

# Eric Rombokas

Department of Veterans Affairs  
Puget Sound Health Care System  
1660 S. Columbian Way  
Seattle, WA 98108-1597

[eric@rombokas.com](mailto:eric@rombokas.com)

<http://www.rombokas.com/eric>

## Education and Employment:

Affiliate Assistant Professor Dept. of Mechanical Engineering University of Washington	Mar 2014 - Present
Research Health Scientist (Principal Investigator) Center of Excellence for Limb Loss Prevention and Prosthetic Engineering Veterans Affairs Rehabilitation Research and Development	Nov 2013 - Present
Postdoctoral Researcher University of Washington Advisor: Dr. Tom Daniel	Oct 2012 - Oct 2013
Ph.D. in Electrical Engineering University Of Washington Advisor: Dr. Yoky Matsuoka Dissertation: "Dynamic Manipulation for Tendon-Driven Hands"	2012
Software Engineer NAVSEA NUWC Keyport SONAR and Tracking	2002 - 2005
Master of Electrical Engineering Rice University	2002
Bachelor of Electrical Engineering Rice University	2001

## Research Interests:

**Dynamic control of robots:** Control in uncertain environments and nonlinear robotic hardware is still impossible, but we are beginning to crack the hard problems. I am interested in using reinforcement and unsupervised learning as a means for achieving model-predictive control without an oracle of system dynamics. I believe that neuroscience provides clues for overcoming the curse of dimensionality and mismatch between models and reality that comes with embodiment in the real world. It also provides clues about the combined nature of sensation and action, and can lead us to a new understanding of active sensing.

**Neural control of movement:** Leveraging our understanding of biological movement control to improve the control of synthetic systems. Animal movement control reveals the deeply intertwined role of movement and sensation, but the details remain mysterious. Of particular interest is the role and self-organization of cerebellar and cortical internal models for movement, and how they are formed and adapted according to experience. Implementation of computational methods from the neural control of movement on biomechanically relevant hardware does more than improve robotic control - it can help us to answer the difficult questions of neuroscience.

### **Activities and Awards:**

Reviewer: NSF Grant Review Panel 2015  
IEEE Conference on Decision and Control  
PLOS ONE  
IEEE Transactions on Automatic Control  
IEEE Transactions on Mechatronics  
Journal Of NeuroEngineering and Rehabilitation  
IEEE Transactions on Biomedical Engineering  
IEEE International Conference on Robotics and Automation  
IEEE/RSJ International Conference on Intelligent Robots and Systems  
The American Controls Conference  
IEEE Transactions on Autonomous Mental Development  
Journal of the Franklin Institute  
Robotica

### **Grants and funding:**

#### **Current:**

"Sensory Feedback for Lower Extremity Prostheses Incorporating Targeted Muscle Reinnervation (TMR)"  
Department of Defense, Defense Medical Research and Development Program, Clinical and Rehabilitative Medicine Research Program, 01/2015

Role: PI

Support: \$1.5M, Role: Initiating PI (2.4 person months donated)

"Acquisition of a Objet500 Connex3 3D Printer"

Department of Veteran Affairs "Sheep" Equipment Grant, 02/2015

Role: Co-Investigator

Support: \$274K

#### **Pending:**

"Robust Safe Flight For Autonomous Flying Vehicles Using Parallel Computing"

Joint Center for Aerospace Technology Innovation, Washington Aerospace Research Program, 07/15-08/16

Role: PI  
Support: \$100K Direct costs

"Prediction of Amputee Movement for Prosthetic Limb Control"  
VA Small Projects in Rehabilitation Research (SPiRE), 03/2015  
Role: PI  
Support: \$200K

Complete:

"Instrumented Task Board with Adjustable Dynamics" (\$4000)  
Center for Sensorimotor Neural Engineering (CSNE) Seed Grant,  
Winter 2012  
Role: PI  
Support: \$4k

Northwest Biomechanics Symposium  
2015 Co-chair  
<http://depts.washington.edu/nwbs/2015/>

Founding member: Student Leadership Committee  
Center for Sensorimotor Neural Engineering (CSNE). 2011-2012.

"Eyes in the sky:" Controlling an aerial robot using body movement.  
Center for Sensorimotor Neural Engineering Tech Sandbox Showcase

Invited talks:

UW Institute of Neuroscience, Seattle WA, May 13 2015 "Sensory augmentation for targeted reinnervation in the lower limb"

Kavli Foundation / CSNE Seminar, Seattle WA, Dec 2013 "Multi-Modal Human-Computer Interaction for Interfaces, Rehabilitation, and Myometric Authentication"

CSNE Industrial Affiliates Board Meeting, Seattle WA, Sep 2013 "Multi-modal Human-Computer Interaction"

Pacific Science Center Festival of the Fountains, Seattle WA, July 2013 "Mind Control: Brain, Body, and Machine"

University of Washington Dept. of Mechanical Engineering Colloquium, Seattle WA, May 2013 "Control of Movement: Clues from Biology"

Office of Naval Research (ONR) MURI Program review, Washington DC, May 2013 "Principles of Sensing and Control in Insect Flight and Biologically Inspired Robotic Flight Platforms"

VA Center of Excellence for Limb Loss Prevention and Prosthetic Engineering,

Seattle WA, March 2013 "Neural Control Principles and Reinforcement Learning for Biomechanically Accurate Robotic Manipulation"

University of Washington Medicine 2013 Mini-Medical School, Seattle WA, March 2013 "Living in an Artificial World: Where Silicon Meets the Neuron"

San Diego State University, San Diego CA, March 2013 "Movement Control and Sensation: From Biorobotics to Robot-Assisted Biology"

Microsoft Research, Seattle, Seattle WA, Jan 2013 "Interfacing With The World: The Sensor, the Motor, and the Sensorimotor"

3rd NSF-JST Joint Workshop On The Development of Model-based Assistive Robotics Technologies for Medicine and Rehabilitation, San Francisco CA, January 2013 "The Sensory, The Motor, and the Sensorimotor: From Biorobotics to Robot-Assisted Biology"

4th NSF-JST Joint Workshop On The Development of Model-based Assistive Robotics Technologies for Medicine and Rehabilitation, San Francisco CA, March 2012 "Manipulation and Contact for Tendon-Driven Hand Robotics"

University of Wisconsin, Madison AISEM Series 2012, Madison WI, February 2012 "Incredible Machines: Body, Brain, and Robot"

Center for Sensorimotor Neural Engineering Research Colloquium, Seattle WA, April 2011 "Neural Control of Movement as a Model for Robotic Manipulation Control"

University of Washington Computer Science Department CS4HS: Computer Science for High School Workshop 2009. "Educational Robots and Braitenberg's Vehicles" (Instruction of a one-day workshop for high school educators)

Internships: Intel Research, Seattle  
Advisor: Ali Rahimi  
Object recognition and computer vision

University of Washington  
Advisor: Rajesh Rao  
Brain-computer interface and Electroencephalography

AT&T Labs  
Advisor: Rich Cox & Group  
Frequency reassignment and modulation filtering

University of Washington  
Advisor: Maya Gupta  
Machine learning for protein folding prediction

Enercorp, LLC. Casablanca, Morocco  
Technical Consultant

### **Peer-Reviewed Journal Publications:**

**Rombokas E**, Malhotra M, Theodorou E, Todorov E, and Matsuoka Y. "Reinforcement learning and synergistic control of the ACT hand." IEEE Transactions on Mechatronics Vol. 18 Issue 2, pp. 569-577 2013

**Rombokas E**, Stepp C E, Chang C, Malhotra M, and Matsuoka Y. "Vibrotactile Sensory Substitution for Electromyographic Control of Object Manipulation." IEEE Transactions on Biomedical Engineering, Vol. 60 Issue 8, pp. 2226-2232, 2013

### **Peer-Reviewed Conference Publications:**

Williams G, **Rombokas E**, and Daniel TL. "GPU based Path Integral Control with Learned Dynamics." Neural Information Processing Systems (NIPS) 2014

Hinson BT, **Rombokas E**, Dyhr JP, Daniel TL, Morgansen KA. "Sensing From Control: Airframe Deformation for Simultaneous Actuation and State Estimation." IEEE Conference on Decision and Control 2013, Venice, Italy.

**Rombokas E**, Malhotra M, Theodorou E, Todorov E, and Matsuoka Y. "Tendon-Driven Variable Impedance Control Using Reinforcement Learning." Robotics: Science and Systems (RSS) 2012, Sidney, Australia.

Chung M\*, **Rombokas E\***, An Q, Matsuoka Y, and Bilmes J. "Continuous Vocalization Control of a Full-Scale Assistive Robot." IEEE RAS and EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob) 2012, Roma, Italy.  
\* equal contribution

**Rombokas E**, Brook P, Smith J R, and Matsuoka Y. "A Simple Grasp Planner Using Orthogonal Approach Angles." IEEE RAS and EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob) 2012, Roma, Italy.

Tejeiro C, Stepp CE, Malhotra M, **Rombokas E**, and Matsuoka Y. "Comparison of remote Pressure and Vibrotactile Feedback for Prosthetic Hand Control." IEEE RAS and EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob) 2012, Roma, Italy.

**Rombokas E**, Theodorou E, Malhotra M, Todorov E, and Matsuoka Y. "Tendon-driven control of biomechanical and robotic systems: A path-integral reinforcement learning approach." IEEE International Conference on Robotics and Automation 2012, St. Paul, USA.

Malhotra M, **Rombokas E**, Theodorou E, Todorov E, and Matsuoka Y. "Reduced dimensionality control for the ACT hand." IEEE International Conference on Robotics and Automation 2012, St. Paul, USA.

**Rombokas E**, Malhotra M, and Matsuoka Y. "Task-specific dynamics for robotic hand control." IEEE EMBS Conference on Neural Engineering 2011, Cancun, Mexico.

**Rombokas E**, Malhotra M, and Matsuoka Y. "Task-specific demonstration and practiced synergies for writing with the ACT hand." IEEE International Conference on Robotics and Automation 2011, Shanghai, China.

**Papers in Preparation:**

**Rombokas E**, Scheuer L, Dyhr JP, Powell N, Morgansen KA, and Daniel TL. "A Robotic Model of Inertial Flight Maneuvering in the Hawkmoth"

**Rombokas E**, Williams G, and Daniel TL. "Receding-Horizon Trajectory Optimization on a GPU" IEEE Transactions on Mechatronics (In review)

Theodorou E, Malhotra M, **Rombokas E**, and Todorov E. "Relative Entropy and Free Energy Dualities: Connections to Path Integral Control and Applications Robotics"