Winona Richey, PhD

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RESEARCH INTERESTS

Computer-Assisted Surgical Navigation • Computer Vision • Machine Learning

EDUCATION

2017-2022 Doctor of Philosophy, *Biomedical Engineering*,
Vanderbilt University, Nashville, TN

2013- 2017 Bachelor of Science, *Biomedical Engineering and Computer Science*,
Tulane University, New Orleans, LA

EXPERIENCE

2022 – Present *PolarisAR*, Staff Research Engineer Dallas, TX (Remote)

- Contributing to the design, implementation, and testing for a total knee arthroplasty surgical guidance platform in augmented reality
- Independently developed tests and analysis tools to characterize point-based and planar tracking accuracy. Authored test reports resulting in FDA clearance without additional information requests.

2017 - 2022 *Biomedical Modeling Lab,* with Dr. Michael Miga;
Vanderbilt University, Nashville, TN

- Dissertation Title: "*A System for Image Guided Breast Conserving Surgery: Leveraging Computer Vision*"
- Characterized supine breast deformations using a custom guidance system for data acquisition and visualization in breast surgery
- Established a model-based breast deformation correction approach using preoperative MR images and sparse intraoperative data
- Developed a framework to monitor soft tissue deformations with automatic computer vision tracking of inked skin fiducials

2016 - 2017 *Biomedical Engineering Lab*, with Dr. Doug Chrisey;
Tulane University, New Orleans, LA

- Thesis Title: "*Matrix assisted pulsed laser evaporation direct write (MAPLE-DW) automated transfer validation: a machine learning approach*"
- Designed experiments and software for detection of 3D bioprinting cell transfers using image processing and machine learning

2016 *NSF REU: Center for Research in Computer Vision*, with Dr. Ulas Bagci;
University of Central Florida, Orlando, FL

- Implemented hand crafted features, combined with deep learning features for lung nodule detection in CT scans

PUBLICATIONS

1. H. J. Cooper, A. Young, J. B. Brenza, M. E. King, **W. L. Richey**. "Accuracy of a novel mixed reality surgical platform for total knee arthroplasty," Arthroplasty Today (In Progress).

2. M. J. Ringel, **W. L. Richey**, J. S. Heiselman, A. Stabile, I. M. Meszoely, and M. I. Miga, "Image Guidance System for Breast Conserving Surgery with Integrated Stereo Camera Monitoring and Deformable Correction," in Medical Imaging 2024: Image-Guided Procedures, Robotic Interventions, and Modeling, 2024. SPIE.
3. M. J. Ringel, **W. L. Richey**, J. S. Heiselman, I. M. Meszoely, and M. I. Miga, "Incorporating heterogeneity and anisotropy for surgical applications in breast deformation modeling," Clinical Biomechanics, vol. 104, p. 105927, 2023.
4. M. J. Ringel, J. S. Heiselman, **W. L. Richey**, I. M. Meszoely, and M. I. Miga, "Regularized Kelvinlet Functions to Model Linear Elasticity for Image-to-Physical Registration of the Breast," in International Conference on Medical Image Computing and Computer-Assisted Intervention, 2023: Springer, pp. 344-353.
5. A. Espinosa, M. J. Ringel, J. S. Heiselman, K. Pereira, F. Servin, **W. L. Richey**, I. Meszoely, and M. I. Miga, "Modeling retraction for breast conserving surgery guidance," in Medical Imaging 2023: Image-Guided Procedures, Robotic Interventions, and Modeling, 2023, vol. 12466: SPIE, pp. 535-540.
6. M. I. Miga, M. Luo, J. Tierney, **W. L. Richey**, J. S. Heiselman, and R. C. Thompson, "Accounting for brain shift during image-guided tumor resection surgeries: an intraoperative feasibility study," in Medical Imaging 2023: Image-Guided Procedures, Robotic Interventions, and Modeling, 2023, vol. 12466: SPIE, pp. 265-275.
7. W. Stabile, M. J. Ringel, **W. L. Richey**, J. S. Heiselman, I. Meszoely, and M. I. Miga, "Stereovision registration using a tracked checkerboard calibration object for a breast surgery image guidance system," in Medical Imaging 2023: Image-Guided Procedures, Robotic Interventions, and Modeling, 2023, vol. 12466: SPIE, pp. 541-548.
8. Xiang, J. S. Heiselman, **W. L. Richey**, W. R. Jarnagin, and M. I. Miga, "Comparison study of intraoperative surface acquisition methods for surgical navigation," in Medical Imaging 2023: Image-Guided Procedures, Robotic Interventions, and Modeling, 2023, vol. 12466: SPIE, pp. 162-168.
9. **W. L. Richey**, J. S. Heiselman, M. J. Ringel, I. M. Meszoely, and M. I. Miga, "Soft tissue monitoring of the surgical field: detection and tracking of breast surface deformations," IEEE Transactions in Biomedical Engineering, 2023.
10. **W. L. Richey**, J. S. Heiselman, M. J. Ringel, I. M. Meszoely, and M. I. Miga, "Computational Imaging to Compensate for Soft-Tissue Deformations in Image-Guided Breast Conserving Surgery," IEEE Transactions in Biomedical Engineering, vol. 69, no. 12, pp. 3760-3771, 2022.
11. **W. L. Richey**, J. Heiselman, M. Ringel, I. M. Meszoely, and M. I. Miga, "Tumor deformation correction for an image guidance system in breast conserving surgery," in Medical Imaging 2022: Image-Guided Procedures, Robotic Interventions, and Modeling, 2022, vol. 12034: SPIE, pp. 122-128.
12. M. J. Ringel, **W. L. Richey**, J. S. Heiselman, M. Luo, I. M. Meszoely, and M. I. Miga, "Supine magnetic resonance image registration for breast surgery: insights on material mechanics," Journal of Medical Imaging, vol. 9, no. 6, pp. 065001-065001, 2022.
13. **W. L. Richey**, J. S. Heiselman, M. Luo, I. M. Meszoely, and M. I. Miga, "Impact of deformation on a supine-positioned image guided breast surgery approach," International Journal of Computer Assisted Radiology and Surgery, vol. 16, no. 11, p. 2055—2066, 2021.
14. J. S. Heiselman, **W. L. Richey**, S. L. Taylor, and M. I. Miga, "Improving accuracy of image-to-physical laparoscopic liver registration via reconstruction of intrahepatic

pressure changes from abdominal insufflation," in Medical Imaging 2021: Image-Guided Procedures, Robotic Interventions, and Modeling, 2021, vol. 11598: SPIE, p. 115980W.

15. **W. L. Richey**, J. Heiselman, M. Luo, I. M. Meszoely, and M. I. Miga, "Textual fiducial detection in breast conserving surgery for a near-real time image guidance system," in Medical Imaging 2020: Image-Guided Procedures, Robotic Interventions, and Modeling, 2020, vol. 11315: SPIE p. 113151L.
16. **W. L. Richey**, M. Luo, S. E. Goodale, L. W. Clements, I. M. Meszoely, and M. I. Miga, "A system for automatic monitoring of surgical instruments and dynamic, non-rigid surface deformations in breast cancer surgery," in Medical Imaging 2018: Image-Guided Procedures, Robotic Interventions, and Modeling, 2018, vol. 10576: SPIE, p. 105761H.
17. N. Khosravan, **W. L. Richey**, and U. Bagci, "How Deep Can Hand-Crafted Features Be?," in 40th IEEE International Engineering in Medicine and Biology Conference (EMBC), 2018.
18. S. C. Sklare, **W. L. Richey**, B. T. Vinson, and D. B. Chrisey, "Directed self-assembly software for single cell deposition," International Journal of Bioprinting, vol. 3, no. 2, 2017.

AWARDS

2022	*Edward Ferguson Jr. Graduate Award,* $5000, Vanderbilt Graduate School • For excellence in research
2021	*1st Place Poster Presentation: Vanderbilt Institute of Surgery and Engineering Symposium*
2019-2021	*T32 Graduate Fellowship Award: Vanderbilt Institute for Surgery and Engineering Training Program for Surgical and Interventional Engineering,* National Institutes of Health National Institute of Biomedical Imaging and Bioengineering T32EB021937
2020	*Poster Presentation Finalist: Vanderbilt Institute of Surgery and Engineering Symposium,* top 5 poster presentations
2018	*Honorable Mention: National Science Foundation Graduate Research Fellowship*, top 30%
2018	*Honorable Mention: Ford Foundation Graduate Research Fellowship*, top 30%
2017	*Vanderbilt Engineering Graduate Fellowship,* $5000, Vanderbilt University
2017	*Tulane 34 Award,* Tulane University • For leadership, service and academic excellence; presented to 34 graduates across undergraduate, graduate, law, and medical schools
2017	*Leaders in Service Award*; Tulane University • For improving the community through service-learning courses and student leadership
2013-2017	*Presidential Scholarship*, 50% of tuition, room and board; Tulane University

CONTRIBUTED TALKS

1. Tumor deformation correction for an image guidance system in breast conserving surgery. *SPIE Medical Imaging*. 2022
2. Textual fiducial detection in breast conserving surgery for a near-real time image guidance system. *SPIE Medical Imaging*. 2020
3. A Novel Guidance System for Breast Conserving Surgery. *Vanderbilt Ingram Cancer Center Breast Cancer Research Program Retreat.* 2020

4. Computer Vision Driven Image Guided Breast Conserving Surgery. *Research in Progress Seminar, Vanderbilt Institute of Surgery and Engineering.* 2020
5. Computer Vision Tracking in an Image Guidance System for Breast Cancer Lumpectomy. *Research in Progress Seminar, Vanderbilt Institute of Surgery and Engineering.* 2019
6. A system for automatic monitoring of surgical instruments and dynamic, non-rigid surface deformations in breast cancer surgery. *SPIE Medical Imaging*. 2018

LEADERSHIP and SERVICE

2017 - 2022 — *Women of Vanderbilt Institute of Surgery and Engineering*; Nashville, TN

- Planning Committee, 2017-2019; Founding President 2019-2020, Steering Committee 2020-2022
- Started and formalized the group to foster community, discuss translational research, and promote the success of women in STEM
- Coordinated monthly events including invited speakers, K-12 outreach, mentorship groups, and gender inequality discussions

2017 – 2022 — *Glencliff High School STEM Outreach*; Nashville, TN

- Biomedical Engineering Graduate Student Alliance Outreach Chair, 2018-2019, 2020-2021; monthly lectures and hands-on activities
- Developed and led events; introductions to Vanderbilt research areas and a discussion panel on college, research, and STEM

2017-2020 — *Vanderbilt Center for Science Outreach, Tutor*

- Tutored computer science, chemistry and pre-calculus

2019 — *Vanderbilt Biomedical Engineering Graduate Recruitment Coordinator*

- Organized the invitation weekend for prospective grad. students

2017-2018 — *Vanderbilt Students Volunteering for Science, Team Leader*

- Led weekly science lectures and hands-on activities

2015-2017 — *Tulane Center for Public Service, Leader of Service Learning Assistants*

- Provide logistical support to Senior Program Coordinator for service learning; manage mentoring and co-training of 27 service learning assistants; organize speakers/special events; aid in hiring
- Coordinated communication between community partners, Tulane professors and service learning students; managed logistics and facilitated class discussions, reflections and workshops

2016-2017 — *Tulane Academic Success Center, Tutoring Team Leader*

- Supervised team of 20 tutors; restructured team meetings to focus on teaching pedagogy; tutored chemistry, physics, calculus, and engineering courses (all levels offered)