

# Robert J. Webster III, Ph.D.

Richard A. Schroeder Professor of Mechanical Engineering, Vanderbilt  
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Curriculum vitae last updated: August 17, 2020

## CV HIGHLIGHTS

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- Education:** Ph.D. December, 2007 Mechanical Engineering, Johns Hopkins University
- Employment:** Prof. of Mech. & Elec. Eng., Medicine, Otolaryngology, Neurological, and Urologic Surgery
- Awards:** IEEE RAS Early Career Award, NSF CAREER Award, Vanderbilt Chancellor's Faculty Fellow, IEEE Volz Award, RSS Early Career Spotlight Award  
24 Best Paper/Poster/Presentation Nominations, 13 Awards
- Publications:** 91 Refereed Journal Articles In Print or In Press  
103 Refereed Conference Papers In Print or In Press
- Funding:** \$16,320,485 in sponsored research as PI or Vanderbilt PI or conducted in my lab  
\$40,800,206 in sponsored research for all projects in which I have been involved  
4 NIH R01 Grants (and a 5th with a fundable score) and an NSF CAREER Award as PI
- Advising:** 10 Ph.D. Students Graduated  
8 Former Advisees/Co-Advisees (4 Ph.D. Students, 4 Postdocs) in Faculty Positions  
9 NSF Fellowships by Graduate Advisees, 2 NSF Fellowships by Undergrad Research Advisees
- Teaching:** Vanderbilt Engineering Award for Excellence In Teaching (i.e. "Teacher Of The Year"), 2014  
105 Undergraduate Research Projects Supervised  
38 Undergraduate Co-Authorships on Peer-Reviewed Publications (8 As First Author)  
Created new Certificate Program in Surgery and Interventional Engineering
- External Service:** Associate Editor: IEEE Transactions Robotics, International Journal of Robotics Research  
Charter Member, NIH BMIT-B Study Section and NIH IGIS Study Section  
Chair, SPIE Image-Guided Procedures, Robotic Interventions, and Modeling Conference  
Associate Editor, IEEE BioRob and IEEE IROS Conferences  
Reviewer of 89 Journal Manuscripts
- Internal Service:** Founder and Steering Committee Member, Vanderbilt Institute for Surgery and Engineering  
University Graduate Faculty Council, ME Department Graduate Committee  
School of Eng. Entrepreneurship Task Force, Incentives, and Diversity/Mentoring Committees  
Design Curriculum Committee, 1st Year Curriculum Committee, Machine Shop Committee
- Technology Transfer:** 16 Patents Awarded  
17 Patents Pending  
16 Licenses or Options of Patents to Commercial Partners  
Founder, President, and CTO, Virtuoso Surgical, Inc.; Founder and President EndoTheia, Inc.  
\$9.5M Raised via Grants and Angel Funds for Virtuoso Surgical Inc., and EndoTheia, Inc.  
NSF I-Corps and NIH 3Ci alumnus, IMPACT and University Entrepreneurship Course instructor, Co-PI on Vanderbilt NSF I-Corps Site Grant

## EDUCATION

- Ph.D. 2007** Mechanical Engineering, Johns Hopkins University, Baltimore, MD, USA  
Dissertation: Design and Mechanics of Continuum Robots for Surgery  
Advisors: Allison M. Okamura and Noah J. Cowan
- M.S. 2004** Mechanical Engineering, Johns Hopkins University, Baltimore, MD, USA
- B.S. 2002** Electrical Engineering, Clemson University, Clemson, SC, USA  
Summa Cum Laude, Departmental Honors

## POSITIONS HELD

- 2018-present Professor, Mechanical Engineering, Vanderbilt University  
2018-present Professor, Electrical Engineering, Vanderbilt University
- 2018-present Professor, Otolaryngology, Vanderbilt University Medical Center  
2018-present Professor, Neurological Surgery, Vanderbilt University Medical Center  
2018-present Professor, Urologic Surgery, Vanderbilt University Medical Center  
2018-present Professor, Medicine (Interventional Pulmonology), Vanderbilt University Medical Center
- 2018-present President, EndoTheia, Inc.  
2016-present President and Chief Technology Officer, Virtuoso Surgical, Inc.
- 2014-2018 Associate Professor, Mechanical Engineering, Vanderbilt University  
2014-2018 Associate Professor, Otolaryngology, Vanderbilt University Medical Center  
2014-2018 Associate Professor, Electrical Engineering, Vanderbilt University  
2014-2018t Associate Professor, Neurological Surgery, Vanderbilt University Medical Center  
2014-2018 Associate Professor, Urologic Surgery, Vanderbilt University Medical Center  
2018-2018 Associate Professor, Medicine (Interv. Pulmonology), Vanderbilt University Medical Center  
2008-2014 Assistant Professor, Mechanical Engineering, Vanderbilt University  
2011-2014 Assistant Professor, Otolaryngology, Vanderbilt University Medical Center  
2013-2014 Assistant Professor, Electrical Engineering, Vanderbilt University  
2013-2014 Assistant Professor, Neurological Surgery, Vanderbilt University Medical Center  
2014-2014 Assistant Professor, Urologic Surgery, Vanderbilt University Medical Center  
2002-2007 Graduate Research Assistant, Mechanical Engineering, Johns Hopkins University  
2006 Visiting Researcher, Scuola Superiore Sant'Anna, Italy  
2001 Visiting Researcher, University of Newcastle, Australia  
2001 Research Engineer, Savannah River Technology Center  
1998-2001 Co-op Engineer, Adtran, Inc.  
1997 Intern, Georgia Power, Vogtle Nuclear Power Plant

## RESEARCH INTERESTS

Electromechanical design, modeling, and control, particularly as applied to medical systems. Image-guided surgery and medical robotics. Continuum (continuously flexible) robots. Needle-sized manipulators, and steerable needles. Devices to make surgery more accurate, easier to perform, and less invasive.

## AWARDS AND HONORS

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### *General*

- 2019 Richard A. Schroeder Chair in Mechanical Engineering, Vanderbilt University
- 2019 Visiting Scholar, University of North Carolina at Chapel Hill
- 2018 Erwin Morscher Visiting Professor, University of Basel, Switzerland
- 2018 Senior Member, SPIE
- 2016 Vanderbilt Chancellor's Faculty Fellow Award
- 2015 IEEE Robotics and Automation Society Early Career Award
- 2015 Robotics Science and Systems, Early Career Spotlight Award
- 2014 **Vanderbilt School of Engineering Award for Excellence in Teaching**
- 2014 IEEE Senior Member
- 2011 National Science Foundation CAREER Award
- 2011 IEEE Volz Award
- 2007 Semifinalist, Damon Runyon-Rachleff Innovation Award
- 2003-2007 National Science Foundation Fellowship
- 2002-2005 National Defense Science and Engineering Graduate Fellowship
- 2003 Best Project, Advanced Computer Integrated Surgery
- 2002 Tau Beta Pi Graduate Fellowship
- 2002 Rhodes Most Outstanding Undergraduate Engineer, Clemson University
- 1999-2002 Most Outstanding Electrical Engineer, Clemson University (3 times)
- 1997-2002 Dixon Fellow, Clemson University
- 2000 Tau Beta Pi Member, Eta Kappa Nu Member, Tau Beta Pi Scholarship

### *Best Paper/Poster/Presentation Awards (Presentation awards won by my students included)*

- 2019 **Best Video Finalist** – American Association of Gynecologic Laparoscopists Annual Meeting
- 2019 **Best Paper Award** – Engineering & Urology Society Annual Meeting
- 2019 **Best Poster/Pres. 2nd Place** – Design of Medical Devices Conf. (3 in 5 Competition)
- 2017 **Best Poster/Presentation Finalist** – Design of Medical Devices Conf. (3 in 5 Competition)
- 2017 **Best Paper** – IEEE ICRA C4 Workshop
- 2016 **Best Paper of the Year** – VU School of Engineering (to my students Gilbert & Hendrick)
- 2016 **Best Poster** – Southeastern Medical Device Association Conference
- 2016 **Best Commercialization Plan Runner Up** – Launch Tennessee Statewide Competition
- 2016 **Best Commercialization Plan** – Vanderbilt TechVenture Challenge
- 2016 **Best Paper Runner Up** (Young Scientist Award) SPIE
- 2015 **Best Basic Science Paper** Endourological Society & the Journal of Endourology
- 2015 **Best Oral Presentation** – Hamlyn Symposium (to my student Swaney)
- 2015 **Valuation Competition Runner Up** – Design of Medical Devices Conference
- 2014 **Best Application Paper Finalist** – IEEE/RSJ Int'l. Conf. Intelligent Robots and Systems
- 2013 **Best Medical Robotics Paper Finalist** – IEEE Int'l. Conf. Robotics and Automation
- 2013 **Best Poster/Presentation** – Design of Medical Devices Conf. (3 in 5 Competition)
- 2012 **Best Medical Robotics Paper Finalist** – IEEE Int'l. Conf. Robotics and Automation
- 2012 **Best Paper** – American Society of Engineering Education Conf., ME Division
- 2012 **Best Poster/Presentation** – Design of Medical Devices Conf. (3 in 5 Competition)
- 2010 **Best Paper of the Year** – VU School of Engineering (to my student Rucker)
- 2010 **Best Poster/Presentation Finalist** – Design of Medical Devices Conf. (3 in 5 Competition)
- 2009 **Best Poster/Presentation** – Design of Medical Devices Conf. (3 in 5 Competition)
- 2006 **Best Paper Finalist** – IEEE/RSJ Int'l. Conf. Intelligent Robots and Systems
- 2002 **Best Paper** – IEEE Piedmont Student Paper Competition

## PUBLICATIONS

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### Journal Articles

- [J1] F. Campisano, A. Ramirez, C. A. Landewee, S. Calo, K. Obstein, R. J. Webster III, and P. Valdastri. Teleoperation and Contact Detection of a Waterjet-Actuated Soft Continuum Manipulator for Low-Cost Gastroscopy. *IEEE Robotics and Automation Letters*, In Press.
- [J2] L. Harvey, R. Hendrick, N. Dillon, E. Blum, L. Branscombe, S. Webster, R. J. Webster III, and T. Anderson. A Novel Robotic Endoscopic Device Used for Operative Hysteroscopy. *Journal of Minimally Invasive Gynecology*, In Press.
- [J3] W. G. Morrel, K. E. Riojas, R. J. Webster III, J. H. Noble, and R. F. Labadie. Custom Mastoid-Fitting Templates to Improve Cochlear Implant Electrode Insertion Trajectory. *International Journal of Computer Assisted Radiology and Surgery*, In Press.
- [J4] J. Gafford, M. Freeman, L. Fichera, J. H. Noble, R. Labadie, and R. J. Webster III. Eyes in Ears: A Miniature Steerable Digital Endoscope for Trans-Nasal Diagnosis of Middle Ear Disease. *Annals of Biomedical Engineering*, In Press.
- [J5] J. M. Ferguson, E. B. Pitt, A. A. Ramirez, M. A. Siebold, A. Kuntz, N. L. Kavoussi, E. J. Barth, S. D. Herrell III, and R. J. Webster III. Toward Practical and Accurate Touch-Based Image Guidance for Robotic Partial Nephrectomy. *IEEE Transactions on Medical Robotics and Bionics*, In Press.
- [J6] A. Kuntz, A. Sethi, R. J. Webster III, and R. Alterovitz. Learning the Complete Shape of Concentric Tube Robots. *IEEE Transactions on Medical Robotics and Bionics*, In Press.
- [J7] J. Till, V. Aloï, K. E. Riojas, P. L. Anderson, R. J. Webster III, and D. C. Rucker. A Dynamic Model for Concentric Tube Robots. *IEEE Transactions on Robotics*, In Press.
- [J8] F. Campisano, A. A. Ramirez, S. Calo, J. J. Chandler, K. L. Obstein, R. J. Webster III, and P. Valdastri. Online Disturbance Estimation for Improving Kinematic Accuracy in Continuum Manipulators. *IEEE Robotics and Automation Letters*, In Press.
- [J9] P. L. Anderson, R. J. Hendrick, M. F. Rox, and R. J. Webster III. Exceeding Traditional Curvature Limits of Concentric Tube Robots Through Redundancy Resolution. *International Journal of Robotics Research*, In Press.
- [J10] T. L. Bruns, K. E. Riojas, Ropella D. S, M. S. Cavilla, A. J. Petruska, M. H. Freeman, R. F. Labadie, J. J. Abbott, and R. J. Webster III. Magnetically Steered Robotic Insertion of Cochlear-Implant Electrode Arrays: System Integration and First-In-Cadaver Results. *IEEE Robotics and Automation Letters*, 5(2):2240–2247, 02/2020 2020.
- [J11] M. F. Rox, D. S. Ropella, R. J. Hendrick, E. Blum, R. P. Naftel, H. C. Bow, S. D. Herrell, K. D. Weaver, L. B. Chambless, and R. J. Webster III. Mechatronic Design of a Two-Arm Concentric Tube Robot System for Rigid Neuroendoscopy. *IEEE Transactions on Mechatronics*, 25(3):1432–1443, 02/2020 2020.
- [J12] J. B. Gafford, S. Webster, N. Dillon, E. Blum, R. Hendrick, F. Maldonado, E. A. Gillaspie, O. B. Rickman, S. D. Herrell, and R. J. Webster III. A Concentric Tube Robot System for Rigid Bronchoscopy: A Feasibility Study on Central Airway Obstruction Removal. *Annals of Biomedical Engineering*, 48(1):181–191, 2019.
- [J13] P. S. Wellborn, P. T. Russell, and R. J. Webster III. A multi-subject accuracy study on granular jamming for non-invasive attachment of fiducial markers to patients. *International Journal of Computer Assisted Radiology and Surgery*, 15(1):69–74, 07/2019 2019.
- [J14] I. S. Godage, R. J. Webster III, and I. D. Walker. Center-of-Gravity-Based Approach for Modeling Dynamics of Multisection Continuum Arms. *IEEE Transactions on Robotics*, 35(5):1097–1108, 2019.

- [J15] K. E. Riojas, P. L. Anderson, R. A. Lathrop, S. D. Herrell, D. C. Rucker, and R. J. Webster III. A Hand-Held Non-Robotic Surgical Tool with a Wrist and an Elbow. *IEEE Transactions on Biomedical Engineering*, 66(11):3176–3184, 2019.
- [J16] K. E. Riojas, R. J. Hendrick, and R. J. Webster III. Can Elastic Instability be Beneficial in Concentric Tube Robots? *Robotics and Automation Letters*, 3(3):1624–1630, 07/2018 2018.
- [J17] Y. Chen, I. S. Godage, Tsz Ho Tse, R. J. Webster III, and E. J. Barth. Characterization and Control of a Pneumatic Motor for MR-conditional Robotic Applications. *IEEE/ASME Transactions on Mechatronics*, 22(6), 2017.
- [J18] N. P. Dillon, L. Fichera, K. Kesler, M. G. Zuniga, J. E. Mitchell, R. J. Webster III, and R. F. Labadie. Pre-operative screening and manual drilling strategies to reduce the risk of thermal injury during minimally invasive cochlear implantation surgery. *Annals of Biomedical Engineering*, 45(9):2184–2195, 2017.
- [J19] M. Mizuta, T. Kurita, N. P. Dillon, E. E. Kimball, C. G. Garrett, M. P. Sivasankar, R. J. Webster III, and B. Rousseau. In-Vivo Measurement of Vocal Fold Surface Resistance. *The Laryngoscope*, 127(10):E364–E370, 2017.
- [J20] P. L. Anderson, A. Mahoney, and R. J. Webster III. Continuum Reconfigurable Parallel Robots for Surgery: Shape Sensing and State Estimation With Uncertainty. *IEEE Robotics and Automation Letters*, 2(3):1617–1624, 04/2017 2017.
- [J21] P. S. Wellborn, N. P. Dillon, P. T. Russell III, and R. J. Webster III. Coffee: the key to safer image-guided surgery— a granular jamming cap for non-invasive, rigid fixation of fiducial markers to the patient. *International Journal of Computer Assisted Radiology and Surgery*, 12(6):1069–1077, 2017.
- [J22] L. Fichera, N. P. Dillon, D. Zhang, I. S. Godage, M. A. Siebold, B. I. Hartley, J. H. Noble, P. T. Russell III, R. F. Labadie, and R. J. Webster III. Through the Eustachian Tube and Beyond: A New Miniature Robotic Endoscope to See Into The Middle Ear. *IEEE Robotics and Automation Letters*, 2(3):1488–1494, 2017.
- [J23] N. P. Dillon, R. Balachandran, M. A. Siebold, R. J. Webster III, G. B. Wanna, and R. F. Labadie. Cadaveric Testing of Robot-Assisted Access to the Internal Auditory Canal for Vestibular Schwannoma Removal. *Otology & Neurotology*, 38(3):441–447, 2017.
- [J24] L. B. Kratchman, T. L. Bruns, J. J. Abbott, and R. J. Webster III. Guiding Elastic Rods with a Robot-Manipulated Magnet for Medical Applications. *IEEE Transactions on Robotics*, 33(1):227–233, 2017.
- [J25] M. A. Siebold, N. P. Dillon, L. Fichera, R. F. Labadie, R. J. Webster III, and J. M. Fitzpatrick. Safety Margins in Robotic Bone Milling: From Registration Uncertainty to Statistically Safe Surgeries. *The International Journal of Medical Robotics and Computer Assisted Surgery*, 13(3), 2017.
- [J26] D. B. Comber, E. B. Pitt, H. B. Gilbert, M. W. Powelson, E. Matijevich, J. S. Neimat, R. J. Webster III, and E. J. Barth. Optimization of Curvilinear Needle Trajectories for Transforaminal Hippocamptomy. *Operative Neurosurgery*, 13(1):15–22, 2017.
- [J27] Philip J. Swaney, Arthur W. Mahoney, Bryan I. Hartley, Andria A. Ramirez, Erik P. Lamers, Richard H. Feins, Ron Alterovitz, and Robert J. Webster III. Toward Transoral Peripheral Lung Access: Combining Continuum Robots and Steerable Needles. *Journal of Medical Robotics Research*, 2(1):1750001, 2017.
- [J28] A. L. Tam, H. J. Lim, I. I. Wistuba, A. Tamrazi, M. D. Kuo, E. Z iv, S. Wong, A. J. Shih, R. J. Webster III, G. S. Fischer, S. Nagrath, S. E. Davis, S. B. White, and K. Ahrar. Image-guided biopsy in the era of personalized cancer care: Proceedings from the society of interventional radiology research consensus panel. *Journal of Vascular and Interventional Radiology*, 27(1):8–19, 2016.

- [J29] C. R. Mitchell, R. J. Hendrick, R.J. Webster III, and S. D. Herrell. Toward Improving Transurethral Prostate Surgery: Development and Initial Experiments with a Prototype Concentric Tube Robotic Platform. *Journal of Endourology*, 30(6):692–696, 2016. **Best Basic Science Paper, Endourology Fellows Competition.**
- [J30] P. S. Wellborn, P. J. Swaney, and R. J. Webster III. Curving Clinical Biopsy Needles: Can We Steer Needles and Still Obtain Core Biopsy Samples? *ASME Journal of Medical Devices*, 10(3):030904, 2016.
- [J31] P. J. Swaney, P. A. York, H. B. Gilbert, J. Burgner-Kahrs, and R. J. Webster III. Design, Fabrication, and Testing of a Needle-sized Wrist for Surgical Instruments. *ASME Journal of Medical Devices*, 11(1):014501–9, 12/2016 2016.
- [J32] N. P. Dillon, J. E. Mitchell, M. G. Zuniga, R. J. Webster III, and R. F. Labadie. Design and Thermal Testing of an Automatic Drill Guide for Less Invasive Cochlear Implantation. *ASME Journal of Medical Devices*, 10(2):020923, 2016.
- [J33] Y. Zhu, P. J. Swaney, I. S. Godage, R. A. Lathrop, and R. J. Webster III. A Disposable Robot for Intracerebral Hemorrhage Removal. *ASME Journal of Medical Devices*, 10(2):020952, 2016.
- [J34] E. B. Pitt, D. B. Comber, Y. Chen, J. S. Neimat, R. J. Webster III, and E. J. Barth. Follow-the-Leader Deployment of Steerable Needles Using a Magnetic Resonance-Compatible Robot with Stepper Actuators. *ASME Journal of Medical Devices*, 10(2):020945, 2016.
- [J35] P. L. Anderson, R. A. Lathrop, and R. J. Webster III. Robot-Like Dexterity Without Computers and Motors: A Review of Hand-Held Laparoscopic Instruments with Wrist-Like Tip Articulation. *Expert Review of Medical Devices*, 13(7):661–672, 06/2016 2016.
- [J36] P. L. Anderson, R. A. Lathrop, S. D. Herrell, and R. J. Webster III. Comparing a Mechanical Analogue with the da Vinci User Interface: Suturing at Challenging Angles. *IEEE Robotics and Automation Letters*, 1(2):1060–1065, 2016.
- [J37] J. Granna, I. S. Godage, R. Wirz, K. D. Weaver, R. J. Webster III, and J. Burgner-Kahrs. A 3D Volume Coverage Path Planning Algorithm with Application to Intracerebral Hemorrhage Evacuation. *IEEE Robotics and Automation Letters*, 1(2):876–883, 2016.
- [J38] H. Su, G. Li, D. C. Rucker, R. J. Webster III, and G. S. Fischer. Concentric Tube Continuum Robot with Piezoelectric Actuation for MRI-Guided Closed-loop Targeting. *Annals of Biomedical Engineering*, 44(10):2863–2873, 2016.
- [J39] R. Ong, C. L. Glisson, J. Burgner-Kahrs, A. Simpson, A. Danilchenko, R. Lathrop, S. D. Herrell, R. J. Webster III, M. I. Miga, and R. L. Galloway. A Novel Method for Texture-mapping Conoscopic Surfaces for Minimally Invasive Image-guided Kidney Surgery. *International Journal for Computer Assisted Radiology and Surgery*, 11(8):1515–1526, 2016.
- [J40] H. B. Gilbert and R. J. Webster III. Rapid, Reliable Shape Setting of Superelastic Nitinol for Prototyping Robots. *IEEE Robotics and Automation Letters*, 1(1):98–105, 2016.
- [J41] H. B. Gilbert, R. J. Hendrick, and R. J. Webster III. Elastic Stability of Concentric Tube Robots: A Stability Measure and Design Test. *IEEE Transactions on Robotics*, 32(1):20–35, 2016. **Best Student Paper of 2016, Vanderbilt School Of Engineering.**
- [J42] I. S. Godage, R. Wirz, I. D. Walker, and R. J. Webster III. Accurate and Efficient Dynamics for Variable Length Continuum Arms: A Center of Gravity Approach. *Soft Robotics*, 2(3):96–106, 2015.
- [J43] R. J. Hendrick, C. R. Mitchell, S. D. Herrell, and R. J. Webster III. Hand-Held Transendoscopic Robotic Manipulators: A Transurethral Laser Prostate Surgery Case Study. *International Journal of Robotics Research*, 34(15):1559–1572, 2015.

- [J44] N. P. Dillon, R. Balachandran, J. M. Fitzpatrick, M. A. Siebold, R. F. Labadie, G. B. Wanna, T. J. Withrow, and R. J. Webster III. A Compact Bone-Attached Robot for Mastoidectomy. *ASME Journal of Medical Devices*, 9(3):031003, 2015.
- [J45] E. P. Lamers, A. A. Ramirez, P. J. Swaney, and R. J. Webster III. A Bronchial Puncture Mechanism for Transoral Access to the Lung Parenchyma. *ASME Journal of Medical Devices*, 9(3):030921, 2015.
- [J46] A. Sarkar, R. J. Hendrick, R. A. Lathrop, B. Alvis, and R. J. Webster III. Design of a Safer Tracheostomy Tube. *ASME Journal of Medical Devices*, 9(2):020939, 2015.
- [J47] H. B. Gilbert, J. Neimat, and R. J. Webster III. Concentric Tube Robots as Steerable Needles: Achieving Follow-The-Leader Deployment. *IEEE Transactions on Robotics*, 31(2):246–258, 2015.
- [J48] P. J. Swaney, H. B. Gilbert, R. J. Webster III, P. T. Russell III, and K. D. Weaver. Endonasal Skull Base Tumor Removal Using Concentric Tube Continuum Robots: A Phantom Study. *Journal of Neurological Surgery Part B: Skull Base*, 76(2):145–149, 2015.
- [J49] R. Wirz, L. Torres, P. J. Swaney, H. B. Gilbert, R. Alterovitz, R. J. Webster III, K. D. Weaver, and P. T. Russell III. An Experimental Feasibility Study on Robotic Endonasal Telesurgery. *Neurosurgery*, 76(4):479–484, 2015.
- [J50] A. A. Ramirez, R. A. Lathrop, P. T. Russell III, and R. J. Webster III. Design of a Stiff Steerable Grasper for Sinus Surgery. *ASME Journal of Medical Devices*, 9(3):030915, 2014.
- [J51] D. B. Comber, E. J. Barth, and R. J. Webster III. Design and Control of an Magnetic Resonance Compatible Precision Pneumatic Active Cannula Robot. *ASME Journal of Medical Devices*, 8(1):011003, 2014.
- [J52] H. B. Gilbert, R. Hendrick, A. Ramirez, and R. J. Webster III. A Robot for Transnasal Surgery Featuring Needle-Sized Tentacle-Like Arms. *Expert Review of Medical Devices*, 11(1):5–7, 2014.
- [J53] S. D. Herrell, R. J. Webster III, and N. Simaan. Future Robotic Platforms in Urologic Surgery: Recent Developments. *Current Opinion in Urology*, 24(1):118–126, 2014.
- [J54] J. L. Gorlewicz, J. Burgner, T. J. Withrow, and R. J. Webster III. Initial Experiences Using Vibratory Touchscreens to Display Graphical Math Concepts to Students with Visual Impairments. *Journal of Special Education Technology*, 29(2):17–26, 2014.
- [J55] J. Burgner, D. C. Rucker, H. B. Gilbert, P. J. Swaney, P. T. Russell III, K. D. Weaver, and R. J. Webster III. A Telerobotic System for Transnasal Surgery. *IEEE/ASME Transactions on Mechatronics*, 19(3):996–1006, 2014.
- [J56] S. Patil, J. Burgner, R. J. Webster III, and R. Alterovitz. Needle Steering in 3D via Rapid Replanning. *IEEE Transactions on Robotics*, 30(4):853–864, 2014.
- [J57] J. L. Gorlewicz, L. B. Kratchman, and R. J. Webster III. Haptic Paddle Enhancements and a Formal Assessment of Student Learning in System Dynamics. *ASEE Advances in Engineering Education*, 4(2):1–31, 2014.
- [J58] R. J. Hendrick, R. A. Lathrop, J. S. Schneider, and R. J. Webster III. Design of an Endonasal Graft Placement Tool for Repair of Skull Base Defects. *ASME Journal of Medical Devices*, 7(2):020916, 2013. **Best Paper/Poster Award – 3 in 5 competition.**
- [J59] J. S. Schneider, J. Burgner, R. J. Webster III, and P. T. Russell III. Robotic Surgery for the Sinuses and Skull Base: What are the Possibilities and What are the Obstacles? *Current Opinion in Otolaryngology & Head and Neck Surgery*, 21(1):11–16, 2013.
- [J60] A. L. Simpson, J. Burgner, C. L. Glisson, S. D. Herrell, B. Ma, T. S. Pfeiffer, R. J. Webster III, and M. I. Miga. Comparison Study of Intraoperative Surface Acquisition Methods for Surgical Navigation. *IEEE Transactions on Biomedical Engineering*, 60(4):1090–1099, 2013.

- [J61] P. J. Swaney, J. Burgner, H. B. Gilbert, and R. J. Webster III. A Flexure-Based Steerable Needle: High Curvature with Reduced Tissue Damage. *IEEE Transactions on Biomedical Engineering*, 60(4):906–909, 2013.
- [J62] J. L. Gorlewicz, S. Battaglia, B. F. Smith, G. Ciuti, J. Gerding, A. Menciassi, K. Obstein, P. Valdastri, and R. J. Webster III. Wireless Insufflation of the Gastrointestinal Tract. *IEEE Transactions on Biomedical Engineering*, 60(5):1225–1233, 2013.
- [J63] J. Ueda, D. B. Comber, J. Slightam, M. Turkseven, V. Gervasi, R. J. Webster III, and E. J. Barth. MRI-Compatible Fluid-Powered Medical Devices. *Dynamic Systems and Control Magazine*, 135(6):13–16, 2013.
- [J64] J. Burgner, A. L. Simpson, J. M. Fitzpatrick, R. A. Lathrop, S. D. Herrell, M. I. Miga, and R. J. Webster III. A Study on the Theoretical and Practical Accuracy of Conoscopic Holography-Based Surface Measurements: Toward Image Registration in Minimally Invasive Surgery. *International Journal of Medical Robotics and Computer Assisted Surgery*, 9(2):190–203, 2013.
- [J65] N. P. Dillon, L. B. Kratchman, M. S. Dietrich, R. F. Labadie, R. J. Webster III, and T. J. Withrow. An Experimental Evaluation of the Force Requirements for Robotic Mastoidectomy. *Otology & Neurotology*, 34(7):e93–e102, 2013.
- [J66] J. Burgner, P. J. Swaney, R. A. Lathrop, K. D. Weaver, and R. J. Webster III. Debulking From Within: A Robotic Steerable Cannula for Intracerebral Hemorrhage Evacuation. *IEEE Transactions on Biomedical Engineering*, 60(9):2567–2575, 2013.
- [J67] J. Bekeny, P. J. Swaney, R. J. Webster III, P. T. Russell, and K. D. Weaver. Forces Applied at the Skull Base During Transnasal Endoscopic Transsphenoidal Pituitary Tumor Excision. *Journal of Neurological Surgery Part B: Skull Base*, 74(6):337–341, 2013.
- [J68] D. C. Rucker, J. Das, H. B. Gilbert, P. J. Swaney, M. I. Miga, N. Sarkar, and R. J. Webster III. Sliding Mode Control of Steerable Needles. *IEEE Transactions on Robotics*, 29(5):1289–1299, 2013.
- [J69] D. Schurzig, R. F. Labadie, A. Hussong, T. S. Rau, and R. J. Webster III. Design of a Tool Integrating Force Sensing with Automated Insertion in Cochlear Implantation. *IEEE/ASME Transactions on Mechatronics*, 17(2):381–389, 2012.
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Poster/Invited/Non-refereed/Abstract Publications

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- [Oth3] M. Freeman, J. Gafford, L. Fichera, R. J. Webster III, and R. Labadie. A Steerable Trans-Eustachian Endoscope for Middle Ear Examination. *American Neurotology Society*, 2020.
- [Oth4] E. B. Pitt, J. M. Ferguson, N. L. Kavoussi, E. J. Barth, R. J. Webster III, and S. D. Herrell. Intraoperative Guidance for Robotic Partial Nephrectomy Using Surface-Based Registration: Initial Model Assessment. *Engineering and Eurology Society*, 2019. **Best Paper Award**.
- [Oth5] W. G. Morrel, K. E. Riojas, N. Narasimhan, R. J. Webster III, J. H. Noble, and R. F. Labadie. Custom Mastoid-Fitting Templates to Improve Cochlear Implant Electrode Insertion Trajectory. *American Neurotology Society 54th Annual Spring Meeting*, 2019.
- [Oth6] D. A. Watkins, A. Bernardo-Colon, R. J. Webster III, and T. S. Rex. A Blast Device for Inducing Ocular Trauma in Mouse Models. *6th Military Vision Symposium on Ocular & Vision Injury*, 2017.
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- [Oth24] D. A. Carnegie, E.M. Boctor, X. Guo, H.-J. Kang, N. Deshmukh, P. Foroughi, E. C. Burdette, R. J. Webster III, J. Burgner, and M. A. Choti. Accurate High-Intensity Focused Ultrasound Ablation in a Porcine Liver Model Through Integration of Real-Time Image Guidance, Robotic Navigation, and Elastographic Monitoring. *SAGES*, 2012.
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## Patents

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- [P15] R. A. Lathrop, R. J. Webster III, J. Netterville, A. Prasad, S. D. Herrell, “Dexterous Surgical Manipulator and Method of Use.” VU Invention VU1157. US Patent 10,653,491.
- [P14] P. J. Swaney, R. Lathrop, J. Burgner, K. Weaver, H. B. Gilbert, R. J. Webster, D. B. Comber, “System, Method, and Apparatus for Configuration, Design, and Operation of an Active Cannula Robot.” VU Invention VU14092. US Patent 10,548,630. **Optioned Once.**
- [P13] P. Swaney and R. J. Webster III, “Steerable Surgical Needle.” VU Invention VU13052. US Patent 10,548,628. **Optioned Once.**
- [P12] S. D. Herrell, R. J. Webster III, R. Lathrop, P. Swaney, R. Hendrick, “Concentric Tube Robot.” VU Invention VU16035. US Patent 10,441,371. **Licensed Once.**
- [P11] S. D. Herrell, R. J. Webster III, R. Lathrop, H. Gilbert, P. Swaney, T. Bruns, R. Hendrick, K. Weaver, A. Mahoney, P. Russell, “Modular Sterilizable Robotic System for Endonasal Surgery.” VU Invention VU16064. US Patent 10,307,214.

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[P10] S. D. Herrell, R. J. Webster III, T. Bruns, P. J. Swaney, R. Hendrick, “System and Method for Endoscopic Deployment of Robotic Concentric Tube Manipulators for Performing Surgery.” VU Invention VU13034. US Patent 10,238,457. **Licensed Once.**

[P9] R. A. Lathrop, R. J. Webster III. “Energy Balance Mechanism for Flexure Joint.” VU Invention VU14011. US Patent 10,149,694.

[P8] R. A. Lathrop, R. J. Webster III, J. Netteville, A. Prasad, S. D. Herrell, “Dexterous Surgical Manipulator And Method of Use,” VU Invention VU1157. US Patent 9,901,412.

[P7] D. B. Comber, E. J. Barth, and R. J. Webster III, “Motive Device for Use in Magnetically-Sensitive Environments.” VU Invention VU12045. US Patent 9,492,234.

[P6] D. C. Rucker and R. J. Webster III, “Continuum Robots and Control Thereof.” VU Invention VU10124. US Patent 9,289,899.

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[P4] M. Quirini, R. J. Webster III, A. Menciassi, P. Dario, “Teleoperated Endoscopic Capsule.” International Publication WO 2008/122997 Al. Patents awarded in Europe (EP 2,136,698 B1), Korea (1020097021103), Japan (JP 4977776 B2), and Germany (DE602007007995D1).

[P3] R. J. Webster III, A. M. Okamura, N. J. Cowan, and R. H. Taylor. “Active Cannula for Bio-Sensing and Surgical Intervention.” US Patent 8,152,756. Canadian Patent 2,630,061. Chinese and European Patents Pending. **Licensed Twice.**

[P2] R. J. Webster III, A. M. Okamura, N. J. Cowan, and R. H. Taylor. “Active Cannula for Bio-Sensing and Surgical Intervention.” US Patent 8,715,226. Canadian, Chinese and European Patents Pending. **Licensed Twice.**

[P1] R. J. Webster III, A. M. Okamura, N. J. Cowan, G. S. Chirikjian, K. Y. Goldberg, and R. Alterovitz, “Distal bevel-tip needle control device and algorithm.” US Patent 7,822,458. **Licensed Twice.**

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[PP17] E. Amanov, D. Ropella, N. Nimmagadda, N. Kavoussi, N. Dillon, R. Hendrick, S. Herrell, R. J. Webster III, “Suturing Method.” VU Invention VU029395.

[PP16] R. J. Webster III, and J. Gafford “Steerable Digital Endoscope” VU Invention VU20078.

[PP15] P. Swaney and R. J. Webster III, “Steerable Surgical Needle.” US Divisional Filed 10/30/2019. Invention VU13052.

[PP14] R. J. Webster III, W. Merryman, M. Bersi, G. Michaud, J. Gafford, “Sheath for Ablation Probe and Methods of Use Thereof.” PCT Application Filed 11/20/2019. VU Invention VU18063.

[PP13] Robert Webster, Trevor Bruns, “System and Method for Real-Time Cochlear Implant Localization.” US Provisional Application 62/825,548 Filed 3/28/2019. VU Invention VU18139. PCT/US2020/028835

[PP12] R. J. Webster III, T. Bruns, “System and Method for Real-Time Cochlear Implant Localization.” US Provisional Application 62/835,912. VU Invention VU18139.

[PP11] R. J. Webster III, J. Mitchell, P. Wellborn, “Magneto-rheological Brake with High Torque and Fast Response Background.” US Provisional Application 62/800,622 Filed 2/4/2019. VU Invention VU18199.

[PP10] P. Swaney, P. York, H. Gilbert, R. J. Webster III, A. Mahoney, P. Wellborn. “Surgical Device Tip with Arc Length Varying Curvature”. Patent application US20190083749. VU Invention VU15143. Published Dec. 1, 2016. **Optioned Twice.**

[PP9] R. J. Webster III, R. Lathrop, R. Hendrick, P. Wellborn, “Variable Rigidity, Conformable Apparatus for Non-Invasively Affixing Surgical Fiducials and Surgical Tools to Patients.” VU Invention VU17021. Published as US20190314112A1.

[PP8] R. J. Webster III, R. Lathrop, R. Hendrick, P. Wellborn, “Variable Rigidity, Conformable Apparatus for Non-Invasively Affixing Surgical Fiducials and Surgical Tools to Patients.” PCT Publication number WO 2018084869. VU Invention Number: VU17021. Filed Nov. 7, 2016, Published May 11, 2018.

[PP7] R. J. Webster III, D. C. Rucker, K. Riojas, K. Oliver-Butler, R. Ponten, “Surgical Device Tip with Deflectable Joint,” VU Invention number: VU18056. US Application number US20190133705A1. **Licensed Once.**

[PP6] R. J. Webster III, D. C. Rucker, K. Riojas, K. Oliver-Butler, R. Ponten, “Surgical Device Tip with Deflectable Joint,” VU Invention number: VU18056. Filed internationally as WO2019/089053. **Licensed Once.**

[PP5] R. J. Webster III, H. Gilbert, P. Swaney, R. Hendrick, R. Alterovitz, “Methods, Systems, and Computer Readable Media for Controlling a Concentric Tube Probe.” USPTO Published application number US 20180232951. VU Invention VU15157. Filed May 23, 2016, Published Aug. 16, 2018. **Optioned Once.**

[PP4] R. J. Webster III, P. Swaney, A. Remirez, B. Hartley, A. Mahoney, E. Lamers, R. Alterovitz, R. Feins, A. Kuntz, “Methods, Systems, and Computer Readable Media for Transoral Lung Access.” USPTO Published application number US 20180214010. VU Invention VU15155. Filed May 23, 2016, Published Aug. 2, 2018. **Optioned Once.**

[PP3] R. J. Webster III, A. Mahoney, P. Anderson, “Snare Tool Manipulation System,” PCT Publication number WO 2017120516. VU Invention VU16086. Filed Jan. 6, 2017. Published July 13, 2017. Nationalized in US and EPO.

[PP2] R. J. Webster III, A. Mahoney, P. Anderson, “Snare Tool Manipulator System,” VU Invention VU16086. Published as US20190015166A1.

[PP1] J. Neimat, E. J. Barth, R. J. Webster III, D. B. Comber, “System and apparatus for performing transforminal therapy.” Filed internationally as PCT/US14/65898 (published WO2015073943A1). VU Invention VU14049.

## GRANTS AND CONTRACTS

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### *Pending*

1. NIH R01 EB031568 “Saving Patients from Invasive Colectomies via Dexterous Luminal Instruments” R. J. Webster III (PI), R. Alterovitz (PI), and D. C. Rucker (PI). For \$2,777,929 over four years (4/1/21–3/31/25).
2. NIH R01 NS120518 “An MRI-Guided Steerable Needle to Replace Open Brain Surgery for Epilepsy Patients” E. J. Barth (PI), R. J. Webster III (PI), W. Grissom, D. Englot, R. Naftel, and J. Neimat. For \$2,521,722 over four years (1/1/21-12/31/24). **Scored 13th percentile.**
3. NIH R21 “A Whole-Cortex fNIR System to Shine Light on the Problem of Post-Operative Delirium” A. Bowden (PI), A. Shah, and R. J. Webster III. For \$436,508 over two years (4/1/21-3/31/23).

### *Current*

1. NIH R01 DC008408 (Renewal) “Clinical Validation and Testing of Percutaneous Cochlear Implantation” R. F. Labadie (PI), J. M. Fitzpatrick, J. Noble, B. M. Dawant and R. J. Webster III. For \$1,686,436 over four years (7/1/18–6/30/23). Webster portion approximately \$87,000.
2. NIH R01 EB023717 “Image Guided Robotic Nephron Sparing Surgery” R. J. Webster III (PI), S. D. Herrell (PI), M. I. Miga (PI). For \$1,394,189 over four years (9/1/17–5/31/21). (Additional administrative supplement of \$95,421 awarded 8/1/18.)
3. NIH R01 DC013168 “Magnetic Guidance for Improved Cochlear Implant Insertion” J. J. Abbott (PI), T. A. Ameal, R. J. Webster III, and F. Warren. For \$1,842,850 over five years (8/1/14–7/31/19. NCE to 7/31/21). *Received a perfect 10 Impact/Priority score.* Webster subcontract \$525,895.

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4. NIH R01 EB024864 “Bronchoscopic Steerable Needles for Transparenchymal Access to Lung Nodules” R. Alterovitz (PI), R. J. Webster III, R. H. Feins, J. Akulian, F. Maldonado. For \$2,059,085 over four years (9/15/17–6/30/21). Webster subcontract: \$791,267.
5. NSF IIS-1718755 “Small: Collaborative Research: A Modular Approach to Robot Systems Incorporating Compliant and Soft Elements” I. Godage (PI), I Walker, K. Galloway, and R. J. Webster III. For \$289,900 over three years (9/1/17–8/31/20). Webster subcontract: \$44,346.
6. NIH R21 DC016153 “Transnasal Diagnosis of Middle Ear Disease” R. J. Webster III (PI), R. Labadie, P. Russell, and J. Noble. For \$446,415 over two years (12/1/17–11/30/19 NCE to 11/30/20).
7. NIH R01 EB026901 “Robot-Enabled Natural Orifice Prostatectomy” R. J. Webster III (PI), S. D. Herrell (PI), and N. Miller. For \$2,136,284 over four years (4/1/19–12/31/22).
8. NIH R21 EB025258 “Actively Shimmed Needles for Interventional MRI” S. Sengupta (PI), T. L. Hoyt, and R. J. Webster III. For approximately \$638,621 over three years (8/1/18–4/30/21). Webster subcontract \$103,596.
9. NIH R41 EB028229 “Enabling Dexterous Surgery at the Tip of a Flexible Endoscope: A Low-Cost, Disposable, Steerable Sheath” R. J. Webster III (PI), J. Gafford, S. Webster, D. C. Rucker, K. Obstein. For \$222,389 over one year (8/1/19–7/31/20). NCE to 7/31/21.
10. R44 HL140709 “Reopening the Central Airway With Needle-Size Tentacle Manipulators” R. J. Hendrick (PI), R. J. Webster III, S. D. Herrell, F. Maldonado, E. Gillaspie, and O. Rickman. For \$1,497,162 over two years (8/5/19–7/31/21). Vanderbilt Subcontract \$54,485. Diversity supplement of \$96,006 awarded 5/1/19.
11. NSF EFMA-1935278 “EFRI C3 SoRo: Model-Based Design and Control of Power-Dense Soft Hydraulic Robots for Demanding and Uncertain Environments” For \$1,999,872 over three years (1/1/20–12/31/23). Webster portion approx. \$120,000.
12. NIH R44 EB024423 “A Hand-Held Robot to Cure BPH” R. J. Hendrick (PI), R. J. Webster III, S. D. Herrell, N. L. Miller, and M. Pickrell. For \$1,459,524 over two years (9/4/17–8/31/19, NCE to 8/31/20). *Received a perfect 10 Impact/Priority score.* Vanderbilt subcontract \$58,569. Administrative supplement of \$30,000 for C3i awarded 9/15/17. Diversity Supplement of \$72,004 awarded 7/9/2019.
13. NIH R44 DK126606 “Squashing the Scope Superbug: A Disposable System for ERCP that Saves Patients from Bacterial Cross-Contamination” J. B. Gafford, S. J. Webster, R. J. Webster III, K. Obstein, D. C. Rucker, P.L. Anderson, and R. L. Galloway. For \$1,157,591 over two years (8/1/20–7/31/22). Vanderbilt Subcontract \$100,357.
14. NSF IIP-1735762 “Type I: Vanderbilt University I-Corps Site” R. Grajewski (PI) and R. J. Webster III (Co-PI). For \$499,680 over five years (8/15/17–8/14/22).
15. NSF GRFP: Nine of my students have won NSF Fellowships. Each is worth approximately \$125,000 in tuition and stipend. Together these are worth approximately \$1,125,000.

*Completed*

1. R41 HL140709 “Reopening the Central Airway With Needle-Size Tentacle Manipulators” R. J. Webster III (PI), R. J. Hendrick, F. Maldonado, E. Gillaspie, and O. Rickman. For \$224,598 over one year (12/15/17–8/4/19).
2. Industry Contract from a major MedTech company for investigating robotic access to internal organs in the human body. R. J. Webster III (PI), R. Alterovitz, R. Feins, F. Maldonado, E. Gillaspie. For \$760,401 over one year (4/19–12/19).
3. Vanderbilt Discovery Grant, “Lifesaving Needle Robots for Ultra-Early Lung Cancer Interventions” R. J. Webster III (PI) and Maldonado. For \$100,000 over two years (7/1/17–6/30/19).

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4. NSF IIP-1646269 “I-Corps: Ultra Minimally Invasive Surgical Tools” R. J. Webster III (PI). For \$50,000 over one year 7/1/2016–6/30/2018, NCE until 1/1/2018.
5. NIH R21 NS091735 “Curing Epilepsy with a Needle” R. J. Webster III (PI), E. J. Barth (PI), W. A. Grissom, and J. S. Neimat. For \$426,050 over two years (6/1/15–5/31/17, NCE until 5/31/18).
6. NIH R01 DC012593 “Safe, Rapid Access to the Internal Auditory Canal for Acoustic Neuroma” R. J. Webster III (PI), J. M. Fitzpatrick, R. Balachandran, G. B. Wanna, T. J. Withrow, R. F. Labadie, B. Dawant, and B. Gibson for \$1,456,393 over four years (2/15/13–2/14/17, NCE until 2/14/18).
7. NIH R01 EB017467 “Robotic Natural Orifice Skull Base Surgery” R. J. Webster III (PI), R. Alterovitz, R. L. Galloway, P. T. Russell, and K. D. Weaver. For \$1,790,618 over four years (7/1/13–6/30/17, NCE until 6/30/18).
8. NSF CAREER IIS-1054331 “Lifesaving Robotic Tentacles” R. J. Webster III (PI). For \$400,000 over five years (7/1/11–6/30/16, NCE until 6/30/17).
9. NIH R01 DC008408 “Clinical Validation and Testing of Percutaneous Cochlear Implantation” R. F. Labadie (PI), J. M. Fitzpatrick, R. Balachandran, J. Noble, B. M. Dawant and R. J. Webster III. For \$3,048,215 over four years (7/1/12–6/30/17). Webster portion approximately \$125,000
10. VISE Seed Grant “A Multi-Needle Robot for Percutaneous Ablation” R. J. Webster III (PI). For \$40,000 over one year (12/16–6/17).
11. NIH R21 NS087796 “Debulking From Within: A Steerable Needle for Intracerebral Hemorrhage Aspiration” R. J. Webster (PI), M. I. Miga (PI), P. Williams, J. Burgner, and K. D. Weaver. For \$383,248 over two years (9/30/14–9/29/16).
12. NSF CCEFP-ERC EEC-0540834 Project “Fluid-Powered Surgery & Rehabilitation via Compact, Integrated Systems” R. J. Webster III (PI), J. Ueda (PI), E. J. Barth, and V. Gervasi. For \$888,275 over six years (6/8/10–6/7/16). Note: This was a subproject within the NSF Engineering Research Center for Compact and Efficient Fluid Power, K. A. Stelson (PI).
13. Vanderbilt Discovery Grant “Curvilinear Brain Surgery: Hope for Inoperable Patients” R. J. Webster III (PI) and K. D. Weaver. For \$100,000 over two years (6/1/13–5/31/16). No cost extension until 5/31/16.
14. Korea Institute of Science and Technology research contract “Development of Next-Generation Micro Surgical Robot Based on Open Platform” R. J. Webster III (PI). For \$115,955 over three years (11/1/13–10/31/16).
15. NIH R01 CA162477 “Clinical Translation of Deformation Compensation for Image-Guided Liver Surgery” M. I. Miga (PI), R. L. Galloway, and R. J. Webster III. For \$3,030,384 over 5 years (7/1/11–6/31/16). Webster portion approximately \$300,000.
16. NSF CPS-1239355 “Synergy: Integrated Modeling, Analysis and Synthesis of Miniature Medical Devices” P. Valdastris (PI), A. Ledeczi, P. Volgyesi, and R. J. Webster III. For \$1,000,000 over four years (12/1/12–11/30/16).
17. NIH R21 EB017952 “Multi-lumen steerable needles for transoral access to lung nodules” Alterovitz (PI), R. H. Feins, and R. J. Webster III. For \$414,572 over two years (09/01/13–8/31/15). Webster subcontract \$161,064. No cost extension until 8/31/16.
18. NSF 1263346 “REU Site: Research Experiences for Undergraduates in Fluid Power” K. Stelson (PI), R. J. Webster III and many other Co-Is. For \$390,000 over three years (7/1/13–6/30/16).
19. Vanderbilt Center for Technology Transfer and Commercialization “Dexterous Surgical Manipulator” R. J. Webster III (PI). For \$10,000 over one year (2/1/13–9/30/13).
20. Vanderbilt Center for Technology Transfer and Commercialization “Bone Graft Holder” R. J. Webster III (PI). For \$1,500 over one year (5/1/13–9/30/13).



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21. Vanderbilt Initiative in Surgery and Engineering: “Transurethral Robotic Radical Prostatectomy for Prostate Cancer” R. J. Webster III (PI), S. D. Herrell (PI). For \$30,000 over one year (6/1/12–5/31/13).
22. Korea Institute of Science and Technology research contract “Needle Sized Robots That Move Like Tentacles for Skull Base Surgery” R. J. Webster III (PI) for \$79,964 over one year (2/1/12–12/31/12).
23. Vanderbilt Institute for Clinical and Translational Research “Translating Parallel Robots from the Benchtop to Clinical Practice in Otolaryngology” R. J. Webster III (PI). For \$9,947 over one year (1/1/12–12/31/12).
24. Intuitive Surgical “Needle-Diameter Patient Side Manipulators” R. J. Webster III (PI). For \$16,200 over one year (1/1/11–12/31/11).
25. MathWorks, Inc. Contract “Modeling and Control of an Educational Haptic Robot Using Matlab / Simulink” R. J. Webster III (PI) and P. Marayong. For \$38,341 over one year (7/1/10–6/30/11).
26. NIH R21 EB011628: “Reaching Inaccessible Anatomy Percutaneously Via Multi-Lumen Steerable Needles” R. J. Webster III (PI) and R. Alterovitz (PI). For \$414,923 over two years (6/1/10–5/31/12). No cost extension until 5/31/13.
27. NIH R01 DC010184: “Pediatric Percutaneous Cochlear Implantation: Clinical Validation and Implementation” R. F. Labadie (PI), J. M. Fitzpatrick, B. M. Dawant and R. J. Webster III. For \$2,970,077 over four years (9/1/09–8/31/13). Webster portion approximately \$100,000.
28. Vanderbilt Discovery Grant “Fluid-Powered Locomotion, Sensing, and Intervention in the GI Tract” R. J. Webster III (PI), K. C. Williams, and H. Correa. For \$100,000 over two years (6/1/09–5/31/11). No cost extension through 6/30/12.
29. NIH R43/R44 CA134169: “Precisely Shaped Acoustic Ablation of Tumors Under 3D Ultrasound Image Guidance” E. C. Burdette (PI), R. J. Webster III, and E. M. Boctor. For \$3,258,392 over four years (8/1/08–7/31/12). No cost Extension until 7/31/13. Webster subcontract \$428,473.
30. NSF CBET-0651803: “Active Cannulas for Bio-Sensing and Surgery” N. J. Cowan (PI), A. M. Okamura, and R. J. Webster III. For \$240,000 over three years (8/15/07–8/14/10). REU Supplement \$3,000 in 2008. No cost extension through 6/31/11. Webster subcontract \$180,589.
31. National Defense Science and Engineering Graduate Fellowship, Robert J. Webster III. For approximately \$167,760 over three years (9/1/02–8/31/05).
32. National Science Foundation Graduate Fellowship, Robert J. Webster III. For approximately \$96,000 over three years (9/1/05–12/31/07).
33. IEEE-RAS/IFRR Travel Grant, 2005.
34. National Science Foundation Travel Grants for conference attendance (5) 1999, 2000, 2002, 2004, 2006.

## INVITED PRESENTATIONS

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### *Keynote and Plenary Presentations*

1. World Congress of Bronchoscopy and Interventional Pulmonology, “Robotic Bronchoscopy and Steerable Needles,” June, 2018. (Invited talk at single-track conference.)
2. Engineering in Urologic Surgery Conference, Improving Rigid Endoscopy: A Robot for HoLEP, May 2018. (Invited talk at single-track conference.)
3. International Symposium on Medical Robotics Semi-Plenary “New Frontiers for Surgical Robots In the Lung”, March, 2018.
4. TEDx, Invited Talk: “The Rise of Robots in the Operating Room”, Nashville TN, August 2017.

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5. Computer Assisted Radiology and Surgery/ISCAS Invited Lecture, “Can Needle-Sized Robots Help Surgeons Save Lives?” June 2017.
6. Frontiers Conference. “Image-Guided Robotic Surgery” Nashville, May, 2017. (Invited Talk at single-track conference.)
7. Keynote Speaker at the 28<sup>th</sup> Conference of the International Society for Medical Innovation and Technology, “Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?” October, 2016.
8. Plenary Speaker at the IEEE Safety Security and Rescue Robotics Conference, “Safer Surgeries Through Smaller, Softer, Image-Guided Robots,” October, 2015.
9. Keynote Speaker at the Computer-Assisted and Robotic Endoscopy Conference, “Transendoscopic Robots,” October, 2015.
10. Greatest Hits Presentation at the International Symposium on Robotics Research, “Design, Sensing, and Planning: Fundamentally Coupled Problems for Continuum Robots,” (Presented by my postdoc Arthur Mahoney), September, 2015.
11. Robotics Science and Systems Early Career Spotlight Presentation, “Continuum Robots: Helping Surgeons Save Lives,” July, 2015.
12. Keynote Speaker, IEEE International Conference on Robotics and Automation Young Professionals Lunch, May, 2015.
13. Faculty Commencement Seminar, Vanderbilt University, “Re-Engineering Surgery: The Rise of Robots in the Operating Room,” Nashville, TN, May, 2012.

*Invited Lectures in University Seminar Series*

1. Leeds University, United Kingdom, Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?, June, 2019.
2. Tennessee State University, Can Needle-Sized Robot Tentacles Help Surgeons Save Lives? March, 2019.
3. University of Basel, Switzerland. Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?, November, 2018.
4. Interventional Pulmonology Grand Rounds, Vanderbilt University Medical Center. New Robots for Interventional Pulmonology. September, 2018.
5. The University of Cork, Ireland, “Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?” June, 2018.
6. University of Hawaii, “Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?”, April, 2018.
7. Johns Hopkins University, “Can Needle-Sized Robots Help Surgeons Save Lives?” December, 2017.
8. Vanderbilt University, Mechanical Engineering External Advisory Committee, “IP and Entrepreneurship at Vanderbilt” April, 2017.
9. Vanderbilt University Medical Center, Neurosurgery Grand Rounds, “How to Become a Medical Device Innovator,” March 2017.
10. University of Minnesota, “Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?” November, 2016.
11. Duke University, “Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?” March, 2016.
12. The University of Pennsylvania, “Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?”, December, 2015.

13. Harvard University, "Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?", November, 2015.
14. University of Utah, "Can Needle-Sized Robot Tentacles Help Surgeons Save Lives?", October, 2015.
15. MD Anderson Cancer Research Center, "Steerable Needles," August, 2015.
16. MD Anderson Cancer Research Center, "Needle-Sized Tools for Natural Orifice Procedures," August, 2015.
17. Hannover University, Germany, "Overview of Vanderbilt MED Lab Research", May, 2015.
18. Johns Hopkins Symposium on Head and Neck Surgery, "Vanderbilt's Tentacle-Like Robot for Skull Base Surgery", Baltimore, MD, July, 2014.
19. Columbia University, "Can Needle-Sized Robots Help Surgeons Save Lives?" April, 2014.
20. Kings College, London, "Enabling Technologies for More Accurate, Less Invasive Robotic Surgery" June, 2013.
21. Stanford University, "Enabling Technologies for More Accurate, Less Invasive Robotic Surgery," May, 2013.
22. Hannover University, "Enabling Technologies for More Accurate, Less Invasive Robotic Surgery," May, 2013.
23. Korea Institute of Science and Technology, "Enabling Technologies for More Accurate, Less Invasive Robotic Surgery," KIST International Symposium on Computer Assisted Micro-Surgical Systems, November, 2012.
24. Georgia Institute of Technology, "Enabling Technologies for More Accurate, Less Invasive Robotic Surgery," Robotics and Intelligent Machines Center Seminar Series, September, 2012.
25. Stanford University, "Enabling Technologies for More Accurate, Less Invasive Robotic Surgery," Stanford, CA, January, 2012.
26. Rice University, Department of Mechanical Engineering and Materials Science, "Enabling Technologies for Reducing Invasiveness and Enhancing Accuracy in Robotic Surgery," Houston, Texas, November, 2010.
27. Scuola Superiore Sant'Anna, Center for Research in Microengineering, "Enabling Technologies for Reducing the Invasiveness of Robotic Surgery," Pontedera, Italy, July, 2010.
28. Scuola Superiore Sant'Anna, Center for Research in Microengineering, "Medical Robotics and Image-Guided Surgery in the MED lab at Vanderbilt," Pontedera, Italy, July, 2009.
29. Carnegie Mellon University Robotics Institute, "Toward Steerable Cannula and Legged Capsule Robots in Medicine," October, 2008.
30. Scuola Superiore Sant'Anna, Center for Research in Microengineering Seminar, "Design, Mechanics, and Control of Surgical Continuum Robots," Pontedera, Italy, July, 2008.
31. Vanderbilt University, Department of Biomedical Engineering, Nashville, TN, March 2008.
32. University of Georgia, Faculty of Engineering, Athens, GA, March, 2007.
33. Duke University Department of Department of Mechanical Engineering and Materials Science, Durham, NC, February, 2007.
34. Vanderbilt University, Department of Mechanical Engineering, Nashville, TN, February, 2007.
35. Engineering Research Center for Computer Integrated Surgical Systems and Technology Seminar Series, Johns Hopkins University, Baltimore, MD, May, 2006.

*Invited Presentations in Conference Workshops and Special Sessions*

1. R. J. Webster III, "The Virtuoso Endoscopy System", Hamlyn Symposium on Medical Robotics Workshop on the Kuka LBR Med. June 2019.
2. Congress of Neurological Surgeons Symposia 2: Surgical Robotics: Engineering to Bedside, "Advances in Minimally Invasive Robotics for Neurosurgery". October, 2018.
3. IEEE/RSJ International Conference on Intelligent Robots and Systems, Workshop on Assistive Technologies for Precision Neurosurgery: Current Successes and Future Challenges. (Speaker: Caleb Rucker gave this presentation on my behalf), October, 2018.
4. Hamlyn Symposium on Medical Robotics, Invited Workshop Talk, "New Frontiers for Surgical Robots in the Lung", June, 2018.
5. Engineering in Urologic Surgery, "Improving Rigid Endoscopy: A Robot for HoLEP", May 2018.
6. Hamlyn Symposium Workshop, Next Generation Continuum Robots, "Clinical Translation of Continuum Robots: Grand Challenges," June, 2017.
7. IEEE International Conference on Robotics and Automation, Invited Workshop Talk: "Single Port Robots as Hand-Held Tools ... and When to do the Opposite", June 2017.
8. Hamlyn Symposium Workshop Towards Clinical Impact in Robotic Assisted Neuro and Skull-Base Surgery, "The Holes in Your Head You Never Knew You Had, and Robots to Reach Through Them," June, 2016.
9. SPIE Medical Imaging Workshop on Sensing Challenges and Prospects in Miniaturizing Surgical Robots and Tools, "Why the Design, Sensing, and Planning Communities Must Collaborate to Create Optimal Surgical Robots," February, 2016.
10. IEEE/RSJ International Conference on Intelligent Robots and Systems: Workshop on Navigation and Actuation of Flexible Instruments in Medical Applications, Hamburg, Germany: "Transendoscopic Delivery of Concentric Tube Manipulators and Steerable Needles," September, 2015.
11. Hamlyn Symposium Smart Surgical Devices Workshop, "Transendoscopic Robots: Needle-Size Manipulators and Steerable Needles," June, 2015.
12. Society of Interventional Radiology Foundation Research Consensus Panel, "Steerable Needles," Washington DC, June 2015.
13. Invited Frontiers Presentation, "Is a Robot Through Your Urethra Really a Good Idea?" ASME Dynamic Systems and Controls Conference, San Antonio, Texas, October, 2014.
14. ISER Invited Workshop Presentation, "Surgery With Needle-Sized Tentacle-Like Robots," Marrakech, Morocco, June, 2014.
15. ICRA Invited Presentation in Workshop on Advances in Flexible Access Robots for Surgical Interventions, "Enabling New Flexible Access Surgeries: The Promise of Concentric Tube Robots," Hong Kong, China, May, 2014.
16. Hamlyn Symposium. Invited Presentation in Emerging Technologies for Robot-Assisted NOTES and SILS and Micro Robotics for Medical Applications Workshop, "A Robotic System for Transnasal Skull Base Surgery," June, 2013.
17. Harvard IDEAS Conference, "Needle-Sized Surgical Tentacles," April, 2013.
18. IEEE International Conference on Biomedical Robotics and Biomechatronics – Surgical Robotics Symposium, "Robotic Endonasal Skull Base Surgery," Rome, Italy, June, 2012.

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19. IEEE International Conference on Robotics and Automation – Workshop: Pathways to Clinical Needle Steering: Recent Advances and Future Applications, “How Do We Get These Darn Things Into Lots of Real Live Patients?” St. Paul, MN, May, 2012.
20. IEEE International Conference on Robotics and Automation workshop on Mechanisms for Surgical Robotics, “Robot-Assisted Percutaneous Cochlear Implantation,” Shanghai, China, May, 2011.
21. Robotics, Science and Systems 2010 – Workshop on Enabling Technologies for Image-Guided Robotic Interventional Procedures, “Continuously Flexible Robots, an Enabling Technology for Less Invasive Surgical Procedures,” Zaragoza, Spain, June, 2010.
22. IEEE International Conference on Robotics and Automation 2010 – Workshop on Snakes, Worms and Catheters: Continuum and Serpentine Robots for Minimally Invasive Surgery, “Modeling, Shape Sensing, Image Guidance, and Therapeutic Applicator Integration: Enabling Technologies for Clinical Continuum Robots,” Anchorage, Alaska, May, 2010 (Presented by graduate student Jenna Toennies).
23. Medical Image Computing and Computer Assisted Intervention 2008 – Workshop, Needle Steering: Recent Results and Future Opportunities, “Modeling and Control of Continuum Robots for Surgery,” New York, NY, September 2008.
24. Workshop on Medical Diagnosis, Micro Surgery, and Performance Evaluation at IEEE/RSJ International Conference on Intelligent Robots and Systems, Beijing, China, October, 2006.

*Other Invited Presentations*

1. IEEE RAS Soft Robotic Podcast. “How Can You Design A Decentralized Medical Soft Robot”. Podcast released August 2020
2. Vanderbilt School of Engineering Board of Visitors, “Commodore Open-Source Ventilator”, April, 2020.
3. Montpelier Surgical Robotics School, “Steerable Scopes, Manipulators, and Needles: Modeling and Design of Curved Surgical Robots,” September, 2013.
4. University of Illinois Urbana-Champaign, “Fluid Powered Surgery and Rehabilitation via Compact, Integrated Systems – 2G,” Center For Compact and Efficient Fluid Power Annual Meeting, 2012.
5. NSF Engineering Research Center for Compact and Efficient Fluid Power Industry Advisory Board Meeting, “Fluid Power in Medicine,” Nashville, TN, March, 2012.
6. Intuitive Surgical, “Needle-Diameter Patient Side Manipulators,” San Jose, CA, January, 2012.
7. Vanderbilt Family Weekend Seminar. Provided a seminar to students and parents during the 2012 family weekend festivities.
8. Vanderbilt Admissions Invited Seminar: Provided an invited seminar on engineering at Vanderbilt for the admissions office, for visiting high school guidance counselors, 2012.
9. Vanderbilt Engineering Alumni Council, “Surgical Engineering,” Nashville, TN, October, 2011.
10. VUMC Otolaryngology Resident Research Symposium, “Toward Robotic, Endonasal, Skull-Base Surgery,” Nashville, TN, August, 2011.
11. Vanderbilt Initiative for Surgery and Engineering Seminar Series, “Next Generation Surgical Technologies and Robots,” Nashville, TN, August, 2011.
12. Denso Manufacturing, “Medical Robotics and Prosthetics Research at Vanderbilt” Maryville, TN, August, 2010.
13. Grant and Fellowship Workshop: Provided a presentation on graduate fellowships for Vanderbilt graduate students, 2009.
14. Vanderbilt University External Advisory Committee Meeting, Nashville, TN, April, 2008.

## ADVISING

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### *Doctoral Students*

Jason Shrand, Ph.D. expected 2025.  
Dominick Ropella, Ph.D. expected 2023.  
Maxwell Emerson, Ph.D. expected 2023.  
James Ferguson, Ph.D. expected 2023.  
Tayfun Ertop, Ph.D. expected 2022.  
Katherine Riojas, Ph.D. expected 2022.  
Margaret Rox, Ph.D. expected 2022.  
Patrick Anderson, Ph.D. expected 2020.  
Andria Ramirez, Ph.D. expected 2020.  
Michael Siebold, Ph.D. expected 2020.  
Patrick Wellborn, Ph.D. Successfully defended, Expected 2020.  
Trevor Bruns, Ph.D. Ph.D. 2020. Systems Engineer, Virtuoso Surgical, Inc.  
Richard Hendrick, Ph.D. 2017. Chief Operations Officer, Virtuoso Surgical, Inc.  
Neal Dillon, Ph.D. 2017. Senior Mechanical Engineer, Virtuoso Surgical, Inc.  
Hunter Gilbert, Ph.D. 2016. Assistant Professor, Louisiana State University.  
Philip Swaney, Ph.D. 2016. Technology Transfer Officer, Vanderbilt University.  
Louis Kratchman, Ph.D. 2015. Research Scientist, Draper Labs.  
Ray Lathrop, Ph.D. 2013. Research Engineer, Eli Lilly, Inc.  
Jenna Gorlewicz, Ph.D. 2013. Associate Professor, Saint Louis University.  
Caleb Rucker, Ph.D. 2011. Associate Professor, University of Tennessee.

### *Doctoral Students Co-Advised*

Bryn Pitt, Ph.D. Expected 2019. (Co-Advised with Eric Barth)  
Yue Chen, Ph.D. 2018. (Co-Advised with Eric Barth). Assistant Professor, University of Arkansas.  
David Comber, Ph.D. 2015. (Co-Advised with Eric Barth). Sarcos Robotics, Inc.  
Jadav Das, Ph.D. 2010. (Co-Advised with Nilanjan Sarkar). Rockwell Automation, Inc.

### *Masters Students*

Stephanie Amack, 2019.  
Shan Lin, M.S. 2017.  
Tate Travaglini, M.S. 2015.  
Christopher Marince, M.S. 2015.  
Byron Smith, M.S. 2012.  
Diana Cardona, M.S. 2012.

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*Research Faculty/Research Engineers Supported/Advised*

Jason Mitchell, Research Assistant Professor, Vanderbilt University

Gregoire Blachon, Research Engineer, Co-Advised with Robert Labadie

Daniel Schurzig, Research Engineer, Co-Advised with Robert Labadie

*Postdoctoral Fellows Supervised*

Connor Forbes, 2020-present

Josephine Granna, 2019-present

Ernar Amanov, 2019-present

Naren Nimmagadda, 2019-present

Nicholas Kavoussi, 2018-present

Smita De, 2016-2018. Assistant Professor, Cleveland Clinic

Loris Fichera, 2015-2017. Assistant Professor, Worcester Polytechnic Institute

Arthur Mahoney, 2014-2017. Sarcos Robotics, Inc.

Isuru Godage, 2014-2017. Assistant Professor, DePaul University

Ray Lathrop, 2014-2016. Research Engineer, Eli Lilly, Inc.

Raul Wirz, 2013-2015. Senior Software Engineer, Globus Medical, Inc.

Jessica Burgner, 2010-2012. Associate Professor, University of Toronto, Canada

*Undergraduate Students*

Katie Gosbee, 2020. Adrian Florea, 2019. Emily Tran, 2019. Mustafa Ugur, 2019. Jacob Rogatinsky, 2019. Nicholas Pieper, 2019. Jason Yang, 2019. Rahul Regula, 2019. Anvitha Kosaraju, 2019. Juyoung Kim, 2019. Mia McConnell, 2018. Lauren Saxon, 2018. James Zhu, 2018. Rachel Welscott, 2018. Adrian Alepuz, 2018. Jasmine Jiang, 2018. Jacob Gloudemans, 2018. Narendran Narasimhan, 2018. Anthony Frederick, 2018. Young-Rae Kim, 2017. Avinash Poola, 2017. Syafiq Rahman, 2017. Alex Reed, 2017. Patrick Hall, 2016. Mitch Fulton, 2016. Asfar Azman, 2016. Nicholas Catalan, 2016. Cindy Liu, 2016. Evan Blum, 2016. Ethan James, 2016. Florian Heilemann (German masters student), 2016. Kaili Wang (high school student), 2016. Sanjid Halim, 2015. Mark Chambliss, 2015. Matthew Medlock, 2015. Matthew Hostetler, 2014. Yifan Zhu, 2014. Erik Lamers, 2014. Peter York, 2013. Dylan Losey, 2013. Dexter Watkins, 2012. Sani Sulaiman, 2012. Syed Hamid, 2012. Michael Jekot, 2011. Amir Razak, 2011. Trevor Bruns, 2010. Scott Nill, 2010. Mohammed Rahman, 2010. Stephen Malanoski, 2010. J. Tyler Steier, 2010. Justin Saunders, 2010. Zach Smith, 2009. David Gostin, 2009. Xavier Waller, 2009. Tiffany Cheng, 2009. Sam Nackman, 2009. Jordan Croom, 2008. James Boyle, 2008. Randy Smith, 2008. Robert Pieper, 2008. Todd Dutton, 2008. Brandon Bolds, 2008. Joseph Romano, 2006. Jasenka Memisevic, 2004.

*Thesis and Exam Committees*

2019: Rashid Yasin (Ph.D.), Federico Campisano (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2018: Nicolo Garbin (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2017: Amanda Shultz (Ph.D.)

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2016: Zhi Zeng (Ph.D.), Spencer Murray (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2015: Steve Boronyak (Ph.D.), Daniel Benett (Ph.D.) Christian Di Natali (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2014: Marco Beccani (Ph.D.), Steve Boronyak (Ph.D.), Fitsum Reda (Ph.D.), Kevin Ha (Ph.D.), Brian Lawson (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2013: Mark Hoffacker (Ph.D.), Andrea Bajo (Ph.D.), Skyler Dalley (Ph.D.), Jason Mitchell (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2012: John Tucker (M.S.), Rowina Ong (Ph.D.), Ryan Farris (Ph.D.), Hugo Quintero (Ph.D.), Liyun Guo (Ph.D.), Courtenay Glisson (Ph.D.), Ishita Chen (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2011: Chao Yong (Ph.D.), Furui Wang (Ph.D.), Uttama Lahiri (Ph.D.), Andrei Danilchenko (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2010: Joel Willhite (Ph.D.), Ishita Garg (Ph.D.), Yu Tian (Ph.D.), Keith Wait (Ph.D.), Vikash Gupta (M.S.), Andrei Danilchenko (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2009: Abhijit Barman (Ph.D.), Yu Tian (Ph.D.), Frank Sup (Ph.D.), Atakan Varol (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

2008: Tyler Li (Ph.D.), and departmental preliminary exam in the area of Dynamic Systems and Control.

## INSTRUCTION AND COURSE DEVELOPMENT

### *Graduate Courses*

**Introduction to Robotics.** Forward kinematics, inverse kinematics, dynamics, and control of robotic manipulators. Also, coverage of more advanced topics such as trajectory generation, mobile robots, motion planning, and medical robotics, among others. *Vanderbilt University: Fall 2012, Enrollment 27. Fall 2013, Enrollment 25. Fall 2014, Enrollment 31. Fall 2015, Enrollment 32.*

**IMPACT** Mechanical engineering special topics graduate course focused on medical device entrepreneurship. In IMPACT (Initiating, Maximizing, Promoting, and Accelerating Commercialization and Translation), students worked in small teams to explore a medical device technology from all angles, including intellectual property issues, customer discovery and minimum viable product considerations, market evaluation, FDA regulatory pathways, securing capital, and the practicalities of setting up and running a small business. The course covered elements of the Stanford Lean Launchpad model (used in the NSF I-Corps program) as well as additional medical device-specific considerations. The course was highly interactive and hands-on, with substantial time for discussion and student presentations, and a number of experienced guest lecturers. By the end of the semester, students were well positioned to determine whether a startup company makes sense for their team's technology, and had gained exposure to the basics of medical device entrepreneurship. *Vanderbilt University: Fall 2016, Enrollment 8.*

**University Course: From Academic Insight to Entrepreneurial Impact** This course provides a unique opportunity for graduate students in engineering, science, medicine, law, and business to gain real-world experience as part of an entrepreneurial team. Multidisciplinary teams will examine inventions from Vanderbilt labs from all angles—technical, business, legal, and regulatory—thinking about how these inventions can make an impact on markets and clinics. Students will learn about patents, legal and business strategies to optimize value, customer discovery, funding, and venture terms from a multi-disciplinary team of Vanderbilt faculty, industry, and legal mentors, and members of the greater Nashville entrepreneurial community. *Vanderbilt University: Fall and Spring, 2018, Enrollment 15. Taught as MGT 6499 Innovation Realization, Fall and Spring 2019, Enrollment 18, and Fall and Spring 2020.*



### *Undergraduate Courses*

**Senior Design.** In the Senior Design course, students undertake a design project for a sponsoring organization (e.g. a private company, government lab, or university agency or lab). Projects in 2008 included robot design, robot motion planning, heat transfer models for industrial glass melters, rocketry, a science museum exhibit, alternative fuels research, and design of various car and motorcycle components, among others. *Vanderbilt University: Spring 2008, Enrollment 20. Spring 2009, Enrollment 27. Spring 2010, Enrollment 23. Spring 2011, Enrollment 34. Spring 2012, Enrollment 31. Spring 2013, Enrollment 21. Spring 2014, Enrollment 27. Spring 2015, Enrollment 71. Spring 2016, Enrollment 79. Fall 2016, Enrollment 84.*

**System Dynamics.** Modeling and analysis of damped and un-damped, forced and free vibrations in single and multiple degree-of-freedom linear dynamical systems. Introduction to stability and control of linear dynamical systems. Implemented a new set of labs incorporating the Haptic Paddle. *Vanderbilt University: Fall 2008, Enrollment 63. Fall 2009, Enrollment 65. Fall 2010, Enrollment 71. Fall 2011, Enrollment 74.*

**Mechatronics (TA)** Taught lab sections of this interdisciplinary course, which teaches the student to design and build mechatronic devices. Topics include mechanism design, motors and sensors, interfacing and programming microprocessors, mechanical prototyping, and creativity in the design process. Course labs and projects are performed in small student groups. Each group develops a microprocessor-controlled electromechanical device capable of producing an original piece of artwork. *Johns Hopkins University: Fall 2006. Approximately 20 students.*

**Design and Analysis of Dynamic Systems (TA)** Taught sections of the lab associated with this course, where students learned hands-on modeling and analysis of damped and undamped, forced and free vibrations in single and multiple degree-of-freedom linear dynamical systems. Introduction to stability and control of linear dynamical systems. *Johns Hopkins University: Spring 2004. Approximately 40 students.*

**Surgery for Engineers (TA)** Assisted with grading exams and teaching labs for this course for graduate engineers (biomedical, mechanical, and computer science), which provides an overview of clinical surgery and concentrates on instrument design and applying engineering principles to the practice of surgery. *Johns Hopkins Medical Institute: 2004. Approximately 12 students.*

### *Curricular Development*

**Undergraduate Design Thread** Served on a committee to create a continuous design experience throughout the undergraduate Mechanical Engineering curriculum at Vanderbilt. The committee was successful in placing one course with a major design project in each semester of our curriculum. It was also successful in creating a new Sophomore Design course, a new Junior Mechatronics course, and a new Junior Machine Analysis and Design course.

**Ph.D. Preliminary Examination:** I was a member of the committee that revamped the mechanical engineering preliminary examination procedure, converting it from a written examination to an oral examination and accelerating and standardizing the timeline for taking it.

**Graduate Certificate in Surgical and Interventional and Engineering** A graduate certificate program that provides students with an additional credential in surgical and interventional engineering. Students must take a course with extensive interaction with physicians, and several other courses related to engineering medical devices to earn this certificate. The objective of this certificate is to provide a broadening experience for the next generation of engineers and scientists interested in the creation, development, implementation, clinical evaluation and commercialization of methods, devices, algorithms, and systems designed to facilitate surgical and interventional processes and their outcome. Students who attain this certificate will be experts in the process of creating novel engineering solutions to surgical and interventional problems, and may pursue careers in academia, industry, startup companies, and in other environments where engineering creativity applied to clinical problems is

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needed. Students graduating with this certificate have taken classes and attended seminars in surgical and interventional engineering and have pursued hands-on projects in engineering better surgical and interventional processes and devices. With Mike Miga, I planned and proposed this certificate. I subsequently became the director of this certificate program.

*Research on Engineering Education*

**A Formal Evaluation of Student Learning in System Dynamics Lab.** Collected quiz data on key learning objectives at a variety of time points to determine when student learning occurred. Administered the same test to different cohorts of students before lecture, after lecture, before lab, after lab, after lab report submission, and at the end of the semester, to determine what was learned and whether it was learned in lecture vs. lab. Found that one of the 5 labs for the course did not statistically significantly improve student learning, but the other four did. Modified the content of that lab. Published results of three year study. Prior to this, the haptic paddle labs had been used at multiple universities including Johns Hopkins, Stanford, and Michigan, with only anecdotal evaluation.

*Publications from this work:*

1. J. L. Gorlewicz, L. B. Kratchman, and R. J. Webster III, Haptic Paddle Enhancements and a Formal Assessment of Student Learning in System Dynamics, ASEE Advances in Engineering Education, vol. 4, no. 2, pp. 1-31, 2014
2. J. L. Gorlewicz and R. J. Webster III, A Formal Assessment of the Haptic Paddle Laboratories in Teaching System Dynamics, in American Society of Engineering Education, 2012. **Best Paper, Mechanical Engineering Division**

**PROFESSIONAL SERVICE**

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*Journal Editorial Boards*

- 2018-present International Journal of Robotics Research, Associate Editor  
2014-2017 IEEE Transactions on Robotics, Associate Editor

*NIH Study Section Membership*

- 2016-2020 Charter Member of NIH Biomedical Imaging Technology (BMIT-B) Study Section. Study section subsequently re-named through reorganization to Image Guided Interventions and Surgery (IGIS). Involves serving in 2-3 study section meetings per year.  
2008-Present Served on many NIH Study Sections  
2018 Reviewer for NIH Entrepreneurial Finance Video Series

*International Scientific Steering Committees*

- 2017-present Strategic Advisory Board, United Kingdom Engineering and Physical Sciences Research Council Grant 'Micro-Robotics for Surgery'

*Conference Chairmanship*

- 2014-2018 Chair of SPIE Image Guided Procedures, Robotic Interventions, and Modeling Conference

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*International Conference Organization and Review Committees*

- 2015-present Hamlyn Symposium Program Committee
- 2015 IEEE International Conference on Robotics and Automation - Mentor for Young Reviewers Program
- 2014 IEEE International Conference on Intelligent Robots and Systems (IROS): Workshop and Tutorials Committee Member
- 2013 Associate Editor, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- 2012 Associate Editor, IEEE/RAS-EMBS International Conference on Biomedical Robotics and Biomechanics (Bio-Rob)
- 2012-present ASME Dynamic Systems and Controls, Bio-Systems and & Healthcare Technical Committee
- 2011-present NIH Reviewer (Many Panels)
- 2010-present SPIE Image-Guided Procedures, Robotic Interventions, and Modeling Program Committee
- 2009-present ASME Dynamic Systems and Controls, Robotics Technical Committee
- 2007-present NSF Proposal Review Panelist (Many Panels)

*Professional Society Committees:*

- American Association of Physicists in Medicine, Task Group on Robot-Assisted Interventions, 2016
- Society of Interventional Radiology Foundation, Research Consensus Panel, Washington DC, June 2015.

*Technical Reviews*

Reviewed 89 papers for Journals including the following:

International Journal of Robotics Research, IEEE Transactions on Robotics, IEEE Transactions on Automation Science and Engineering, IEEE Transactions on Biomedical Engineering, IEEE Transactions on Medical Robotics and Bionics, IEEE Sensors Journal, IEEE Transactions on Haptics, IEEE Transactions on Medical Imaging, IEEE/ASME Transactions on Mechatronics, ASME Journal of Dynamic Systems, Measurement, and Control, ASME Journal of Medical Devices, ASME Journal of Mechanisms and Robotics, Robotica, Autonomous Robots, Journal of Medical and Biological Engineering, International Journal of Medical Robotics and Computer Assisted Surgery, Journal of Applied Bionics and Biomechanics, Medical Physics

Reviewed many papers for conferences such as the following:

IEEE International Conference on Robotics and Automation (ICRA), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Workshop on the Algorithmic Foundations of Robotics (WAFR), IEEE International Conference on Biomedical Robotics and Biomechanics (BioRob), Eurohaptics, Worldhaptics, International Symposium on Robot and Human Interactive Communication (RO-MAN), International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), ASME Design of Medical Devices Conference (DMD), International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), SPIE Medical Imaging, ASME Fluid Power and Motion Control Conference (FPMC), ASME Dynamic Systems and Control Conference (DSCC), IFTOMM International Symposium on Robotics and Mechatronics (ISRM), Hamlyn Symposium on Medical Robotics

Reviewed many papers conferences such as the following:

Book Proposals Reviewed:

Reviewed two book proposals for Springer Tracts on Advanced Robotics.

*Workshop Organization*

Endoluminal Intervention, Hamlyn Symposium on Medical Robotics, 2018.

Hamlyn Symposium Surgical Robotic Challenge Judge, 2017.

Hamlyn Symposium Surgical Robotics Challenge Judge, 2016.

SPIE Workshop “Novel Robots for Less Invasive Surgery” at the Image-Guided Procedures, Robotic Interventions, and Modeling Conference, Orlando, Florida, February, 2015.

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IEEE International Conference on Biomedical Robotics and Biomechatronics: Surgical Robotics Symposium, Rome, Italy, June, 2012.

IEEE International Conference on Robotics and Automation: Pathways to Clinical Needle Steering: Recent Advances and Future Applications, St. Paul, MN, May, 2012.

Robotics, Science and Systems: Enabling Technologies for Image-Guided Robotic Interventional Procedures, June 28, 2010.

OR2020 Operating Room of the Future Workshop, Ellicott City, Maryland, March 18-20, 2004. Volunteer Student Organizer.

#### *Workshop Participation*

Hamlyn Symposium on Medical Robotics, Workshop on the Kuka LBR Med. June 2019.

Congress of Neurological Surgeons Symposia 2: Surgical Robotics: Engineering to Bedside, October, 2018.

Next Generation Continuum Robots, Hamlyn Symposium, 2017.

C4 Surgical Robots: Compliant, Continuum, Cognitive, and Collaborative, IEEE International Conference on Robotics and Automation, 2017.

Towards Clinical Impact in Robot Assisted Neuro and Skull-Base Surgery, Hamlyn Symposium, 2016.

Sensing Challenges and Prospects in Miniaturizing Surgical Robots and Tools, SPIE, 2016.

Research Consensus Panel, Society of Interventional Radiology, 2015.

Navigation and Actuation of Flexible Instruments in Medical Applications, IROS, 2015.

Smart Surgical Devices, Hamlyn Symposium, 2015.

Robotics Workshop For Local Students, ISER, 2014.

Advances in Flexible Access Robots for Surgical Interventions, ICRA, 2014.

Harvard IDEAS Conference, 2013.

Flexible Access Surgery Workshop, Hamlyn Symposium, 2013.

Symposium on Surgical Robotics, BioRob, 2012.

NSF Advocacy Day, Washington D.C., 2012.

Image-Guided Medical Robotic Interventions, IROS, 2011.

Mechanisms for Surgical Robotics, ICRA, 2011.

Meso-Scale Robotics for Medical Interventions, ICRA, 2010.

Snakes, Worms and Catheters: Continuum and Serpentine Robots for Minimally Invasive Surgery, ICRA, 2010.

Needle Steering: Recent Results and Future Opportunities, MICCAI, 2008.

WPI Robotics Symposium: Engineering the Revolution, 2007.

Workshop on Medical Diagnosis, Micro Surgery, and Performance Evaluation, IROS, 2006.

Medical Robotics and Welfare: Medical Robotics in the Surgical Theater, ICRA, 2005.

Operating Room of the Future Workshop, OR2020, 2004.

Reality-Based Modeling of Tissues for Simulation and Robot-Assisted Surgery, IROS, 2003.

#### *Memberships*

Senior Member: Institute of Electrical and Electronics Engineers (IEEE)

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Senior Member & Lifetime Member, SPIE International Society for Optics and Photonics

Permanent Member, American Society of Mechanical Engineers

Other memberships held at various times:

IEEE Robotics and Automation Society, American Society of Engineering Education (ASEE), Washington Computer Aided Surgery Society, Tau Beta Pi, Eta Kappa Nu, IEEE Mechatronics, Communications, and Power Societies, Medical Image Computing and Computer-Assisted Intervention (MICCAI) Society

*University Service*

Vanderbilt Limited Submission Opportunity Review Committee

Vanderbilt Graduate Leadership Institute Planning Committee

Vanderbilt Provost's Research Council

Vanderbilt International Research and Engagement Subcommittee

Vanderbilt University Limited Submission Opportunity Review Committee

Vanderbilt Engineering Faculty Development & Diversity Committee

Vanderbilt Work Group on Faculty Financial Incentives Related to Research

Vanderbilt Institute for Surgery and Engineering Steering Committee

Vanderbilt Discovery Grant Review Committee (Chaired in 2019)

Vanderbilt Graduate Faculty Council (Elected Secretary 2015)

Vanderbilt Biomedical Engineering Faculty Search Committee

Vanderbilt Mechanical Engineering Faculty Search Committee

Vanderbilt Computer Science Faculty Search Committee

Vanderbilt Mechanical Engineering Design Curriculum Committee

Vanderbilt Mechanical Engineering Webpage Coordinator

Vanderbilt Mechanical Engineering Graduate Program Committee

Vanderbilt Mechanical Engineering Graduate Program SACS Accreditation Committee

Vanderbilt Mechanical Engineering Alumni Development and Industrial Relations Committee

Vanderbilt School Dean's Consultive Committee on Promotion and Tenure

Vanderbilt School of Engineering Strategic Planning Committee

Vanderbilt School of Engineering Grants Management Task Force

Vanderbilt School of Engineering Faculty Development & Diversity Committee

Vanderbilt School of Engineering Working Group on Faculty Financial Incentives Related to Research

Vanderbilt School of Engineering Entrepreneurship Task Force

Vanderbilt School of Engineering Admission and Scholarship Committee

Vanderbilt School of Engineering Webpage Committee

Vanderbilt Goldwater Scholarship Review Committee

Vanderbilt School of Engineering Admission and Scholarship Committee

Vanderbilt School of Engineering Committee on 1<sup>st</sup> Year Engineering Curriculum

Vanderbilt School of Engineering Senior Design Committee

Robert J. Webster III, Ph.D.

Vanderbilt School of Engineering Machine Shop Committee

*Educational Outreach Activities*

**A Haptic Touch Screen to Help Blind Children “See” Graphical Mathematics.**

My student Jenna Gorlewicz and I developed a vibratory touch screen interface that displays graphical mathematics concepts to blind children through touch. The concept is to use vibrations of different frequencies and amplitudes to represent different objects and to display them as the user’s finger explores the screen and passes over them. This enables blind children to feel concepts that most students would learn by sight. We obtained IRB approval for this concept and partnered with Metro Nashville principals, teachers, parents and blind students to test the idea. A video on this project can be found by searching YouTube for Teaching Through Touch. It also resulted in the following publication: J. L. Gorlewicz, J. Burgner, T. J. Withrow, and R. J. Webster III, Initial Experiences Using Vibratory Touchscreens to Display Graphical Math Concepts to Students with Visual Impairments, *Journal of Special Education Technology*, 29(2), 17-26, 2014.

**Research Experiences for Teachers Mentor**

I have hosted high school teachers for four different summer-long research experiences in my laboratory. These led to curricula that the teachers could bring back to their classrooms on robotic and dynamic systems, including hands-on demonstrations that they could share with their students.

**Lab Tours for Middle and High School Students**

My lab has supported many tours for groups of high school and middle school students to expose them to engineering, and get them excited about careers in science and technology.

**Engineering Course at a Local High School**

Nearly every year my graduate students teach a three week long engineering class at a local girls high school. In it they present many different aspects of engineering including hands-on robotics projects, as well as competitions like popsicle stick bridge building and breaking under loads. This course exposes the girls to many aspects of engineering, science, and technology and serves as an outreach to young women at an age when positive experiences with these topics can have career-long positive impacts.

**PERSONAL DATA**

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Laboratory Web page: <http://research.vuse.vanderbilt.edu/MEDLab/>