

David Isaac Grow

Department of Mechanical Engineering
New Mexico Tech
122 Weir Hall, Socorro, NM 87801

email: dgrow@nmt.edu
Office: (575) 835-5109
Fax: (575) 835-5209

EDUCATION

Ph.D. May 2011, Mechanical Engineering, Johns Hopkins University, Baltimore, MD

- Dissertation: Robot-assisted Modeling and Rehabilitation Strategies for Cerebellar Ataxia
- Primary Advisor: Dr. Allison Okamura (Mechanical Engineering)
Secondary AdvD. Patterson, C. White, and D. Grow. Visualization of Tipover Stability Measures for Mobile Robots. In *Student Research Symposium*, Socorro, NM, April 2013.isor: Dr. Amy Bastian (Neuroscience)

M.S. December 2006, Mechanical Engineering, University of Utah, Salt Lake City, UT

- Thesis: Harness Design for Two-Axis Torso Haptics
- Advisor: Dr. John Hollerbach (Computer Science)

B.S. August 2004 (with Honors), Physics, University of Utah, Salt Lake City, UT

- Thesis: Pressurization of Thermoacoustic Refrigerators
- Advisor: Dr. Orest Symko (Physics)

HONORS AND AWARDS

Best Paper Award, IEEE Green Technologies Conference, 2014
NIH Ruth Kirschstein National Research Service Award Predoctoral Fellowship, 2008 – 11
Departmental Outstanding Undergraduate Research Award, 2004
Departmental Outstanding Teaching Assistant Award, 2004
University of Utah Annual Autonomous Robot Competition: First Place, 2004
University of Utah Undergraduate Research Fellowship, 2003
Society of Physics Students Outstanding Chapter Award (president), 2003

TEACHING EXPERIENCE

Biomedical Mechatronics **Spring 2013,2014**
Instructor, New Mexico Tech. A graduate-level course covering the kinematics and dynamics of human movement, computational modeling of biological tissue, and medical robotics (prostheses, orthotics, surgery, and rehabilitation).

Engineering Dynamics **Fall/Spring 2011 – present**
Instructor, New Mexico Tech. Undergraduate course in particle and rigid body dynamics covering force/acceleration, work/energy, and impulse/momentum methods.

Dynamic Systems and Controls **Fall 2011 –2013**
Teaching Assistant, Johns Hopkins University. Undergraduate course in classical control theory: dynamic modeling, system response, root locus, and controller design.

Haptic Systems for Teleoperation and Virtual Reality **Spring 2012**
Instructor, New Mexico Tech. Graduate-level course covering manipulator kinematics and dynamics, impedance and admittance control, teleoperation systems, human haptic sensing, and haptic rendering and design of virtual environments.

Design and Analysis of Dynamic Systems **Spring 2007**
Teaching Assistant, Johns Hopkins University. Senior-level course covering design, modeling, and control of dynamic mechanical and electromechanical systems.

Haptic Systems for Teleoperation and Virtual Reality **Fall 2006**
Teaching Assistant, Johns Hopkins University. Mentored semester-length student projects in haptics and related fields, gave one lecture, held office hours, and graded assignments.

RESEARCH
EXPERIENCE

My technical expertise is in human-robot interfaces — specifically in dynamic modeling, system identification, teleoperation, and human psychophysics. Past projects have included the design and construction of robotic devices for neurorehabilitation, clinical training, and remote handling of hazardous materials.

Robotic Interfaces

2011 – present

Robotic Interfaces Laboratory at New Mexico Tech

- Design of semi-autonomous controllers for mobile and aerial robots
- Development of intelligent explosive ordinance disposal (EOD) robots
- Kinematic and dynamic modeling of human motor control
- Design of classroom and clinical robotic training tools

Rehabilitation Robotics

2006 – 2011

Haptics Laboratory at The Johns Hopkins University and

Motion Analysis Laboratory at the Kennedy Krieger Institute, Johns Hopkins Medical Institutions

- Improved the sensing and safety characteristics of a KINARM robotic exoskeleton
- Dynamic modeling and system identification of a KINARM robotic exoskeleton
- Developed models of the cerebellum's role in human motor control
- Validated motor control models via cerebellar patient studies
- Investigated targeted rehabilitation techniques for cerebellar patients

Haptic Training Devices

2006 – 2008

Haptics Laboratory at The Johns Hopkins University and

Motion Analysis Laboratory at the Kennedy Krieger Institute, Johns Hopkins Medical Institutions

- Improved students physical intuition of dynamic systems by incorporating haptic devices and simulations into graduate, undergraduate, and grade school curricula
- Designed and fabricated robust haptic device to train physical therapists in assessment of muscle spasticity in children

Locomotion Interfaces for Virtual Environments

2004 – 2006

School of Computing, University of Utah

- Assisted in adding hydraulic tilt mechanism to Sarcos Treadport
- Designed and fabricated torso exoskeleton for Treadport
- Extended the Treadport's force feedback capability from 1-D (push pull) to 2-D in the sagittal plane
- Investigated the energetic, biomechanical, and psychological equivalence of actual vs. simulated sloped overground locomotion

Thermoacoustic Engines

2001 – 04

Center for Acoustic Cooling, University of Utah

- Designed and fabricated thermoacoustic prime movers and refrigerators
- Investigated the effects of working-gas pressurization on cooling efficiency

GRADUATE MENTORING	Fritz Hieb	Summer 2014 – present
	Innovative tools and techniques for bone density assessment .	
	Ashkan Pourkand	Summer 2014 – present
	Robotic training and assessment tools for orthopaedic surgery.	
	Chris White	Summer 2013 – present
	Dynamic stability of mobile and aerial robots during manipulation tasks.	
	David Patterson	Fall 2012 – present
Implementation and comparison of tip-over stability algorithms for mobile robotics.		
Lizzy Schares	Fall 2012 – Summer 2014	
Computational motor control of humans: real-time motion capture and visualization.		
David Siler	Fall 2012 – Summer 2014	
Teleoperation controller design for to improve quadrotor aircraft maneuvering.		
John Tidman	Fall 2012 – Summer 2014	
Frequency-domain characterization of ground surface for EOD robotic platforms.		
Ryan Grainger	Spring 2012 – Summer 2014	
Development of graphical programming environment for Mindstorms for mobile devices.		
UNDERGRAD. MENTORING	Amanda Innis	Spring 2012 – Spring 2014
	Low cost spasticity simulation training and assessment tool.	
	Chris Frederick	Spring 2012 – Fall 2012
	Experimental apparatus design and fabricaiton; sensor characterization (NSF AMP).	
	Jason Lee	Spring 2012 – Fall 2012
	Experimental apparatus design and fabrication; software development (NSF AMP).	
	Mario Naranjo	Spring 2012
	Modeling and assessment of a flywheel-based energy storage system (NSF AMP).	
Michael Tango	Summer 2010	
Proprioceptive guidance for handwriting in children with autism spect. disorder (NSF REU).		
Michael Locastro	Summer 2007, Summer 2008	
Design and fabrication of haptic device; system ident.; software development (NSF REU).		
Sugandha Arora	Summer 2007	
Mathematical models of muscle spasticity; software development (NSF REU).		
POSTDOC. FELLOWS	Curtis O'Malley	March – July 2012
Component and system modeling of a flywheel-based energy storage system.		
DESIGN TEAM MENTORING	Bone Drill Training & Assessment Team	Fall 2013 – present
	Design of haptic feedback training and assessment tool for orthopaedic drilling.	
	Prosthetic Leg Feedback	Fall 2012 – Spring 2013
	Design of haptic feedback system to warn leg prosthesis user of potential buckling.	
	Reduced Cost Heliostat	Fall 2012 – present
Design and fabrication of assistive lifting technology for disabled individuals.		
Ability One	Spring 2012	
Design and fabrication of novel drive system; economic analysis.		
Intrusion Detecting Security Door	Fall 2011 – present	

Design and fabrication; frequency-domain characterisation of intrusion and tampering events.

PEER-
REVIEWED
PUBLICATIONS

R. P. Grainger and D. Grow. Leveraging Mobile Devices to Enhance the Performance and Ease of Programming from Low-Cost Mobile Robots, *IJITE*. In press.

D. Grow, A. Bastian, A. Okamura. Testing Models of Cerebellar Ataxia via Dynamic Simulation, *Robotica*. September 2014.

D. Grow, A. Bastian, and A. Okamura. Robotic Assistance for Cerebellar Reaching, In Panagiotis Artemiadis (ed.), *Neuro-robotics: From brain machine interfaces to rehabilitation robotics*, Springer 2014.

D. Grow, M. Swanson, D. Patterson, and C. White. Advanced Control Architecture for EOD Robotics. In *ICRA Workshop on Human Robot Interaction*, Karlsruhe, Germany, May 2013.

N. Norton-Cormier, H. Humpman, T. Rushenberg, N. Alvarez, A. Smith, D. Patterson, and D. Grow. Designing and Constructing an Alternative Reduced-Cost Heliostat Drive System. In *IEEE Green Technologies Conference*, Denver, CO, April 2013.

D. Grow, N. Bhanpuri, S. Charles, A. Bastian, and A. Okamura. A Proposed Method for Correcting Coordination Deficits: Models and Simulations. In *ICRA Workshop on Softening Rehabilitation Robotics*, Anchorage, AK, May 2010.

D. Grow, M. Wu, M. Locastro, S. Arora, A. Bastian, and A. Okamura. Haptic Simulation of Elbow Joint Spasticity. In *16th Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, pp. 475-476, Reno, NV, March 2008.

D. Grow, L. Verner, and A. Okamura. Educational Haptics. In *AAAI 2007 Spring Symposium - Robots and Robot Venues: Resources for AI Education*, Stanford, CA, March 2007.

D. Grow and J. Hollerbach. Harness Design and Coupling Stiffness for Two-Axis Torso Haptics. In *14th Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, pp. 83-87, Washington, DC, March 2006.

J. Hollerbach, D. Grow, and C. Parker. Developments in Locomotion Interfaces. In *Proceedings of the IEEE International Conference on Rehabilitation Robotics*, pp. 522-525, Chicago, IL, July 2005.

D. Grow. Experiments on the Effects of Pressurization of a Thermoacoustic Refrigerator. In *University of Utah UROP Research Abstracts*, 4: Spring 2004.

EXTENDED
ABSTRACTS

A. Innis, E. Schares, and D. Grow. Low Cost Spasticity Simulation Device for Education. In *Student Research Symposium*, Socorro, NM, April 2013.

D. Patterson, C. White, and D. Grow. Visualization of Tipover Stability Measures for Mobile Robots. In *Student Research Symposium*, Socorro, NM, April 2013.

M. Rayl, A. Innis, C. Sniegowski, K. Carson, E. Trujillo, S. Wells, S. Werner, M. Williams, J. Lamberti, and D. Grow. Design of a Vibro-Tactile Feedback System for a Power Knee Prosthetic. In *Student Research Symposium*, Socorro, NM, April 2013.

T. Rushenberg, N. Alvarez, E. Hays, J. Anderson, D. Patterson, N. Norton, and D. Grow. Designing a Reduced-Cost Heliostat. In *Student Research Symposium*, Socorro, NM, April 2013.

E. Schares, A. Innis, and D. Grow. Motion Capture Analysis with Microsoft Kinect. In *Student Research Symposium*, Socorro, NM, April 2013.

J. Tidman and D. Grow. Frequency-Domain Surface Characterization for Mobile Robots. In *Student Research Symposium*, Socorro, NM, April 2013.

J. Kuker, S. Hussan, S. Martinez, C. Santistevan, Z. Taylor, D. Grow. Advanced Control Architecture for EOD Robots. In *Student Research Symposium*, Socorro, NM, April 2012.

M. Swanson, C. Frederick, and D. Grow. Design of an Intrusion Detecting Security Door. In *Student Research Symposium*, Socorro, NM, April 2012.

ABSTRACTS AND POSTERS D. Patterson, C. White, M. Andreani, D. Grow. Dynamic-Model-Based Stability of Mobile Manipulators. Abstract and poster in *ITEA System-of-Systems Workshop*, El Paso, Texas, March 2014.

D. Patterson, C. White, M. Andreani, D. Grow. Virtual Fixtures for Tip-Over Stability of Teleoperated Mobile Manipulators. Demonstration and poster in *IEEE Haptics Symposium*, Houston, Texas, February 2014.

C. Frederick, J. Lee, and D. Grow. Design and Construction of a Scale Test Bed for Testing Smart EOD Robot Control. In *New Mexico AMP Student Research Conference*, Las Cruces, NM, October 2012.

N. Bhanpuri, D. Grow, A. Okamura, A. Bastian. Can cerebellar dysmetria be explained by an incorrect internal model of limb dynamics? In *Society for the Neural Control of Movement Conference*, Waikoloa, HI, May 2009.

D. Grow, M. Wu, M. Locastro, S. Arora, A. Bastian, and A. Okamura. Haptic Simulation of Elbow Joint Spasticity. In *16th Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, Reno, NV, March 2008.

D. Grow, L. Verner, and A. Okamura. Educational Haptics (with accompanying demonstration). In *AAAI 2007 Spring Symposium - Robots and Robot Venues: Resources for AI Education*, Stanford, CA, March 2007.

INVITED UNM Bioengineering Seminar, Albuquerque, NM, August 28, 2013.

PRESENTATIONS ICRA Workshop on Human Robot Interaction, Karlsruhe, Germany, May 10, 2013.

Communication in Engineering, NMT, Socorro, NM, January 30, 2013.

Human Factors in Science and Engineering, NMT, Socorro, NM, November 16, 2012.

Communication in Engineering, NMT, Socorro, NM, February 1, 2012.

Student chapter of American Society of Mech. Eng., NMT, Socorro, NM, October 25, 2011.

Department of Mechanical Engineering, NMT, Socorro, NM, September 6, 2011.

General Dynamics Robotic Systems, Westmister, MD, July 12, 2011.

Intuitive Surgical, Sunnyvale, CA, June 23, 2011.

Department of Mechanical Engineering, NMT, Socorro, NM, July 7, 2011.

Weapons and Systems Engineering, US Naval Academy, Annapolis, MD, February 10, 2011.

ICRA Workshop on Softening Rehabilitation Robotics, Anchorage, AK, May 3, 2010.

JHMI Sensorimotor Research Day, Baltimore, MD, December 7, 2009.

AAAI Spring Symposium Series, Stanford, CA, March 26, 2007.

IEEE VR2006, Washington D.C., March 25, 2006.

ITR Summit Meeting, University of Utah, July 2005.