

# Winona Richey, PhD

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## RESEARCH INTERESTS

Computer-Assisted Surgical Navigation • Computer Vision • Machine Learning

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## 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

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## 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

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## 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 Review).

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

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2022	<i>Edward Ferguson Jr. Graduate Award</i> , \$5000, Vanderbilt Graduate School <ul style="list-style-type: none"> <li>• For excellence in research</li> </ul>
2021	<i>1<sup>st</sup> Place Poster Presentation: Vanderbilt Institute of Surgery and Engineering Symposium</i>
2019-2021	<i>T32 Graduate Fellowship Award: Vanderbilt Institute for Surgery and Engineering Training Program for Surgical and Interventional Engineering</i> , National Institutes of Health National Institute of Biomedical Imaging and Bioengineering T32EB021937
2020	<i>Poster Presentation Finalist: Vanderbilt Institute of Surgery and Engineering Symposium</i> , top 5 poster presentations
2018	<i>Honorable Mention: National Science Foundation Graduate Research Fellowship</i> , top 30%
2018	<i>Honorable Mention: Ford Foundation Graduate Research Fellowship</i> , top 30%
2017	<i>Vanderbilt Engineering Graduate Fellowship</i> , \$5000, Vanderbilt University
2017	<i>Tulane 34 Award</i> , Tulane University <ul style="list-style-type: none"> <li>• For leadership, service and academic excellence; presented to 34 graduates across undergraduate, graduate, law, and medical schools</li> </ul>
2017	<i>Leaders in Service Award</i> ; Tulane University <ul style="list-style-type: none"> <li>• For improving the community through service-learning courses and student leadership</li> </ul>
2013-2017	<i>Presidential Scholarship</i> , 50% of tuition, room and board; Tulane University

## CONTRIBUTED TALKS

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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**

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2017 - 2022	<p><i>Women of Vanderbilt Institute of Surgery and Engineering</i>; Nashville, TN</p> <ul style="list-style-type: none"> <li>• Planning Committee, 2017-2019; Founding President 2019-2020, Steering Committee 2020-2022</li> <li>• Started and formalized the group to foster community, discuss translational research, and promote the success of women in STEM</li> <li>• Coordinated monthly events including invited speakers, K-12 outreach, mentorship groups, and gender inequality discussions</li> </ul>
2017 – 2022	<p><i>Glenclyff High School STEM Outreach</i>; Nashville, TN</p> <ul style="list-style-type: none"> <li>• Biomedical Engineering Graduate Student Alliance Outreach Chair, 2018-2019, 2020-2021; monthly lectures and hands-on activities</li> <li>• Developed and led events; introductions to Vanderbilt research areas and a discussion panel on college, research, and STEM</li> </ul>
2017-2020	<p><i>Vanderbilt Center for Science Outreach, Tutor</i></p> <ul style="list-style-type: none"> <li>• Tutored computer science, chemistry and pre-calculus</li> </ul>
2019	<p><i>Vanderbilt Biomedical Engineering Graduate Recruitment Coordinator</i></p> <ul style="list-style-type: none"> <li>• Organized the invitation weekend for prospective grad. students</li> </ul>
2017-2018	<p><i>Vanderbilt Students Volunteering for Science, Team Leader</i></p> <ul style="list-style-type: none"> <li>• Led weekly science lectures and hands-on activities</li> </ul>
2015-2017	<p><i>Tulane Center for Public Service, Leader of Service Learning Assistants</i></p> <ul style="list-style-type: none"> <li>• 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</li> <li>• Coordinated communication between community partners, Tulane professors and service learning students; managed logistics and facilitated class discussions, reflections and workshops</li> </ul>
2016-2017	<p><i>Tulane Academic Success Center, Tutoring Team Leader</i></p> <ul style="list-style-type: none"> <li>• Supervised team of 20 tutors; restructured team meetings to focus on teaching pedagogy; tutored chemistry, physics, calculus, and engineering courses (all levels offered)</li> </ul>