
Associate Professor
University of Wisconsin-Madison
Departments of Kinesiology, Biomedical Engineering, and Mechanical Engineering
2000 Observatory Drive
Madison, Wisconsin 53706-1189
kreg.gruben@wisc.edu
608-262-2711

Education:

1993–94 *Johns Hopkins University, Baltimore, Maryland*

Post-doctoral Fellow in the Department of Radiology

Research area: surgical robotics (laparoscopy)

May, 1993 *Johns Hopkins University*

Doctor of Philosophy in Biomedical Engineering

Emphasis on biomechanics and biomedical instrumentation.

Dissertation Title: Mechanics of Pressure Generation During Cardiopulmonary Resuscitation.

May, 1985 *University of Illinois, Urbana-Champaign*

Bachelor of Science in Agricultural Engineering, highest honors (GPA: 4.945/5.0)

Power and Machinery specialization

Professional Experience:

2003– Associate Professor

1994–2003 Assistant Professor

University of Wisconsin, Madison

Departments of Kinesiology, Biomedical Engineering, and Mechanical Engineering

1993–94 Post-doctoral Fellow

IBM T.J. Watson Research Center, Yorktown Heights, New York

Johns Hopkins University, Baltimore, Maryland

Grants: since 2014 (principal investigator unless noted)

National Science Foundation

9/2018–8/2021, ‘High-Power Physically Interactive Human-Robot Collaboration through Balanced Active-Passive Hybrid Actuation’

PI: P. Adamczyk, Co-PI: M. Zinn, Co-PI: K. Gruben

University of Wisconsin, Discovery to Product (D2P) Igniter Fund

9/2014–12/2016, Pre-commercialization of KIINCE: Kinetic Immersive Interface for Neuro-muscular Coordination Enhancement.’

University of Wisconsin, Graduate School

7/2015–6/2016, ‘The neuromechanics of human walking postural control: variability across cycles.’

7/2017–6/2018, ‘The Balance Deficits of Aging and Stroke.’

University of Wisconsin Foundation: Virginia Horne Henry Fund for Women’s Physical Education Issues

5/2014–8/2016, ‘Balance control in elderly women.’

5/2015–8/2017, ‘Mechanism of Balance Control in Elderly Women: Inter-joint Coordination.’

5/2016–8/2018, ‘Balance control in elderly women: optimal feedback space.’

University of Wisconsin Graduate School, Robert Draper Technology Innovation Fund (TIF)

1/2017–12/2017, ‘Human standing balance deficit detection.’

Honors:

1. Finalist (in top 13 of 238) in Wisconsin Governor's Business Plan Contest, 2015, KIINCE Clinical therapy device to restore walking after stroke.
2. Winner of Wisconsin Technology Council June 2015 Shark Tank Business Pitch Contest.

Patents:

1. Gelfand M, Gruben K, Halperin H, Koepsell J, Rothman N, Tsitlik J: Improved vest design for a cardiopulmonary resuscitation system. 1997, European patent #96908807.9-2305.
2. Gelfand M, Gruben K, Halperin H, Koepsell J, Rothman N, Tsitlik J: Vest design for a cardiopulmonary resuscitation system. June 23, 1998, U.S. patent #5,769,800.
3. Gruben K, Schmidt M: Electromechanical force-magnitude, force-angle sensor. Sept. 2, 2008, U.S. patent #7,418,862.
4. Gruben K, Schmidt M: Training device for muscle activation patterns. Sept. 4, 2012, U.S. Patent #8,257,284 B2.
5. Gruben K, Boehm W: Footplate harness for natural kinematics in walking training apparatus. Jan. 22, 2019, U.S. Patent #10,182,958 B2.
6. Gruben K, Boehm W, Nichols K: Apparatus for assessing human balance capacity. Nov 17, 2016, U.S. Patent application filed.

Publications:

Book Chapters

1. Taylor RH, Funda J, Eldridge B, LaRose D, Gomory S, Gruben K, Talamini M, Kavoussi L, Anderson J: A telerobotic assistant for laparoscopic surgery. Chapter 46 in *Computer-Integrated Surgery: Technology and Clinical Applications*, eds. Taylor RH, Lavallée S, Burdea GC, Mösges R, MIT Press, Cambridge, MA, 1995.

Peer Reviewed

Ethics of Life Support and Resuscitation

1. Bankman IN, Gruben KG, Halperin HR, Popel AS, Guerci AD, Tsitlik JE: Identification of dynamic mechanical parameters of the human chest during manual cardiopulmonary resuscitation. **IEEE Transactions on Biomedical Engineering**, 37(2):211–217, 1990.
2. Gruben KG, Romlein J, Halperin HR, Tsitlik JE: System for mechanical measurements during cardiopulmonary resuscitation in humans. **IEEE Transaction on Biomedical Engineering**, 37(2):204–210, 1990.
3. Gruben KG, Guerci AD, Halperin HR, Popel AS, Tsitlik JE: Sternal force-displacement relationship during cardiopulmonary resuscitation. **J Biomech Eng**, 115:195–201, 1993.
4. Halperin HR, Tsitlik JE, Gelfand M, Weisfeldt ML, Gruben KG, Levin HR, Rayburn BK, Chandra NC, Scott CJ, Kreps BJ, Siu C, Guerci AD: A preliminary study of cardiopulmonary resuscitation by circumferential compression of the chest with use of a pneumatic vest. **New Eng J Med**, 329(11):762–8, 1993.
5. Chandra NC, Gruben KG, Tsitlik JE, Brower R, Guerci AD, Halperin HR, Weisfeldt ML, Permutt S: Observations of ventilation during resuscitation in a canine model. **Circulation**, 90(6):3070–5, 1994.
6. Taylor RH, Funda J, Eldridge B, Gruben K, LaRose D, Gomory S, Talamini M, Kavoussi L, Anderson J: A Telerobotic assistant for laparoscopic surgery. **IEEE Engineering in Medicine and Biology Society Magazine**, 14(3):279-291, 1995.
7. Funda J, Taylor R, Eldridge B, Gomory S, Gruben K: Constrained Cartesian motion control for teleoperated surgical robots. **IEEE Transactions on Robotics and Automation**, 12(3):453–465, June 1996.
8. Eldridge B, Gruben K, LaRose D, Funda J, Gomory S, Karidis J, McVicker G, Taylor R, Anderson J: A remote center of motion robotic arm for computer assisted surgery. **Robotica**, 14(1):103–109, Jan–Feb 1996.
9. Gruben KG, Halperin HR, Popel AS, Tsitlik JE: Canine sternal force-displacement relationship during cardiopulmonary resuscitation. **IEEE Trans. on Biomedical Engineering**, 46(7):788–796, 1999.

10. Miller BF, Gruben KG, Morgan BJ: Circulatory responses to voluntary and electrically stimulated muscle contractions in humans. **Physical Therapy**, 80(1):53–60, 2000.
11. Gruben KG, López-Ortiz C: Characteristics of the force applied to a pedal during human pushing efforts: Emergent linearity. **J Motor Behavior**, 32(2):151–162, 2000.
12. Gruben KG, López-Ortiz C, Schmidt MW: The control of foot force during pushing efforts against a moving pedal. **Experimental Brain Research**, 148(1):50–61, 2003.
13. Gruben KG, Rogers LM, Schmidt MW: Direction of foot force for pushes against a fixed pedal: role of effort level. **Motor Control**, 7(3):229-41, 2003.
14. Schmidt MW, López-Ortiz C, Barrett PS, Rogers LM, Gruben KG: Foot force direction in an isometric pushing task: prediction by kinematic and musculoskeletal models. **Experimental Brain Research**, 150(2):245-54, 2003.
15. Gruben KG, López-Ortiz C, Giachetti RS: Muscular and postural components of foot forces during quasi-static extension efforts. **J Applied Biomechanics**, 19:239-245, 2003.
16. Gruben KG, Rogers LM, Schmidt MW, Tan L: Direction of foot force for pushes against a fixed pedal: variation with pedal position. **Motor Control**, 7(4):366-383, 2003.
17. Rogers LM, Brown DA, Gruben KG: Foot force direction control during leg pushes against fixed and moving pedals in persons post-stroke. **Gait and Posture**, 19(1):58-68, 2004.
18. Moerchen VA & Gruben KG: Afferent contributions to digit force coupling and force level variation during non-lift pinch. **Neurocase**, 12(5), 300-306, 2006.
19. Moerchen VA, Lazarus J, Gruben KG: Task-dependent organization of pinch grip forces. **Experimental Brain Research**, 180(2), 367-376, 2007.
20. Irwin CB, Kage CC, Gruben KG, Sesto ME: Examination of older females' grip characteristics. **Human Factors and Ergonomics Society Conference**, San Francisco, CA. 2010.
21. Gruben KG, Boehm WL: Force direction pattern stabilizes sagittal plane mechanics of human walking. **Human Movement Science**, 31(3), 649-659, 2012.
doi:10.1016/j.humov.2011.07.006
22. Gruben KG, Boehm WL: Mechanical interaction of center of pressure and force direction in the upright human. **J Biomechanics**, 45(9), 1661-1665, 2012.
doi: 10.1016/j.jbiomech.2012.03.018
23. Gruben KG, Boehm WL: Response to letter to the editor: 'The ground reaction vector in walking passes always (almost) through the same point.' **J Biomechanics**, 46, 632-633, 2012.
doi:10.1016/j.jbiomech.2012.10.008
24. Gruben KG, Boehm WL: Ankle torque control that shifts the center of pressure from heel to toe contributes non-zero sagittal plane angular momentum during human walking. **J Biomechanics**, 47(6), 1389-1394, 2014.
10.1016/j.jbiomech.2014.01.034.
25. Boehm WL, Gruben KG: Post-stroke walking behaviors consistent with altered ground reaction force direction control advise new approaches to research and therapy. **Translational Stroke Research**, 7, 3-11, 2016. DOI: 10.1007/s12975-015-0435-5, <http://link.springer.com/article/10.1007/s12975-015-0435-5>
26. Travers BG, Mason A, Gruben KG, Dean D, McLaughlin K: Standing balance on unsteady surfaces in children on the autism spectrum: The effects of IQ. **Research in Autism Spectrum Disorders**, 51, 9-17, 2018.
27. Boehm WL, Gruben KG: Development of KIINCE: A kinetic feedback-based robotic environment for study of neuromuscular coordination and rehabilitation of human standing and walking, **Journal of Rehabilitation and Assistive Technologies Engineering**, 5, 2018.
28. Boehm WL, Nichols KM, Gruben KG: Frequency-dependent contributions of sagittal-plane foot force to upright human standing, **J Biomechanics**, 83, 305-309, 2019. (doi.org/10.1016/j.jbiomech.2018.11.039)

Abstracts and Conference Papers

1. Bankman IN, Gruben KG, Popel AS, Halperin HR, Thakor NV, Tsitlik JE: Least-mean-square parameter identification for chest compliance modeling in CPR. **Proc. of the IEEE/9th Annual Conference of the Engineering in Medicine and Biology Society**, :1207–1208, 1987.
2. Gruben KG, Bankman IN, Halperin HR, Guerci AD, Popel AS, Tsitlik JE: Linearity of chest mechanics during manual CPR. **FASEB Journal**, 3(3):A694, 1989.
3. Guerci AD, Chandra NC, Gelfand MI, Tsitlik JE, Gruben KG, Scott CJ, Weisfeldt ML, Halperin HR: Vest CPR increases aortic pressure in humans. **Circulation**, 80(4):II-496, 1989.
4. Gruben KG, Halperin HR, Levin HR, Guerci AD, Bankman IN, Popel AS, Tsitlik JE: Sternal compliance during manual cardiopulmonary resuscitation in humans. **First World Congress of Biomechanics**, II:188, 1990.
5. Tsitlik JE, Gelfand M, Gruben KG, Guerci AD, Halperin HR: Vest CPR - A promising new modality of resuscitation. **Proc. of the IEEE/12th Annual Conference of the Engineering in Medicine and Biology Society**, 12:0737–0738, 1990.
6. Levin HR, Gruben KG, Tsitlik JE, Guerci AD, Sullivan D, Weisfeldt ML, Halperin HR: Determinants of vascular pressure generation during cardiopulmonary resuscitation: the effect of rise time. **American College of Cardiology 40th Annual Scientific Session**, 1991.
7. Gruben KG, Halperin HR, Guerci AD, Tsitlik JE: A model of right atrial pressure generation during cardiopulmonary resuscitation. **Proc. of the IEEE/13th Annual Conference of the Engineering in Medicine and Biology Society**, 13:2123–2124, 1991.
8. Levin HR, Gruben KG, Tsitlik JE, Guerci AD, Rothman NS, Sullivan WD, Weisfeldt ML, Halperin HR: Chest mechanics during impact loading differ from manual CPR. **Circulation**, 84(4):II-8, 1991.
9. Chandra NC, Gruben KG, Tsitlik JE, Guerci AD, Permutt S, Weisfeldt ML: Ventilation during CPR. **Circulation**, 84(4):II-9, 1991.
10. Halperin HR, Rayburn BK, Levin HR, Gruben KG, Tsitlik JE: The hemodynamics of manual CPR with and without active decompressions and vest CPR. **Circulation**, 86(4):I-233, 1992.
11. Halperin HR, Tsitlik JE, Gelfand M, Weisfeldt ML, Gruben KG, Levin HR, Rayburn BK, Siu C, Guerci AD: Improved cardiopulmonary resuscitation with circumferential thoracic vest inflations in humans. **Circulation**, 86(4):I-235, 1992.
12. Funda J, Taylor R, Gruben K, LaRose D: Optimal motion control for teleoperated surgical robots. **Proc. of the 1993 SPIE International Symposium on Optical Tools for Manufacturing and Advanced Automation: Telem manipulator and Telepresence Technologies**, 1993.
13. Funda J, Taylor R, Eldridge B, Gruben K, LaRose D, Gomory S: Image-guided command and control of a surgical robot. **Medicine Meets Virtual Reality II**, San Diego, CA, 1994.
14. Funda J, Taylor R, Gomory S, Eldridge B, Gruben K, Talamini M: An experimental user interface for an interactive surgical robot. **Proc. of First Int'l Symposium on Medical Robotics and Computer Assisted Surgery**, Pittsburgh PA, Sept. 1994.
15. Taylor RH, Funda J, Eldridge B, Gomory S, Gruben K, LaRose D, Talamini M, Kavoussi L: Telerobotic assistant for laparoscopic surgery. Invited paper in **IEEE Engineering in Medicine and Biology Magazine, Special Issue on Robotics in Surgery**, 14(3):279–288, May-Jun 1995 (reprinted in **Computer-Integrated Surgery: Technology and Clinical Applications**, MIT Press, 1995).
16. Funda J, Eldridge BN, Gruben K, Gomory S, Taylor RH: Comparison of two manipulator designs for laparoscopic surgery. **Proc. of the 1994 SPIE International Symposium on Optical Tools for Manufacturing and Advanced Automation: Telem manipulator and Telepresence Technologies**, Boston, MA, 2351:172-183, 1995.
17. Funda J, Gruben K, Eldridge B, Gomory S, Taylor R: Control and evaluation of a 7-axis surgical robot for laparoscopy. **Proc. of the 1995 IEEE International Conference on Robotics and Automation**, Nagoya, Japan, Part 2 (of 3):1477-1484, 1995.
18. Gruben KG, Côté JN: Foot forces using constrained motion exercise machine. **Proc. of the Association**

- for the **Advancement of Medical Instrumentation**, Washington, DC, p. 58, June, 1997.
19. Côté JN, Gruben KG: Foot force during constrained motion exercise. **Proc. of the Twelfth Int'l Society of Electrophysiology and Kinesiology Congress**, Montreal, Quebec, Canada, p. 138, June, 1998.
 20. Gruben KG, López-Ortiz C: Foot force direction during static extension efforts: muscular component. **Advances in Motor Rehabilitation Symposium**, Lisle, Illinois, p. 14, June, 1998.
 21. Gruben KG: Joint moment proportionality during cycling. **Progress in Motor Control-II: Structure-Function Relations in Voluntary Movements**, State College, Pennsylvania, pp. 84–85, Aug., 1999.
 22. Moerchen V, Gruben KG, Lazarus J: Sensorimotor integration in the neuromechanical control of visually-guided pinch force regulation in individuals with and without down syndrome. **25th Annual Motor Development Research Consortium**, Madison, Wisconsin, Oct. 1999.
 23. Gruben KG, López-Ortiz C: Foot force path linearity in the frontal-plane during pushes on stationary and moving pedals. **American Soc. of Biomechanics Annual Mtg.**, Chicago, IL, pp. 25–26, July, 2000.
 24. Barrett PS, Gruben KG: Orientation of linear foot force path depends on limb axis during human lower limb pushing efforts. **American Soc. of Biomechanics Annual Mtg.**, Chicago, IL, pp. 147–148, July, 2000.
 25. Gruben KG, López-Ortiz C, Mynark R: Limb force control in infants: motor primitives. **Soc. for Neuroscience Annual Mtg.**, New Orleans, LA, Nov., 2000.
 26. Moerchen VA, Gruben KG, Lazarus JC: Interdigit force coupling in a visually guided pinch task. **Progress in Motor Control-III: From Basic Science to Application**, Montreal, Aug. 2001.
 27. Barrett PS, Gruben KG: Lower limb force generation: control of initial and added forces. **Progress in Motor Control-III: From Basic Science to Application**, Montreal, Aug. 2001.
 28. Moerchen VA, Lazarus JC, Gruben KG: Coupling of digit forces in mechanically constrained, visually guided pinch. **Motor Development Research Consortium**, Ann Arbor, MI, Oct 5–6, 2001.
 29. Barrett PS, Gruben KG: Force path linearity in human lower limb pushing efforts. **Motor Development Research Consortium**, Ann Arbor, MI, Oct 5–6, 2001.
 30. Moerchen VA, Lazarus JC, Gruben KG: Interdigit force coupling during pinch in children and adults. **Society for Neuroscience Annual Mtg.**, San Diego, CA, Nov., 2001.
 31. Gruben KG, Rogers LM, Mynark R, Brown DA: Foot force control post-stroke: emergent linearity. **Society for Neuroscience Annual Mtg.**, San Diego, CA, Nov., 2001.
 32. López-Ortiz C, Schmidt MW, Gruben KG: Emergent linearity of the foot force paths in kinematically constrained motion of the lower limb: quasi-static case. **Society for Neuroscience Annual Mtg.**, San Diego, CA, Nov., 2001.
 33. López-Ortiz C, Schmidt MW, Gruben KG: Foot force, net joint torques, and EMGs in kinematically constrained motion of the lower limb. **Society for Neuroscience Annual Mtg.**, Orlando, FL, Nov., 2002.
 34. Rogers LM, Brown DA, Gruben KG: Foot force control post-stroke: constant direction, shifted orientation. **Society for Neuroscience Annual Mtg.**, Orlando, FL, Nov., 2002.
 35. Moerchen V, Gruben KG: Digital anesthetization reduced thumb-index finger coupling in pinch: A case study. **Physical Therapy 2003: Annual Conference & Exposition of the American Physical Therapy Association**, Washington, DC, June 18-22, 2003.
 36. Moerchen V, Gruben KG: Interdigit force coordination among individuals with Down syndrome in a visually guided pinch force task. **Physical Therapy 2003: Annual Conference & Exposition of the American Physical Therapy Association**, Washington, DC, June 18-22, 2003.
 37. Hasman CL, Gruben KG: The effect of acute stroke on foot force generation. **Wisconsin Physical Therapy Association Annual Meeting**. April, 2005.
 38. Gruben KG, Hasman C, Schmidt MW, Giachetti RS, Tan L: Altered directional control of foot force is a primary effect of stroke. **Progress in Motor Control V**, Penn State, Aug. 2005.
 39. Giachetti RS, Gruben KG: Foot force direction control and center of pressure. **Progress in Motor Control V**, Penn State, Aug. 2005.
 40. Gruben KG, Giachetti RS, Schmidt MW: Control of force direction depends on center of pressure, not limb posture. **Society for Neuroscience Annual Mtg.**, Atlanta, GA, Oct., 2006.

41. Moerchen VA, Gruben KG, Lazarus JC: Age related changes in accurate performance of a visually-guided force task supports dimensional processing. **Society for Neuroscience Annual Mtg.**, San Diego, CA, Nov., 2007.
42. Gruben KG, Giachetti RS, Lazarus JA: Directional control of foot force in Parkinson's disease. **Movement Disorder Society**, Chicago, IL, June, 2008.
43. Gruben KG, Liske HA, Oats NJ, Kohli DL, Gutierrez AR: Human upright posture during walking: Neural control and mechanics interact to produce stabilizing force direction, **Society for Neuroscience Annual Meeting**, Chicago, IL, Oct, 2009.
44. Gruben KG, Gutierrez A, Boehm WL: Human walking stabilized by foot force direction control. **Society for Neuroscience Annual Meeting**, San Diego, CA, Nov, 2010.
45. Gruben KG, Boehm WL: Stabilization of upright walking posture due to body mechanics and heel-to-toe center-of-pressure shift. **Dynamic Walking Conference**, Pensacola Beach, FL, May, 2012. Voted Best Poster Presentation.
46. Gruben KG, Boehm WL: Post-stroke gait deviations predicted by foot force misdirection. **Society for Neuroscience Annual Meeting**, New Orleans, LA, Oct, 2012.
47. Boehm WL, Gruben KG: Mechanical interaction of the center of pressure and direction of foot force helps maintain upright posture in human walking. **17th U.S. National Congress on Theoretical & Applied Mechanics**, Michigan State University, June, 2014.
48. Boehm WL, Gruben KG: Compulsory joint torque coordination interfaces for neuromuscular training and rehabilitation of human walking. **Society for Neuroscience Annual Meeting**, Washington, DC, November, 2014.
49. Gruben KG, Boehm WL: Bifurcation in lower limb muscle coordination frequency content during quiet standing reflects structure of neuromuscular control. **Society for Neuroscience Annual Meeting**, Washington, DC, November, 2014.
50. Boehm WL, Gruben KG: Atypical muscle coordination present in hemiparetic walking as an explanation for impairment. **Society for Neuroscience Annual Meeting**, Chicago, IL, Oct, 2015.
51. Nichols K, Boehm W, Gruben K: Characteristic force intersection points present in standing balance coordination. **Biomechanics and Neural Control of Movement**, Ohio, June 2016.
52. Boehm W, Gruben K: Altered lower limb standing coordination following stroke: Getting to the point. **Biomechanics and Neural Control of Movement**, Ohio, June 2016.
53. Gruben K, Boehm W: 'Point'-blank distinction in lower limb walking coordination following stroke. **Biomechanics and Neural Control of Movement**, Ohio, June 2016.
54. Boehm W, Nichols K, Gruben K: A novel characterization of human balance control during standing with visual sensory deprivation. **Society for Neuroscience Annual Meeting**, San Diego, CA, Nov, 2016.
55. Mason AH, Gruben KG, Dean DC, McLaughlin DK, Travers BG: Standing balance on rigid and unstable surfaces in children on the autism spectrum: interaction between symptom and motor domains. **International Society for Autism Research (INSAR)**, San Francisco, CA, May, 2017.
56. Gruben KG, Boehm WL: Real-time feedback modalities for training neuromuscular coordination during walking and standing following stroke. poster and presentation **Dynamic Walking**, Mariehamn, Finland, June 2017.
57. Boehm WL, Gruben KG: Frequency-dependent lower-limb coordination patterns vary during standing across population types. **Dynamic Walking**, Mariehamn, Finland, June 2017.
58. Boehm WL, Gruben KG: Lower-limb coordination during standing after stroke: paretic and non-paretic legs differ from control. **American Society of Biomechanics**, Boulder, CO, August 2017.
59. Boehm WL, Gruben KG, Winter L, Doyle-Greene K: Frequency-dependent lower-limb coordination during standing is altered in Parkinson's disease. **Society for Neuroscience Annual Meeting**, Washington DC, November 2017.
60. Gruben KG, Dutt-Mazumder A: Frequency-dependent lower-limb coordination during standing is altered with age. **Society for Neuroscience Annual Meeting**, Washington DC, November 2017.

61. Gruben KG, Yamagata M, Falaki A, Latash M: Standing balance control with voluntary co-activation. Progress in Clinical Motor Control, State College, PA, July 2018.
62. Yamagata M, Latash M, Gruben K, Falaki A: Effects of voluntary co-activation on the control of vertical posture. Progress in Motor Control XII: Movement Improvement, Amsterdam, Netherlands, July 2019.
63. Lefranc A, Gruben K: Absence of visual feedback during standing alters force direction/location ratio. American Society of Biomechanics/International Society of Biomechanics Meeting, Calgary, Alberta, Canada, July 2019.