JASON JAMES KUTCH
Curriculum Vitae
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Address: The University of Southern California
3710 McClintock Ave., RTH 421
Los Angeles, CA 90089-2905
kutch@usc.edu
Voice: 734-604-4358
Fax: 213-821-5696
bbdl.usc.edu/jason.php

Citizenship: United States

Education

Ph.D., May 2008, Applied and Interdisciplinary Mathematics
University of Michigan, Ann Arbor, in collaboration with The Rehabilitation Institute of Chicago
Advisors: Anthony Bloch, W. Zev Rymer, and Arthur Kuo

B.S.E *Magna cum laude*, June 2001, Mechanical Engineering
Princeton University
Certificates (minors): Engineering Biology & Robotics and Intelligent Systems
Advisors: Michael Littman (Mech. Eng.) & Thomas Buchanan (Mech. Eng., U. of Delaware)

Employment History

July 2010-present	Research Assistant Professor, Department of Biomedical Engineering, University of Southern California.
June 2008-June 2010	Postdoctoral Research Associate, Department of Biomedical Engineering, University of Southern California. Mentor: Dr. Francisco J. Valero-Cuevas
June 2002-May 2008	Doctoral training
June 2001-May 2002	Research Assistant, Center for Biomedical Engineering Research, Mentor: Dr. Thomas S. Buchanan

Research Support

Title: "Revolutionizing surgical options for restoration of pinch in persons with cervical spinal cord injury" (Pending)
Role: Principal Investigator
Source: Christopher and Dana Reeve Foundation
Dates: 2012-2014
Funding: $150,000 total cost
Goal: To greatly expand surgical options for restoration of pinch after spinal cord injury by showing that previously ignored weakened muscles can also serve as effective donors for a greater repertoire of post-operative function.

Title: "Control of Finger Motion and Force for Precision Pinch"
Role: Co-author as Postdoctoral Research Associate
Principal Investigator: Dr. Francisco J. Valero-Cuevas
Score: Priority score of 11 with a percentile of 1.0
Source: National Institutes of Health, R01
Dates: 2010-2014
Funding: $1,900,060 total cost
Goal: To describe and explain how multifinger musculature enables manipulation.

Title: "Neuromechanics of differential motor unit control in multifunctional muscles"
Role: Principal Investigator
Sponsor: Dr. W. Zev Rymer
Score: Priority score of 138 with a percentile of 11
Source: National Institutes of Health, National Research Service Award (trainee-initiated)
Dates: 2007-2008
Goal: To establish the mechanical basis of differential motor unit activation within a muscle.

Publications

Dissertations and theses

1. "Signal in Human Motor Unsteadiness: Determining the Action and Activity of Muscles". Applied and Interdisciplinary Mathematics, University of Michigan, 2008.

2. "State observability in neuromuscular control systems: optimal subspace representations and EMG reconstructions", Mechanical Engineering, Princeton University, 2001. **Awarded best thesis in Mechanical Engineering**.

Peer-reviewed Journal Articles

1. **Kutch JJ**, Valero-Cuevas FJ, "Challenges and new approaches to proving the existence of muscle synergies of neural origin", *In Review*

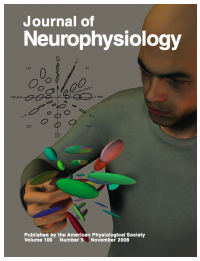
2. Inouye JM, **Kutch JJ**, Valero-Cuevas FJ. "A Comprehensive Computational Framework to Evaluate Grasp Quality of Tendon-Driven Hands with Arbitrary Topology" *In Review*

3. **Kutch JJ**, Valero-Cuevas FJ, "Muscle redundancy does not imply robustness to muscle dysfunction", *Journal of Biomechanics*, 44:1264-1270, 2011. PDF of paper

4. **Kutch JJ**, Kuo AD, Rymer WZ, "Extraction of individual muscle mechanical action from endpoint force". *Journal of Neurophysiology* 103: 3535-3546, 2010. PDF of paper Citations of this paper

5. **(All authors contributed equally)**, Valero-Cuevas FJ, Hoffmann H, Kurse MU, **Kutch JJ**, Theodorou EA, "Computational models for neuromuscular function" (Invited review), *IEEE Reviews in Biomedical Engineering*, 2:110-135, 2009. PDF of paper Citations of this paper

6. **Kutch JJ**, Kuo AD, Bloch AM, Rymer WZ "Endpoint force fluctuations reveal flexible rather than synergistic patterns of muscle cooperation". *Journal of Neurophysiology* 100: 2455-2471, 2008. PDF of paper Citations of this paper



   - Cover article in November 2008 issue
   - Article of **outstanding** interest in review by Tresch MC and Jarc A, "The case for and against muscle synergies". *Current Opinion in Neurobiology* 2009, 19:1-7.

7. **Kutch JJ**, Suresh NL, Bloch AM, Rymer WZ, "Analysis of firing rate and synchronization on spike-triggered averaging of multidirectional motor unit torque", *Journal of Computational Neuroscience*, 22(3): 347-361, 2007. PDF of paper Citations of this paper

8. **Kutch JJ**, Buchanan TS, "Human elbow joint torque is linearly encoded in electromyograhpic signals from multiple muscles", *Neuroscience Letters*, 311(2): 97-100, 2001. PDF of paper Citations of this paper

Peer-reviewed Conference Papers

1. **Kutch JJ**, Valero-Cuevas FJ, "Feasibility before optimality: What complete solution sets tell us about muscle redundancy and synergies", Advances in Computational Motor Control (Society for Neuroscience satellite meeting), San Diego, CA, November 12, 2010.

2. **Kutch JJ**, Valero-Cuevas FJ, "Computational Hypothesis Testing for Neuromuscular Systems", 32nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Buenos Aires, Argentina, August 31-September 4 2010.

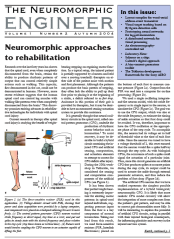
3. **Kutch JJ**, Kurse MU, Hentz VR, Lightdale N, Fassola I, Valero-Cuevas FJ, "Biomechanical and experimental confounds to the detection of neurally-generated muscle synergies", *The Annual Meeting for the American Society of Biomechanics*, August 18-21, 2010, Providence, Rhode Island.

4. **Kutch JJ**, Kurse MU, Hoffmann H, Hentz VR, Leclercq C, Fassola I, Valero-Cuevas FJ, "Simple finger movements require complex coordination of excursions and forces across all muscles", *The Annual Meeting for the American Society of Biomechanics*, August 26-29, 2009, State College, Pennsylvania.

5. **Kutch JJ**, Suresh NL, Kuo AD, Bloch AM, Rymer WZ, "Analysis of firing rate and synchronization on spike-triggered averaging of multidimensional motor unit output", *45th Conference on Decision and Control*, December 2006, San Diego, CA. PDF of paper

6. **Kutch JJ**, Gurfil P, "Optimal control of HIV infection with a continuously-mutating viral population" (ACC02-ASME1028), *2002 American Controls Conference*, May 2002, Anchorage, Alaska. PDF of paper Citations of this paper

Periodicals



1. **Kutch JJ**, "Neuromorphic approaches to rehabilitation", *The Neuromorphic Engineer*, 1(2): 1-2, Autumn 2004. PDF of paper Citations of this paper

Symposia

1. **Kutch JJ**, "EMG is not recruitment", part of symposium entitled "Myths and Monsters in Motor Control", *21st annual meeting of the Society for the Neural Control of Movement*, San Juan, Puerto Rico, May 2011.

2. **Kutch JJ**, "Noise as a window to neuromuscular function: A tutorial", *Workshop on Noise, Delays and Balance Control*, Banff International Research Station, November 2009.

3. **Kutch JJ**, "Force variability as an indicator of neural control dimensionality", *Biomechanics: Muscle, Limb, and Brain*, Mathematical Biosciences Institute, The Ohio State University, January 14-18, 2008. RealPlayer

4. **Kutch JJ**, "Using spike-triggered averaging to investigate differential force generation and connectivity among motor units", *Motoneurons and their Firing Properties*, Panum Institute, Copenhagen, Denmark, July 2006.

5. **Kutch JJ**, "Does the CNS encode torque to control movement?", *Mid-Atlantic Motor Control Meeting*, University of Delaware, April 2002.

Invited Seminars

1. "May the best muscles win: new insights into how the nervous system controls multiple muscles", *Biomedical Engineering Seminar, University of Southern California*, March 2010.

2. "Muscle redundancy revisited: if muscles are redundant, which one can you spare?", *USC Biokinesiology Division Seminar*, October 2009.

3. "Muscle Synergies Without a Brain or Spinal Cord", *UCLA Bioengineering Seminar*, June 2009.

4. "Non-invasive muscle activity measurement using physiological tremor in the human finger", *UCSD Orthopedics Seminar*, October 2008.

5. "Flexible motor action but simple neural architecture: is it possible?", *Simon Fraser University Kinesiology Seminar*, June 2008.

6. "An experimental approach to muscle redundancy", *University of Michigan Mathematical Biology Seminar*, October 2007.

7. "Non-uniform patterns of multidirectional isometric force noise", *Neural Signal Processing Seminar*, Rehabilitation Institute of Chicago, February 2007.

8. "Eigenfaces: decomposing facial image databases into orthogonal components", *University of Michigan Applied Mathematics Seminar*, January 2003.

9. "Hodgkin-Huxley: from neuron to equation", *University of Michigan Mathematical Biology Seminar*, November 2002.

Abstracts

1. **Kutch JJ**, Kurse MU, Valero-Cuevas FJ, "Muscle redundancy does not imply robustness to muscle dysfunction", *40th Annual Meeting of the Society for Neuroscience*, San Diego CA, November 2010. PDF of poster

2. **Kutch JJ**, Valero-Cuevas FJ, "Obtaining complete solution sets for neuromuscular models", *ASME 2010 Summer Bioengineering Conference*, Naples, FL, June 2010.

3. **Kutch JJ**, Kurse MU, Hoffmann H, Kuo AD, Valero-Cuevas FJ, "Muscle synergies may be artifacts of biomechanics rather than neural constraints, and are not necessary to simplify control", *39th Annual Meeting of the Society for Neuroscience*, Chicago IL, October 2009. PDF of poster

4. **Kutch JJ**, Kuo AD, Rymer WZ, "Non-invasively revealing the mechanical action of human muscle", 2009 Workshop on Multi-Scale Muscle Mechanics, Woods Hole, MA, September 18-21, 2009.

5. Kurse MU, **Kutch JJ**, Hoffmann H, Fassola I., Lipson H.,Valero-Cuevas FJ,"A strain-energy approach to simulating slow finger movements and changes due to loss of musculature", *Annual Meeting for the American Society of Biomechanics*, State College, Pennsylvania, August 26-29, 2009.

6. Hoffmann H, **Kutch JJ**, Kurse MU, Valero-Cuevas FJ, "Control of muscle strain energy as a robust means to produce slow and accurate finger movements: Proof of concept via hardware and cadaver implementation" *19th Annual Meeting of the Society for the Neural Control of Movement*, Waikoloa Beach, Hawaii, April 2009.

7. **Kutch JJ**, Valero-Cuevas FJ, "All muscles are redundant, but some are less redundant than others", *19th Annual Meeting of the Society for the Neural Control of Movement*, Waikoloa Beach, Hawaii, April 2009. PDF of poster

8. **Kutch JJ**, Chardon MK, Bloch AM, Rymer WZ, (2007) "Non-uniform patterns of signal-dependent noise during isometric force production at the human metacarpophalangeal joint", *17th Annual Meeting of the Society for the Neural Control of Movement*, Seville, Spain, March 2007.

9. **Kutch JJ**, Suresh NL, Kuo AD, Bloch AM, Rymer WZ, "Effects of discharge synchrony on estimates of motor unit twitch force direction in the first dorsal interosseous muscle", *36th Annual Meeting of the Society for Neuroscience*, Atlanta GA, October 2006.

10. **Kutch JJ**, Kuo AD, Bloch AM, "Modeling optimal neural excitation of muscle" *35th Annual Meeting of the Society for Neuroscience*, Washington DC, November 2005.

11. **Kutch JJ**, Bloch AM, "Muscular synergies and limb control: toward a minimum synergy hypothesis", *14th Annual Meeting of the Society for the Neural Control of Movement*, Sitges, Spain, March 28 - April 3, 2004.

12. **Kutch JJ**, Buchanan TS, "Self-organizing maps and the representation of EMG signals in terms of muscular synergies", *Fourth World Congress of Biomechanics*, August 2002, Calgary, Alberta, Canada.

13. **Kutch JJ**, Buchanan TS, "Individual muscle EMG reconstruction from joint torque", *31st Annual Meeting of the Society for Neuroscience*, San Diego, November 2001.

Memberships

- Society for Neuroscience
- Society for the Neural Control of Movement
- American Society of Biomechanics

Reviewer

- Journal of Biomechanics
- Experimental Brain Research
- IEEE Transactions on Neural Systems and Rehabilitation Engineering
- Journal of Applied Biomechanics
- Human Movement Science

Awards and Honors

- National Science Foundation VIGRE Fellowship, 2002-2005
- Alice Webber Glover Scholarship, University of Michigan, 2006
- Morgan W. McKinzie '93 [best Mech. Eng.] Senior Thesis Prize, Princeton University, 2001
- Donald Janssen Dike Award, Princeton University, 2001
- John Marshall II Memorial Prize (Honorable Mention), Princeton University, 2000

Teaching

· Design and implementation of an EMG laboratory assignment, BME 599 Neuromusclar Biomechanics (Professor Valero-Cuevas), University of Southern California, September 2010.

· Guest lectures on robotic approaches to biomechanical systems, BME 599 Neuromusclar Biomechanics (Professor Valero-Cuevas), University of Southern California, September 2010.

· Guest lectures on the Hodgkin-Huxley Equations, BME 599 Neuromusclar Biomechanics (Professor Valero-Cuevas), University of Southern California, September 2009.

· Co-supervisor with Professor Valero-Cuevas of REU summer students, Cecilia Jou and Vy Vo, Summer 2009.

· Student research mentoring
  ·Ben Sinder (Jun 2007 - Aug 2007):
    Computer simulations of muscle mechanical action identification
  · Stan Chikando (Jan 2007 - Sept 2007):
    · Spike-triggered averaging applied to surface-detected motor unit action potentials
    · Constructing a general program to manage neural data in MATLAB
  · Matthieu Chardon, M.S. (Jun 2006 - Jun 2007):
    Modeling patterns of index finger force fluctuation

· Recitation/lab instructor for Introduction to Differential Equations (Sept 2005 - Dec 2005)
Course in the University of Michigan Mathematics Department. 100 students in my section.

· Sole instructor for a section of Calculus 1 (Sept 2004 - Dec 2004)
Course in the University of Michigan Mathematics Department. 30 students in my section.