canine tendons, computer-aided design and fabrication of tendon-grip interface, subsequent mechanical testing, digital video analysis of strain micro-characteristics

**WRIGHT PATTERSON AIR FORCE BASE, Dayton, OH**

*Undergraduate Student Researcher, May 1999 – Aug 1999*

- Collected and analyzed bio-acceleration data for live experiments on human test replicas for simulating automobile, air vehicle crashes

## **EDUCATION**

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**CASE WESTERN RESERVE UNIVERSITY, Cleveland, OH**

*Doctor of Philosophy in Biomedical Engineering, Dec 2010*

- GPA: 4.0/4.0
- *Thesis Advisor:* Ronald J. Triolo
- *Committee Members:* Robert Kirsch (chair), Musa Audu, Patrick Crago, Roger Quinn

**CASE WESTERN RESERVE UNIVERSITY, Cleveland, OH**

*Master of Science in Biomedical Engineering, May 2007*

- GPA: 3.88/4.0
- *Committee Members:* Musa Audu, Robert Kirsch, Ronald J. Triolo

**STANFORD UNIVERSITY, Palo Alto, CA**

*Master of Science in Mechanical Engineering, January 2003*

- GPA: 4.0+/4.0
- *Project Supervisors:* Thomas Andriacchi, Scott Delp

**CASE WESTERN RESERVE UNIVERSITY, Cleveland, OH**

*Bachelor of Science in Biomedical Engineering, May 2001*

- GPA: 3.97/4.0 (Summa Cum Laude)
- *Academic Advisers:* Steven Eppell, Hunter Peckham, Robert Kirsch

**BEAVERCREEK HIGH SCHOOL, Beavercreek, OH**

*Bachelor of Science in Biomedical Engineering, May 2001*

- GPA: 4.0+/4.0 (Salutatorian)

Academic Concentration Areas:

Functional Electrical Stimulation, Neuromuscular Biomechanics of Movement, Finite Element Analysis, Robotics, Advanced Dynamics, Computational Intelligence, Advanced Dynamics, Controls – Classical, Robust, Linear and Non-linear System Theory

**TEACHING EXPERIENCE**

- Teaching Assistant, Case Western Reserve University, EBME 201 – Physiology I (Fall 2004)
- Teaching Assistant, Case Western Reserve University, EBME 427 – Biomechanics (Spring 2004, Spring 2005)
- Substitute Lecturer, Cleveland State University, MCE 260 – Kinematics (Fall 2015)
- Invited Lecturer, Stevens Institute of Technology, BME 306 – Introduction to Biomedical Engineering (Spring 2017, Fall 2017, Spring 2018, Fall 2018, Spring 2019)
- Invited Lecturer, Stevens Institute of Technology, BME 701 – Selected Topics in BME (Spring 2018, Spring 2019)
- Invited Lecturer, Stevens Institute of Technology, PIN 184 – Pinnacle Scholars Course (Spring 2019)
- Main Instructor, Stevens Institute of Technology, BME 556 – Advanced Biomechanics (Fall 2017, Spring 2018, Fall 2018, Spring 2019)

**INSTITUTIONAL MEMBERSHIPS, AFFILIATIONS, AND SUPPORT**

- Member IEEE (Institute of Electrical and Electronic Engineers)
- American Society of Biomechanics (ASB)
- Society for Neuroscience (SfN)
- American Society for Engineering Education (ASEE)
- American Society of Mechanical Engineers (ASME)
- Neural Control of Movement (NCM)
- Stanford Alumni Association
- Cleveland Functional Electrical Stimulation (FES) Center
- Case Western Reserve University, Department of Biomedical Engineering
- Stanford University, Department of Mechanical Engineering
- Cleveland Clinic Lerner Research Institute, Department of Biomedical Engineering
- Advanced Platform Technology (APT) Center at Cleveland Louis Stokes Veterans Affairs Medical Center
- University Hospitals/Case Western Reserve University, Department of Orthopaedics
- Cleveland State University, Department of Mechanical Engineering
- Stevens Institute of Technology, Department of Biomedical Engineering, Shaefer School of Engineering
- Parker Hannifin Endowment van den Bogert (PI) 07/01/12-06/30/16  
HUMAN MOTION CONTROL LABORATORY AT CLEVELAND STATE UNIVERSITY  
A primary objective of this research is to develop new technology for prosthetics and powered orthotics with establishment of the Human Motion and Control Laboratory.  
Received partial support from: National Science Foundation (Grant No. NSF 1344954) Simon (PI), van den Bogert (co-PI), Richter (co-PI), *Role: Postdoctoral Research Associate*
- R01NS0817104 Marasco (PI) 12/01/13 – 11/30/17  
RESTORING UPPER LIMB MOVEMENT SENSE TO AMPUTEES  
The goal of this project is investigation of kinesthetic feedback through targeted reinnervation to a prosthetic limb following upper-limb amputation. *Role: Postdoctoral Research Associate*
- R01 NS040547 Triolo (PI) 09/21/00-06/30/16  
AUTOMATIC CONTROL OF STANDING BALANCE WITH FUNCTIONAL NEUROMUSCULAR STIMULATION  
The goal of this project is to investigate the development of a neuroprosthesis to restore standing balance function following spinal cord injury. *Role: Graduate Student Researcher*
- R01 AR056964 Li (PI) 04/01/11-03/30/15

**HAND SENSORIMOTOR FUNCTION AND CARPAL TUNNEL SYNDROME**

The goal of this project is to investigate the sensorimotor dysfunction produced by the median nerve compression yielding carpal tunnel syndrome. *Role: Postdoctoral Researcher*

- T32 AR00750525 Greenfield (PI) 07/01/85-04/30/17

**TRAINING PROGRAM IN MUSCULOSKELETAL RESEARCH**

The missions of this longstanding Training Grant are to provide training in musculoskeletal research to academically gifted individuals at the postdoctoral and predoctoral level and to develop these individuals towards productive careers in musculoskeletal research. *Role: Postdoctoral Research Fellow*

**AWARDS, HONORS, SERVICES**

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- CWRU President Scholarship (1997)
- Tau Beta Pi (1999-current)
- Golden Key Honor Society (1999-current)
- Case Alumni Scholarship (2000)
- Stanford Mechanical Engineering Department Fellowship (2001-2002)
- NSF-IGERT Fellowship at CWRU (2003)
- NIH CWRU-BME Departmental Training Grant (2004, 2005, 2006)
- 3rd place, Neural Engineering Research Lectures. Cleveland, OH 2006.
- 1st place Metro Research Festival (2006) Cleveland, OH 2006.
- VA Rehabilitation Pre-Doctoral Fellowship for 2008-09
- NIH T32 Musculoskeletal Research Postdoctoral Fellowship from CWRU-Orthopaedics for 2014-15
- Senior Membership to IEEE (2017)
- Invited and Serving Special Topics Editor: Frontiers in Bioengineering and Biotechnology
- Organizer for Stevens g-tec BCI Workshop (Fall 2018)
- New Jersey Health Foundation (NJHF) Research Grant for 2019
- Reviewer for NIDILRR (Field Initiated Projects (FIP) Program Grants Competition, 2019)
- Academic Editor for PLOS ONE (2019)
- The BRAIN Center – Planning Meeting Participant (Tempe, AZ 2019)
- For Stevens and Biomedical Engineering Program/Department
- Research student advising:
  - Sean Sanford, PhD program (BME, since Fall 2016)
  - Aniket Shah, PhD program (BME, since Fall 2017)
  - Yongqi (Felix) Chen, Stevens scholar, MS thesis (CPE, since Summer 2017)
  - David Hollinger, MS thesis and units (BME and BME 800, since Fall 2017)
  - Michael Pacelli, MS units (BME 800, Spring 2017)
  - Jialin Su, MS units (BME 800, Spring 2017)
  - Anna Kedzierska, MS units (BME 800, Summer 2017)
  - Ivette Marte, undergraduate volunteer (BME, Spring 2017)
  - Thomas Selvaggi, undergraduate (BME, since Spring 2017)
  - Gabriella Borodyansky, BS/MS program (BME, since Summer 2017)
  - Vasundhra Srevatsan, Stevens scholar, undergraduate volunteer (Math, since Summer 2017)
  - Harshith Atluri, undergraduate volunteer from TCNJ (BME, since Summer 2017)
  - Dylan DeBoer, undergraduate volunteer (BME, Summer 2017)
  - Brandon Mooney, high school volunteer (Ramapo H.S., since Summer 2017)
  - Corrine Rybarsky, I&E undergraduate scholar (Summer 2018 - current)
  - Michael Blas, undergraduate volunteer (BME, since Summer 2018)
  - Daniel Kang, undergraduate volunteer (BME, since Summer 2018)
  - Samuel Wilder, MS thesis and units (since Summer 2018)
  - Claudia Malletti, high school volunteer (Brooklyn Tech H.S., Summer 2018)
  - Mingxiao Liu, PhD program (BME, since Fall 2018)
  - Kevin Walsh, MS thesis (since Fall 2018)

- Chi-chia (Norika) Cheng, MS units (BME 800, Fall 2018)
- Tariq Charleston, MS units (BME 800, Fall 2018)
- Anthony Santo, MS units (BME 800, Spring 2019)
- Breanna Veilleux, undergraduate volunteer (EE, Spring 2019)
- Academic advising
  - Undergraduate students: since Fall 2017, ~10 students/year
  - Graduate students: since Fall 2017, ~5 students/year
- PhD/ME Application Review Committee (Fall 2017 – current)
- PhD/ME Guidelines/Curriculum Review Committee (Fall 2017 – current)
- BME Faculty Search Committee (3 tenure-track hires for Fall 2018)
- BME Faculty Search Chairman (2 hires for Fall 2019)
- BME Seminar Committee Chairman (Fall 2017, Spring 2018, Fall 2018, Spring 2019)
- PhD University Task Force Committee (2018-19)
- PhD Proposal Review Committees:
  - Maryam Vantankah, Fall 2016
  - Hanyan Li, Fall 2017
  - Ibrahim Dulijan, Spring 2018
  - Martin Burns, Summer 2018
  - Valerie DeAngelo, Fall 2018 – Spring 2019
  - Nicholas Payne (ME - Pochiraju), Fall 2018
- PhD Defense Committees:
  - Vrajeshri Patel, Fall 2017
  - Maryam Vantankah, Spring 2018
- Primary Thesis Advisor:
  - Yongqi Chen, MS-CPE, Spring 2018 (graduated)
  - David Hollinger, MS-BME, Fall 2018 (graduated)
  - Aniket Shah, Engineer's Degree, Spring 2019 (expected)
  - Kevin Walsh, MS-BME, Spring 2019 (expected)
  - Sam Wilder, MS-BME, Spring 2020 (expected)
  - Sean Sanford, PhD-BME Spring 2021 (expected)
  - Mingxiao Liu, PhD-BME Fall 2021 (expected)
- Invited Oral Presentations:
  - ISCSB conference 2005
  - IFESS conference 2007
  - FESC seminar 2011
  - NASA seminar 2013
  - CSU seminar, guest lecture, 2015
  - Cleveland Clinic, department seminar, 2016
  - ASB conference 2016
  - Kessler Foundation – Saddle Brook, Stroke Rehabilitation Group 2016, 2017
  - Kessler Institute for Rehabilitation – West Orange, Human Performance and Engineering Research Group 2017
  - Spinal Cord Damage Research Center, James J Peters VAMC, Bronx, NY 2018
  - ASB conference 2018
  - Stevens g-tec BCI workshop 2018
  - NEBEC 2019 Rutgers University
- Invited and Contributing Reviewer to Scientific Journals:
  - Medical & Biological Engineering & Computing
  - IEEE Transactions on Neural Systems & Rehabilitation Engineering
  - IEEE Transactions on Biomedical Engineering
  - Journal of Biomechanical Engineering
  - Journal of Rehabilitation Research and Development
  - Journal of Biomechanics

- PLOSONE
- Frontiers in Neuroscience
- IEEE Transactions on Mechatronics
- Frontiers in Robotics
- Biomedical Engineering Online
- Scientific Reports
- Development Workshops or Events
  - NSF Grants Conference 2018 (Detroit, MI, USA)
  - Stevens Workshop – Preparing for Tenure (2018, 2019 – Chassapis, Whitaker, Hadim)
  - Stevens Workshop – NIH Grant Writing (2018 – Perlman)
  - Stevens Workshop – NSF Grant Writing (2018 – Libera)
  - Stevens Workshop – NJHF Grant Writing (2017, 2018, 2019 – Nobelman, Du)
  - Stevens Workshop – NSF CAREER Preparation (2017, 2018 - Nobelman, Du, Dehghani)
  - NSF CAREER Writing Workshop 2019 (Washington D.C., USA)

## BOOK CHAPTERS

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- R Nataraj (2018). Optimizing User Integration for Individualized Rehabilitation, Biomimetic Prosthetics, Dr. Ramana Vinjamuri (Ed.), InTech, DOI: 10.5772/intechopen.70267.
- R Nataraj (2019, Invitation for Springer Book Chapter), “Cognitive and Physiological Intent for the Adaptation of Motor Prostheses” in progress\*\*\*

## CONFERENCE PRESENTATIONS

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1. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Artificial Neural Network Prediction of Center of Pressure Using Trunk Acceleration Inputs during Perturbed Human Bipedal Stance”, International Society of Biomechanics (July 2005), Cleveland, OH.
2. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Controller Development for Automatic Standing Balance using Functional Neuromuscular Stimulation following Spinal Cord Injury”. International Symposium on Computer Simulation in Biomechanics (July 2005), Cleveland, OH.
3. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Artificial Neural Network Prediction of Center of Pressure Using Trunk Acceleration Inputs during Perturbed Human Bipedal Stance”, International Society of Biomechanics (July 2005), Cleveland, OH.
4. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Controller Development for Automatic Standing Balance using Functional Neuromuscular Stimulation following Spinal Cord Injury”. International Symposium on Computer Simulation in Biomechanics (July 2005), Cleveland, OH.
5. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Automatic Standing Balance using Functional Neuromuscular Stimulation following Spinal Cord Injury”, National Institutes of Health Neural Interfaces Workshop (August 2005), Bethesda, MD.
6. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Developing an artificial neural network controller for automated standing balance using functional neuromuscular stimulation following spinal cord injury”, Dynamic Walking (May 2006), University of Michigan, Ann Arbor, MI.
7. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Developing an artificial neural network controller for automated standing balance using functional neuromuscular stimulation following spinal cord injury”, National Institute of Biomedical Imaging and Bioengineering Training Grantee Workshop (June 2006), Washington D.C.
8. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Developing an Artificial Neural Network Controller for Automated Standing Balance Using Functional Neuromuscular Stimulation (FNS) following Spinal Cord Injury (SCI)”, National Institutes of Health Neural Interfaces Workshop (August, 2006), Bethesda, MD.
9. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Control System Development for Automatic Standing Balance using Functional Neuromuscular Stimulation following Spinal Cord Injury”, American Society of Biomechanics (August, 2007), Stanford University, Palo Alto, CA.
10. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. “Automatic Control of Standing Balance Using Functional Electrical Stimulation Following Spinal Cord Injury”, International Functional Electrical Stimulation Society Conference (November, 2007), Shriner's Hospital for Children, Philadelphia, PA.

11. ML Audu, R Nataraj, RF Kirsch, RJ Triolo. "Dynamic Computer Optimization for Standing Balance and Control of Postural Sway after Spinal Cord Injury", International Functional Electrical Stimulation Society Conference (November, 2007), Shriner's Hospital for Children, Philadelphia, PA.
12. R Nataraj, ML Audu, RF Kirsch, RJ Triolo. "Automatic Control of Standing Balance Using Functional Electrical Stimulation Following Spinal Cord Injury", National Institutes of Health Neural Interfaces Conference (June, 2008), Case Western Reserve University, Cleveland, OH.
13. R Nataraj, ZM Li. "Calculating Thumb and Index Finger Postures during Pinch with a Minimal Marker Set", American Society of Biomechanics (August 2012), University of Florida, Gainesville, FL.
14. K Li, R Nataraj, TL Marquardt, ZM Li. "Synergistic control of fingertip force directions during precision pinch", WACBE World Congress on Bioengineering (August 2013), Beijing, China.
15. R Nataraj, PJ Evans, WJ Seitz, ZM Li. "Effects of Carpal Tunnel Syndrome on Precision Pinch Kinematics", American Association for Hand Surgery Annual Meeting (January 2014), Kauai, Hawaii.
16. R Nataraj, ML Audu, RJ Triolo. "Feedback control to restore forward standing using functional neuromuscular stimulation following spinal cord injury", Midwest American Society of Biomechanics Regional Meeting (March 2014), University of Akron, Akron, OH.
17. R Nataraj, ML Audu, ZM Li. "Precision pinch joint mechanics in relation to digit endpoint compliance", World Congress of Biomechanics (July 2014), Boston, MA.
18. R Nataraj, ML Audu, RJ Triolo. "Estimating Center of Mass Kinematics with a Networked Neuroprosthesis for Standing", 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (August 2014), Sheraton Chicago Hotel and Towers, Chicago, IL.
19. R Nataraj, ML Audu, RJ Triolo. "Simulation of Leaning Standing after Spinal Cord Injury", Dynamic Walking 2015: Principles and Concepts of Legged Motion (July 2015), The Ohio State University, Columbus, OH.
20. R Nataraj, AJ van den Bogert. "Simulation Analysis of Linear Quadratic Regulator Control of Gait", Wearable Robotics Association Conference, WearRAcon16 (February 2016), Arizona Grand Resort Hotel, Phoenix, AZ.
21. R Nataraj, AJ van den Bogert. "Simulation Analysis of Linear Quadratic Regulator Control of Gait – Implications for Exoskeleton Control", American Society of Biomechanics (August 2016), North Carolina State University, Raleigh, NC.
22. P Marasco, J Hebert, J Sensinger, C Shell, J Schofield, Z Thumser, R Nataraj, D Beckler, M Dawson, D Blustein, S Gill, R Granja-Vazquez, J Carey and B Orzell "Functional Kinesthetic Perception of Complex Bionic Hand Movements", Myoelectric Control Symposium (August 2017), University of New Brunswick, Canada.
23. R Nataraj, S Sanford, A Shah, Y Chen, G Borodyansky, V Srevatsan "Cognitive agency in hand grasp performance - implications for rehabilitation", Neuroscience 2017 presented by the Society for Neuroscience (November 2017), Washington DC.
24. R Nataraj, A Shah, S Sanford "Cognitive agency in visual-guided performance of hand grasp", Society for Neural Control of Movement (May 2018), Santa Fe, NM.
25. R Nataraj, A Shah, S Sanford "Cognitive agency for rehabilitation of grasp performance", Progress in Clinical Motor Control (July 2018), State College, PA.
26. S Sanford, A Shah, G Borodyansky, V Srevatsan, R Nataraj "Dependence of Agency and Performance on Visualized Precision Pinch Force", American Society of Biomechanics (August 2018), Rochester, MN.
27. S Sanford, G Borodyansky, T Selvaggi, C Rybarski, A Shah, R Nataraj "Discrete Visual Feedback on Short-term Retention of Learned Movements", American Society of Biomechanics (August 2018), Rochester, MN.
28. A Shah, S Sanford, Y Chen, R Nataraj "Role of Cognitive Agency in Reach-to-Grasp Movement Performance", American Society of Biomechanics (August 2018), Rochester, MN.
29. D Hollinger, A Shah, R Nataraj "Accelerating Neuromotor Rehabilitation with Reward Feedback", Biomedical Engineering Society Annual Meeting (October 2018), Atlanta, GA.
30. R Nataraj, S Sanford, A Shah, M Liu, S Wilder (CMBBE, New York – Columbia) 2019 upcoming/expected\*\*\*
31. M Liu, S Wilder, R Nataraj (BMES, Philadelphia) 2019, upcoming/expected\*\*\*

## JOURNAL PUBLICATIONS

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1. R Nataraj, ML Audu, RF Kirsch, and RJ Triolo, "Comprehensive joint feedback control for standing by functional neuromuscular stimulation following spinal cord injury: a simulation study", IEEE Transactions in Neural Systems and Rehabilitation, vol. 18, no. 6, pp. 646-657, 2010.
2. ML Audu, R Nataraj, SJ Gartman, and RJ Triolo, "Posture shifting after spinal cord injury using functional neuromuscular stimulation: a computer simulation study", Journal of Biomechanics, vol. 44, no. 9, pp. 1639-1645, 2011.

3. R Nataraj, ML Audu, RF Kirsch, and RJ Triolo, "Trunk acceleration for neuroprosthetic control of standing: a pilot study", *Journal of Applied Biomechanics*, vol. 28, no. 1, pp. 85-92, 2012.
4. R Nataraj, ML Audu, RF Kirsch, and RJ Triolo, "Center of mass acceleration feedback control for standing by functional neuromuscular stimulation: a simulation study", *Journal of Rehabilitation Research and Development*, vol. 49, no. 2, pp. 279-296, 2012.
5. R Nataraj, ML Audu, and RJ Triolo, "Comparing joint kinematics and center of mass acceleration as feedback for control of standing balance by functional neuromuscular stimulation", *Journal of NeuroEngineering and Rehabilitation*, vol. 9, no. 25, 11 pages, 2012.
6. R Nataraj, ML Audu, and RJ Triolo, "Center of mass acceleration feedback control for standing by functional neuromuscular stimulation in the presence of internal perturbations", *Journal of Rehabilitation Research and Development*, vol. 49, no. 6, pp. 889-912, 2012.
7. ZL Shen, TA Mondello, R Nataraj, MF Domalain, and ZM Li, "A digit alignment device for kinematic analysis of the thumb and index finger", *Gait & Posture*, vol. 36, no. 3, pp. 643-645, 2012.
8. R Nataraj, ML Audu, and RJ Triolo, "Center of mass acceleration feedback control for standing by functional neuromuscular stimulation against external perturbations", *IEEE Transactions in Biomedical Engineering*, vol. 16, no. 1, pp.10-19, 2013.
9. R Nataraj and ZM Li, "Robust identification of three-dimensional thumb and index finger kinematics with a minimal set of markers", *Journal of Biomechanical Engineering*, vol. 135, no. 9, 2013.
10. R Nataraj, ZM Li, "Integration of marker and force data to compute three-dimensional joint moments of the thumb and index finger digits during pinch", *Computer Methods in Biomechanics and Biomedical Engineering*, vol. 18, no. 16, pp. 592-606, 2015 (final version accepted June 2013).
11. K Li, R Nataraj, TL Marquardt, ZM Li, "Directional coordination of thumb and finger forces during precision pinch", *PLOS ONE*, vol. 8, no. 11, pp. e79400, 2013.
12. R Nataraj, PJ Evans, WH Seitz, ZM Li, "Pathokinematics of precision pinch associated with carpal tunnel syndrome", *Journal of Orthopaedic Research*, vol. 32, no. 6, pp. 786-792, 2014.
13. R Nataraj, PJ Evans, WH Seitz, ZM Li, "The effects of carpal tunnel syndrome on the reach-to-pinch maneuver", *PLOS ONE*, vol. 9, no. 3, pp. e92063, 2014.
14. TL Marquardt, R Nataraj, PJ Evans, WH Seitz, ZM Li, "Thumb kinematic performance with carpal tunnel syndrome", *Clinical Orthopaedics and Related Research*, vol. 472, pp. 2526-2533, April 2014.
15. ML Audu, SJ Gartman, R Nataraj, RJ Triolo, "Posture dependent muscle stimulation control in a standing neuroprosthesis: A simulation feasibility study", *Journal of Rehabilitation Research and Development*, vol. 51, no. 3, pp. 481-496, 2014.
16. R Nataraj, CF Pasluosta, ZM Li, "Visual feedback regulates kinematic variability of the grasping digits relatively more than hand transport during reach-to-pinch", *Human Movement Science*, vol. 36, pp. 134-153, August 2014.
17. R Nataraj, ML Audu, and RJ Triolo, "Adapting gains of control system using center of mass acceleration feedback for standing by functional neuromuscular stimulation", *Applied Bionics and Biomechanics*, vol. 11, no. 4, pp. 169-174, November 2014.
18. R Nataraj, ML Audu, ZM Li, "Changes in the precision pinch mechanics with surface compliance", *Journal of Biomechanics*. Vol. 48, no. 4, pp. 672-680, February 2015.
19. R Nataraj, ML Audu, RJ Triolo, "Simulating the restoration of standing balance at leaning postures with functional neuromuscular stimulation following spinal cord injury", *Med Biol Eng Comp*, vol. 54, no. 1, pp. 163-176, January 2016.
20. R Nataraj, ML Audu, RJ Triolo, "Restoring standing capabilities with feedback control of functional neuromuscular stimulation following spinal cord injury", *Med Eng Phys*, vol. 42, pp. 13-25, February 2017.
21. R Nataraj, AJ van den Bogert, "Simulation Analysis of Linear Quadratic Feedback Control of Walking" to *J Biomech Eng*, vol. 139, no. 10, 11 pages, August 2017.
22. P Marasco, J Hebert, J Sensinger, C Shell, J Schofield, Z Thumser, R Nataraj, D Beckler, M Dawson, D Blustein, S Gill, B Mensh, R Granja-Vazquez, M Newcomb, J Carey and B Orzell "Illusory movement perception improves motor control for prosthetic hands", *Science Translational Medicine*, vol. 10, no. 432, eaao6990, March 2018.



23. J Schofield, C Shell, Z Thumser, D Beckler, R Nataraj, P Marasco “Characterization of the Sense of Agency over the Actions of Neural-machine Interface-operated Prostheses”, Journal of Visualized Experiments (JoVE), (143), e58702, doi: 10.3791/58702 (2019)

In Preparation:

- S Hnat, R Nataraj, AJ van den Bogert, “Evaluation of a Virtual Muscle Model using a Powered Exoskeleton”, to IEEE-TBME
- R Nataraj, S Sanford, A Shah, M Liu “Cognitive Agency and Performance for Hand Prosthesis Movement Function”
- R Nataraj, S Sanford, A Shah, M Liu “Cognitive Agency and Performance for Hand Prosthesis Grasp Force”
- R Nataraj, S Sanford, A Shah, M Liu “Cognitive Agency and Performance for Non-dominant Hand Movement Function”
- R Nataraj, S Sanford, A Shah, M Liu “Cognitive Agency and Performance for Hand Prosthesis Grasp Force on a Compliant Surface”
- R Nataraj, D Hollinger, A Shah, M Liu “Bimodal Knowledge of Result in Reaching Performance and Touch Agency”
- S Sanford, R Nataraj, “Visual Feedback to Optimize Squat Movements”
- S Wilder, M Liu, R Nataraj “Agency-based for 6-DoF Control Devices”
- M Liu, S Wilder, R Nataraj “Cognition Glove for Secure Grasp and Multi-Sensory Agency Feedback”