

Curriculum Vitae

Rebecca Ann (MacDonald) Wachs

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Education and Training

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|--|----------------------------------|-----------------|
| Postdoctoral Training, 2014 - 2016 | University of Florida | Gainesville, FL |
| <ul style="list-style-type: none">▪ <i>Development of novel biomaterials to direct nerve growth after spinal cord injury, peripheral nerve injury, and in pain conditions.</i>▪ <i>Advised by Dr. Christine Schmidt</i> | | |
| Ph.D., Biomedical Engineering, 2013 | Rensselaer Polytechnic Institute | Troy, NY |
| <ul style="list-style-type: none">▪ <i>Correlations between muscle activity, kinematics, and in vivo loading in the spine.</i>▪ <i>Advised by Dr. Eric H. Ledet</i> | | |
| M.Eng., Biomedical Engineering, 2005 | Rensselaer Polytechnic Institute | Troy, NY |
| <ul style="list-style-type: none">▪ <i>Electrical based characterization of carboxylated SWNT-collagen composites.</i>▪ <i>Advised by Dr. Jan P. Stegemann</i> | | |
| B.S., Mechanical Engineering, 2003 | Worcester Polytechnic Institute | Worcester, MA |
| <ul style="list-style-type: none">▪ <i>Concentration in Biomechanics</i>▪ <i>Minor in Materials; Minor in Society, Technology, and Policy</i> | | |

Research Experience

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|--|----------------------------------|-----------------|
| Assistant Professor, Orthopaedic & Neural Engr Lab | University of Nebraska – Lincoln | Lincoln, NE |
| January 2017 – Present | | |
| <ul style="list-style-type: none">▪ <i>Unite lab personnel around common research vision to create novel biomaterial interventions to address musculoskeletal pain using neural engineering and drug delivery techniques.</i>▪ <i>Develop strategic grants to submit to federal agencies, private foundations, and internal opportunities to obtain funding to perform impactful research.</i>▪ <i>Mentor graduate and undergraduate students in a research setting to become independent scientists and engineers capable of complex problem solving through experimental design, execution, and analysis.</i>▪ <i>Teach diverse group of undergraduate and graduate students in biological systems engineering courses.</i>▪ <i>Advise undergraduate students to identify their passions and goals, and develop a course curriculum to meet these goals.</i> | | |
| Postdoctoral Research, Biomimetic Materials Lab | University of Florida | Gainesville, FL |
| June 2014 – December 2016 | | |
| <ul style="list-style-type: none">▪ <i>Designed and developed tissue engineered peripheral nerve interfaces with expert collaborators in electrical and biomedical engineering to revolutionize how amputees interact with prosthetic devices.</i>▪ <i>Directed a group of six graduate and undergraduate students to translate lab knowledge of extracellular matrix of the central nervous system to create novel biomaterials to treat innervation in low back pain.</i>▪ <i>Developed strategic research direction for lab and assisted in writing grants for national and local awards.</i>▪ <i>Mentored nine graduate and undergraduate students with technical skills and career guidance.</i>▪ <i>Established targeted research collaborations to expand the impact of the expertise and knowledge of the lab.</i> | | |
| Doctoral Research, Musculoskeletal Mechanics Lab | Rensselaer Polytechnic Institute | Troy, NY |
| August 2009 – February 2013 | | |
| <ul style="list-style-type: none">▪ <i>Designed, fabricated, and tested a patent-pending wireless passive single component inductor-capacitor force sensor.</i> | | |

- *Developed an in vivo pre-clinical model to test research hypothesis that loss of muscle function (often caused by fatigue or injury) leads to increased loading across the intervertebral disc.*
- *Demonstrated that muscle fatigue can lead to altered kinematics and compensation in pre-clinical model.*
- *Managed a project team of six graduate and undergraduate students towards strategic aims.*

Research Assistant, Functional Tissue Engr Lab Rensselaer Polytechnic Institute Troy, NY

May 2004 – May 2006

- *Designed and developed instrumentation for electrical characterization of composite biological materials.*
- *Major contributor on first team of researchers to demonstrate an increase in electrical conductivity through carbon nanotube incorporation into biological collagen composites.*
- *Analyzed composites to assess impact on cellular viability, material interactions and material properties.*

Major Qualifying Project Worcester Polytechnic Institute Worcester, MA

August 2002 – May 2003

- *Designed and fabricated a six degree of freedom radiolucent external fracture fixation device for alignment of highly comminuted fractures.*

NSF Research Experience for Undergraduates Massachusetts Institute of Technology Cambridge, MA

May 2002 – August 2002

- *Investigated the effect of cyclic mechanical loading on chondrocytes in bovine cartilage plugs in vitro in Dr. Alan Grodzinsky's Lab.*

Teaching Experience

Instructor of Record, School of Engineering University of Florida Gainesville, FL

Summer 2015

- *Designed and developed the Biomedical Engineering component of the college-wide Introduction to Engineering course by incorporating novel teaching techniques including flipped classrooms and team based learning to increase student understanding of topics.*
- *Created learning objectives and appropriate evaluation methods to ensure widespread comprehension of the material and enable adequate assessment.*
- *Mentored two teaching assistants to develop skills in lecturing and assessment techniques to improve their teaching abilities.*

Teaching Assistant, School of Engineering Rensselaer Polytechnic Institute Troy, NY

August 2009 – December 2012

- *Held weekly office hours to provide students with an expert resource on course material.*
- *Assisted in grading all course assignments and helped proctor exams.*
- *Aided in the following courses: Biomedical Engineering Senior Design Capstone, Mechanobiology, Biomaterial Applications in Medicine, Tissue-Biomaterial Interactions.*

Math and Science Tutor Big Mind Learning Cohoes, NY

February 2010 – September 2011

- *Used traditional and alternative teaching strategies to help struggling students succeed with Algebra, Geometry, AP Physics and improve standardized test scores.*

Teaching Assistant, School of Engineering Rensselaer Polytechnic Institute Troy, NY

August 2003 – May 2004

- *Held weekly office hours to provide students with an expert resource on course material.*
- *Assisted in grading all course assignments and helped proctor exams.*
- *Aided in the following courses: Biomedical Engineering Senior Design Capstone, Introduction to Thermodynamics*

Work Experience

Senior Engineer, Research and Development RTI Surgical, Inc. Alachua, FL

February 2013 – June 2014

- *Led large multi-company, multi-national, multi-disciplinary project team through entire product design life cycle; pre-clinical study, 510(k) regulatory submission, design control process, manufacture, and launch.*

- *Worked in close collaboration with early stage research team to identify unique areas of opportunity and develop concept stage projects to fill these voids.*
- *Collaborated with clinicians in the fields of orthopaedics, neurosurgery, reconstructive surgery, and wound care to understand real-world problems and brainstorm innovative solutions within the realm of the RTI Surgical business model.*
- *Created novel mechanical characterization strategies to validate new human and animal derived biologic tissue products adequately met user needs.*

Advanced Imaging Microscopy Specialist

Carl Zeiss Inc., Microimaging

Thornwood, NY

October 2006 – July 2009

- *Generated \$5.5 million in revenue by identifying customer imaging technology needs and leveraging networking and interpersonal skills.*
- *Expanded customer base by providing expert training and support in: 1) Microscope hardware installation and maintenance, 2) Image acquisition and image processing, and 3) Quantitative image analysis techniques.*
- *Actively participated as a member of a 12 person U.S. team that provided valuable input for a major software overhaul leading to dramatic improvement in ease of use and functionality.*

Microscopy Technician

Marine Biology Laboratory

Woods Hole, MA

June 2006 – September 2006

- *Enabled more than 25 Ph.D.-level researchers by providing in-kind support on laser scanning microscopes, light microscopes, scanning electron microscopes and transmission electron microscopes for data collection to be submitted in publications and grant applications.*

Patents

Schmidt CE, Cornelison RC, **Wachs RA**. Submitted July 2016. PCT/US2016/42273. Apoptosis-Assisted Method of Tissue Decellularization.

Ledet EH, **Wachs RA**, Cole KP, Fiorella D. Submitted February 2012. PCT/US2013/024706. Sensor System, Implantable Sensor and Method for Remote Sensing of a Stimulus In Vivo.

Stegemann, JP, **MacDonald RA**, Laurenzi BF. Provisional Patent (2004). Tissue Substitutes Compromising Living Cells, Hydrogel Matrix and Carbon Nanotubes.

Publications

Wachs RA, Hoogenboezem EN, Huda HI, Xin S, Porvasnik, SL, Schmidt CE. Creation of an injectable in situ gelling native extracellular matrix for nucleus pulposus tissue engineering. *The Spine Journal*. 2016, In Press.

Ledet EH, Peterson JM, **Wachs RA**, Grabowsky MBM, Glennon JC, DiRisio DJ. Direct Measure of Cervical Interbody Forces In Vivo: Load Reversal After Plating. *The Spine Journal*. 2016; 16(10S):S238-9.

Wachs RA, Ellstein D, Drazan J, Healey CP, Uhl RL, Connor, KA, Ledet EH. Elementary implantable force sensor—for smart orthopaedic implants. *Advances in Biosensors and Bioelectronics*. 2013; 2(4).

Ledet EH, D’Lima D, Westerhoff P, Szivek J, **Wachs RA**, Bergmann G. Implantable sensor technology: from research to clinical practice. *J Am Acad Orthop Surg*. 2012; 20(6):383-392.

Wachs RA, Grabowsky MBM, Glennon J, Ledet EH. *In Vivo* Loads in the Cervical Spine: A preliminary investigation using a force-sensing implant. *The Spine Journal*. 2012; 12(9), S141.

Wachs RA, Michna VM, Ledet EH. Three-dimensional morphometry of human cervical endplates. *The Spine Journal*. 2012; 12(9), S141-S142.

Grabowsky MBM, Pallotta NA, Connelly MW, Van Etten B, **MacDonald RA**, Alley M, Glennon JC, Dubin AH, German JW, Uhl RL, Ledet EH. The potential role of extensor muscle fatigue in the onset of intervertebral disc degeneration: A novel in vivo model. *The Spine Journal*. 2010; 10(9S):74S-5S.

MacDonald RA, Voge CM, Kariolis M, Stegemann JP. Carbon nanotubes increase the electrical conductivity of fibroblast-seeded collagen hydrogels. *Acta Biomaterials*. 2008 Jul;4:1583-1592.

Voge CM, Kariolis M, **MacDonald RA**, Stegemann JP. Directional conductivity in SWNT-collagen-fibrin composite biomaterials through strain-induced matrix alignment. *J Biomed Mater Res A*. 2008 Jul;86(1):269-77.

Laraia K, Leone N, **MacDonald RA**, Blanchet TA. Effect of water and serum absorption on wear of unirradiated and crosslinked UHMWPE orthopedic bearing materials. *Tribology Transactions*. 2006; 49: 338-346.

MacDonald RA, Laurenzi BF, Viswanathan G, Ajayan PM, Stegemann JP. Collagen-carbon nanotube composite materials as scaffolds in tissue engineering. *J Biomed Mater Res A*. 2005 Sep 1;74(3):489-96.

Podium Presentations

Mertz MW, Cornelison RC, **Wachs RA**, Cerqueira SR, Lee YS, Bunge MB, and Schmidt CE. Novel Injectable Acellular Peripheral Nerve Scaffold Supports Schwann Cell therapies for Spinal Cord Injury Repair. 2016 Regenerative Medicine Workshop. Hilton Head, SC, March 2016.

Wachs, RA, Schmidt CE. Creation of Novel Hydrogels to Reverse and Prevent Disc Innervation and Pain. University of Florida 2015 Postdoctoral Research Symposium. Gainesville, FL, April 2015.

Moore S, **Wachs RA**, Qiu QQ, Michaelson J. Comparison of Bacterial Clearance with Contaminated Biologic and Synthetic Mesh Implants in a Rat Abdominal Hernia Model. Proceedings of the 8th Annual Symposium on Biologic Scaffolds for Regenerative Medicine. Napa, CA, April 2014.

Wachs RA, Cole KP, Ellstein D, Fiorella DB, Connor K, Ledet EH. A Force Sensor With No Electrical Connections For Orthopaedic Smart Implants. Proceedings of the 2012 Orthopaedic Research Society Meeting. San Francisco, CA, February 2012.

Ledet EH, Helder C, Grabowsky MBM, **Wachs RA**, Leimer E, Cole K, Dubin A, Glennon JC. Factors That Affect Loading in the Spine *In Vivo* as Measured With a Novel Force-sensing Implant. Proceedings of the 2011 Biomedical Engineering Society Meeting. Hartford, CT, October 2011.

Wachs RA, Cole KP, Fiorella DL, Alley M, Ledet EH. Design, Fabrication and Characterization of Miniature Passive Wireless Force Sensors. Proceedings of the 37th Annual Northeast Bioengineering Conference. Troy, NY, April 2011.

Grabowsky MBM, Pallotta NA, Connelly MW, Van Etten B, **MacDonald RA**, Alley M, Glennon JC, Dubin AH, German JW, Uhl RL, Ledet EH. The Potential Role of Extensor Muscle Fatigue in the Onset of Intervertebral Disc Degeneration: a Novel *In Vivo* Model. Proceedings of the 25th Annual Meeting of the North American Spine Society. Orlando, FL, October, 2010.

Voge CM, Kariolis M, **MacDonald RA**, Stegemann JP. Directional Conductivity in Protein-Nanotube Biomaterials through Strain-Induced Matrix Alignment. 8th World Biomaterials Congress. Amsterdam, Netherlands, June 2008.

Poster Presentations

Spearman BS, **Wachs RA**, Desai V, Shafor C, Graham J, Atkinson E, Nunamaker E, Otto K, Schmidt CE, Judy J. Development of Mechanically Tunable Hydrogel Scaffolds for a Regenerative Peripheral Nerve Interface. IEEE Engineering in Medicine and Biology Conference. Orlando, FL, August 2016.

Desai V, Shafor C, Spearman BS, **Wachs RA**, Graham J, Atkinson E, Nunamaker E, Otto K, Schmidt CE, Judy J. Design and Fabrication of a Scalable Tissue-Engineered Electronic Nerve Interface (TEENI). IEEE Engineering in Medicine and Biology Conference. Orlando, FL, August 2016.

Graham J, Atkinson E, Nunamaker E, Spearman BS, **Wachs RA**, Desai V, Shafor C, Otto K, Schmidt CE, Judy, J. Histological Evaluation of Implanted Tissue-Engineered Electronic Nerve Interface (TEENI) Devices. IEEE Engineering in Medicine and Biology Conference. Orlando, FL, August 2016.

Wachs RA, Hoogenboezem EN, Schmidt CE. Novel Biomaterials to Prevent Innervation: Implications to Reduce Painful Disc Degeneration. Proceedings of the 2016 Orthopedic Research Society Meeting. Orlando, FL, March 2016.

Spearman BS, **Wachs RA**, Schmidt CE. Mechanically-tunable Natural Hydrogel Scaffolds for Peripheral Nerve Regeneration. 2016 Regenerative Medicine Workshop. Hilton Head, SC, March 2016.

Wachs RA, Xin S, Huda HI, Hoogenboezem EN, Stanton DN, Porvasnik SP, Schmidt CE. Targeted Engineering of the Nucleus Pulposus Using a Tissue Specific Acellular Matrix. Biomedical Engineering Society 2015 Annual Meeting. Tampa, FL, October 2015.

Cornelison RC, Park JH, **Wachs RA**, Wellman, Schmidt CE. Harnessing Apoptosis for Enhanced Tissue Preservation During Decellularization. Biomedical Engineering Society 2015 Annual Meeting. Tampa, FL, October 2015.

Wachs, RA, Cornelison RC, Xin S, Schmidt CE. Development of a Proteoglycan Rich Matrix for Nucleus Pulposus Regeneration. 2015 Regenerative Medicine Workshop. Hilton Head, SC, May 2015.

Wachs RA, Hyyti A, Cornelison RC, Schmidt CE. Development of a Tissue Specific Acellular Extracellular Matrix for Intervertebral Disc Regeneration Using a Gentle Decellularization Process. Society for Biomaterials 2015 Annual Meeting. San Antonio, TX, April 2015.

Wachs RA, Michna VM, Ledet EH. Three Dimensional Morphometry of Human Cervical Endplates. Proceedings of the 2012 North American Spine Society Meeting. Dallas, TX, October 2012.

Grabowsky MBM, **Wachs RA**, Helder CW, Leimer E, Cole K, Glennon JC, Dubin A, Uhl RL, Ledet EH. *In Vivo* Loads in the Cervical Spine: A Preliminary Investigation Using a Force-Sensing Implant. Proceedings of the 2012 North American Spine Society Meeting. Dallas, TX, October 2012.

Wachs RA, Michna VM, Ledet EH. Human Cervical Vertebral Endplate Morphometry: Variation by Gender and Age. Proceedings of the 2012 Orthopaedic Research Society Meeting. San Francisco, CA, February 2012.

Grabowsky MB M, **Wachs RA**, Helder CW, Dubin A, Glennon JC, Leimer E, Cole K, Uhl RL, Ledet EH. Posture and Motion Technique Modulate Interbody Forces in the Cervical Spine: Direct *In Vivo* Measurements Using a Force-Sensing Implant in the Goat. Proceedings of the 2012 Orthopaedic Research Society Meeting. San Francisco, CA, February 2012.

Helder CW, Grabowsky MB, **Wachs RA**, Leimer E, Cole K, Dubin A, Glennon JC, Ledet EH. Behavior Compensation Reduces Loads in the Cervical Spine Measured With a Force-Sensing Implant. Proceedings of the 37th Annual Northeast Bioengineering Conference. Troy, NY, April 2011.

Grabowsky MB, Pallotta NA, Connelly MW, Van Etten B, **MacDonald RA**, Alley M, Glennon JC, Dubin AH, German JW, Uhl RL, Ledet EH. A Novel *In Vivo* Model To Characterize The Role Of Extensor Muscle Fatigue In The Onset Of Intervertebral Disc Degeneration. Proceedings of the 2nd Annual World Forum for Spine Research. Montreal, QP, Canada, July 2010.

MacDonald RA, Voge C, Ajayan PM, Stegemann JP. Collagen-Carbon Nanotube Composite Biomaterials. Society for Biomaterials 2007 Annual Meeting. Chicago, IL, April 2007.

MacDonald RA and Stegemann JP. Electrically Conductive Biopolymers Incorporating Carbon Nanotubes. Society for Biomaterials 2006 Annual Meeting. Pittsburgh, PA, April 2006.

Invited/Guest Lectures

Wachs RA, Novel Biomaterial Solutions for the Treatment of Low Back Pain. Society for Biomaterials Student Chapter Meeting, University of Florida, October 2016.

Wachs RA, Clinically Relevant Solutions for the Treatment of Low Back Pain. Student Science Training Program, Center for Precollegiate Education and Training, University of Florida, July 2016.

Wachs, RA, Neural Tissue Engineering. Tissue Engineering Course, University of Florida, Gainesville, FL, April 2015.

Wachs RA, Things I didn't learn in school. Graduate Seminar Course, University of Florida, Gainesville, FL, November 2014.

Wachs RA, Intervertebral Disc Anatomy and Pathology, Clinical Orthopaedics, Rensselaer Polytechnic Institute, Troy, NY, November 2011.

MacDonald RA, The Effects of Primary Extensor Muscle Fatigue on Axial Forces in the Spine: Direct *In Vivo* Measurements. Animal Resource Facility, Albany Medical College, Albany, NY, February 2011.

MacDonald RA, Collagen: The Key Structural ECM Protein, Engineering of the Extracellular Matrix, Rensselaer Polytechnic Institute, Troy, NY, March 2006.

Honors and Awards

- Invited Rapporteur at the National Academies of Science, Engineering, and Medicine Roundtable on Biomedical Engineering Materials and Applications, 2016
- Recipient of the University of Florida BME Department Travel Award, 2014, 2015
- Recipient of the Biomedical Engineering Society BME Innovation and Career Development Award, 2014
- Lemelson-MIT Rensselaer Student Prize Finalist for Implantable Sensor, 2013

- Recipient of the American Association of University Women American Dissertation Fellowship, 2011-2012
- Recipient of the Rensselaer Founders Award for Excellence, 2011
- Meister for Carl Zeiss Microimaging, Inc., #1 in Nationwide Sales Performance, 2007
- National Science Foundation Graduate Research Fellow, Honorable Mention, 2003
- Member of Tau Beta Pi Honor Society, Inducted in 2003
- Recipient Foundry Educational Foundation Fellowship, 2002

Leadership and Community Activities

- Outreach Coordinator, University of Florida/Girls Place, Inc., May 2015-August 2016
 - Created a program to engage young girls in Science Technology Engineering and Mathematics (STEM) through the use of interactive lectures, design problems, and laboratory experiments.
 - Design, develop, and coordinate monthly visits to 20-30 6th and 7th grade girls at the Girls Place, Inc..
 - Mentor students and postdoctoral associates to implement this program and serve as positive role models to the young women at Girls Place, Inc..
- Three Minute Thesis Judge, University of Florida, 2015-2016
- Outreach Coordinator, Schmidt Lab, University of Florida, 2014-2016
 - Mentor graduate and undergraduate students in the lab to design and develop outreach activities at local elementary and middle schools that encourage children to consider pursuing a career in STEM.
 - Activities to date have included an anatomy lecture and lab with 3rd and 4th grades, as well as a two whole day visits to a 7th grade classroom to give lectures and labs on: 1) the nervous system, injury, and repair, and 2) the scientific method.
- Postdoctoral Affairs Advisory Committee Member, University of Florida, 2014-2016
- Graduate Student Research Day Judge, University of Florida, 2014-2016
- Science Fair Judge, Alachua County, 2013-2016
- InvenTeams Judge, Lemelson-MIT Eureka Fest, Summer 2013
- Industry Seminar Coordinator, Biomedical Engineering Department, 2011-2013
- AAU Girl's Basketball Coach, Albany Capitals, 2004-2012
- Weekly Dog Care Volunteer at Mohawk Hudson River Humane Society, 2011
- Exploring Engineering Day Instructor, 2011
- Science Olympiad Volunteer Instructor, 2006
 - Enabled 6th and 7th grade students to master the topics of Food Science, and The Physics of Waves over the course of a semester in preparation for a multi-school competition.
- Biomedical Engineering Graduate Council Chair, Rensselaer Polytechnic Institute, 2005
- Captain WPI Women's Basketball Team, 2002-2003
- Chair of the WPI Student Athlete Advisory Council, 2001-2003

Professional Societies

- Biomedical Engineering Society
- Orthopaedic Research Society
- Society for Biomaterials