# Gregory I. Holste

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## Education

**The University of Texas at Austin**, Austin, TX
*Ph.D. in Electrical Engineering* **Aug. 2021-present**

- Ph.D. student in DICE track of ECE department
- NSF Graduate Research Fellow (2023-2025)
- Advisor: Zhangyang (Atlas) Wang

*M.S.E. in Electrical Engineering* **Aug. 2021-May 2024**

- GPA: 3.87 / 4.00

**Kenyon College**, Gambier, OH
*B.A. in Mathematics & Statistics* **Aug. 2016-May 2020**

- GPA: 3.91 / 4.00 (*summa cum laude*)
- Concentration in Scientific Computing; Minor in Biology

## Research Experience

**The University of Texas at Austin**, Austin, TX
*Visual Informatics @ UT Austin (VITA)* **Jul. 2021-present**

- Self-supervised learning for data-efficient cardiac disease diagnosis from echocardiogram videos [1,4,9,p2]
- Long-tailed learning of thorax diseases on chest X-rays [2,11]
- Organized the ICCV CVAMD 2023 workshop and CXR-LT challenges for long-tailed chest X-ray classification
- Advisor: Zhangyang (Atlas) Wang

**Weill Cornell Medicine**, New York City, NY
*Peng Lab, Population Health Sciences* **May. 2023-present**

- Deep survival analysis from longitudinal medical imaging for eye disease prognosis [p1]
- Led an open competition for multi-label, long-tailed learning on chest X-rays [2]
- Advisor: Yifan Peng

**Artera Inc**, Mountain View, CA
*Artificial Intelligence Team* **May. 2022-Oct.2022**

- Implemented methods for multimodal fusion of histopathology images and clinical data for prostate cancer prediction [8]
- Improved upon productionalized biomarker by 0.02 mean cross-validation AUROC
- Advisors: Akinori Mitani, Andre Esteva

**Michigan State University**, East Lansing, MI
*Medical Imaging & Data Integration Lab* **Aug. 2019-Jul. 2021**

- Developed and compared multimodal fusion models that learn jointly from breast MRI images and associated non-image clinical data [13]
- Applied novel ensemble methods to pediatric rib fracture detection in X-rays [3,12]

- Submitted solutions to RSNA Pulmonary Embolism Detection Challenge and MICCAI 2020 RibFrac Challenge (top 8-performing solution) [p3]
- Advisor: Adam Alessio

**Michigan State University**, East Lansing, MI
*ACRES Research Experience for Undergraduates (REU)* **Summer 2019**

- Implemented methods to segment eight regions of the chest in pediatric radiographs
- Compared methods to improve anatomic segmentation with $10^5$-fold imbalance between classes, including custom pixel weight maps and loss functions [14]
- Advisor: Adam Alessio

## Publications

[1] **G. Holste**, E.K. Oikonomou, B.J. Mortazavi, Z. Wang, R. Khera. "Efficient deep learning-based automated diagnosis from echocardiography with contrastive self-supervised learning." *Communications Medicine*. 6 July 2024.

[2] **G. Holste**, Y. Zhou, S. Wang, A. Jaiswal, M. Lin, S. Zhuge, Y. Yang, D. Kim, T. Nguyen-Mau, M. Tran, J. Jeong, W. Park, J. Ryu, F. Hong, A. Verma, Y. Yamagishi, C. Kim, H. Seo, M. Kang, L.A. Celi, Z. Lu, R.M. Summers, G. Shih, Z. Wang, Y. Peng. "Towards long-tailed, multi-label disease classification from chest X-ray: Overview of the CXR-LT challenge." *Medical Image Analysis*. 31 May 2024.

[3] J. Burkow, **G. Holste**, J. Otjen, F. Perez, J. Junewick, A. Zbojniewicz, E. Romberg, S. Menashe, J. Frost, A. Alessio. "High sensitivity methods for automated rib fracture detection in pediatric radiographs." *Scientific Reports*. 10 April 2024.

[4] E.K. Oikonomou, **G. Holste**, N. Yuan, A. Coppi, R.L. McNamara, N.A. Haynes, A.N. Vora, E.J. Velazquez, F. Li, V. Menon, S.R. Kapadia, T.M. Gill, G.N. Nadkarni, H.M. Krumholz, Z. Wang, D. Ouyang, R. Khera. "A Multimodal Video-Based AI Biomarker for Aortic Stenosis Development and Progression." *JAMA Cardiology*. 6 April 2024.

[5] V. Sangha, A. Khunte, **G. Holste**, B.J. Mortazavi, Z. Wang, E.K. Oikonomou, R. Khera. "Biometric contrastive learning for data-efficient deep learning from electrocardiographic images." *Journal of the American Medical Informatics Association*. 24 January 2024.

[6] M. Lin, T. Li, Y. Yang, **G. Holste**, Y. Ding, S.H. Van Tassel, K. Kovacs, G. Shih, Z. Wang, Z. Lu, F. Wang, Y. Peng. "Improving model fairness in image-based computer-aided diagnosis." *Nature Communications*. 6 October 2023.

[7] **G. Holste**, Z. Jiang, A. Jaiswal, M. Hanna, S. Minkowitz, A.C. Legasto, J.G. Escalon, S. Steinberger, M. Bittman, T.C. Shen, Y. Ding, R.M. Summers, G. Shih, Y. Peng, Z. Wang. "How Does Pruning Impact Long-Tailed Multi-Label Medical Image Classifiers?" in *Proc. Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2023*. 1 October 2023.

[8] **G. Holste**, D. van der Wal, H. Pinckaers, R. Yamashita, A. Mitani, A. Esteva. "Improved Multimodal Fusion for Small Datasets with Auxiliary Supervision" in *Proc. IEEE International Symposium on Biomedical Imaging (ISBI) 2023*. 1 September 2023.

[9] **G. Holste**, E.K. Oikonomou, B.J. Mortazavi, A. Coppi, K.F. Faridi, E.J. Miller, J.K. Forrest, R.L. McNamara, L. Ohno-Machado, N. Yuan, A. Gupta, D. Ouyang, H.M. Krumholz, Z. Wang, R. Khera. "Severe aortic stenosis detection by deep learning applied to echocardiography." *European Heart Journal*. 23 August 2023.

[10] Y. Han, **G. Holste**, Y. Ding, A. Tewfik, Y. Peng, Z. Wang. "Radiomics-Guided Global-Local Transformer for Weakly Supervised Pathology Localization in Chest X-Rays." *IEEE Transactions on Medical Imaging*. 26 October 2022.

[11] **G. Holste**, S. Wang, Z. Jiang, T.C. Shen, G. Shih, R.M. Summers, Y. Peng, Z. Wang. "Long-Tailed Classification of Thorax Diseases on Chest X-Ray: A New Benchmark Study" in *Proc. MICCAI Workshop on Data Augmentation, Labelling, and Imperfections*. 16 September 2022.

[12] J. Burkow, **G. Holste**, J. Otjen, F. Perez, J. Junewick, A. Alessio. "Avalanche decision schemes to improve pediatric rib fracture detection" in *Proc. SPIE Medical Imaging 2022: Computer-Aided Diagnosis*. 4 April 2022.

[13] **G. Holste**, S. Partridge, H. Rahbar, D. Biswas, C. Lee, A. Alessio. "End-to-End Learning of Fused Image and Non-Image Features for Improved Breast Cancer Classification from MRI" in *Proc. International Conference on Computer Vision (ICCV) Workshops*. 31 October 2021.

[14] **G. Holste**, R. Sullivan, M. Bindschadler, N. Nagy, A. Alessio. "Multi-class semantic segmentation of pediatric chest radiographs" in *Proc. SPIE Medical Imaging 2020: Image Processing*. 10 March 2020.

[15] R. Sullivan, **G. Holste**, J. Burkow, A. Alessio. "Deep learning methods for segmentation of lines in pediatric chest radiographs" in *Proc. SPIE Medical Imaging 2020: Computer-Aided Diagnosis*. 16 March 2020.

## Preprints

[p1] **G. Holste**, M. Lin, R. Zhou, F. Wang, L. Liu, Q. Yan, S.H. Van Tassel, K. Kovacs, E.Y. Chew, Z. Lu, Z. Wang, Y. Peng. "Harnessing the power of longitudinal medical imaging for eye disease prognosis using Transformer-based sequence modeling." *arXiv preprint*. 14 May 2024.

[p2] E.K. Oikonomou, **G. Holste**, A. Coppi, R.L. McNamara, G. Nadkarni, C. Baloescu, H. Krumholz, Z. Wang, R. Khera. "Artificial intelligence-guided detection of under-recognized cardiomyopathies on point-of-care cardiac ultrasound." *medRxiv preprint*. 15 March 2024.

[p3] J. Yang, R. Shi, L. Jin, X. Huang, K. Kuang, D. Wei, S. Gu, J. Liu, P. Liu, Z. Chai, Y. Xiao, H. Chen, L. Xu, B. Du, X. Yan, H. Tang, A. Alessio, G. Holste, J. Zhang, X. Wang, J. He, L. Che, H. Pfister, M. Li, B. Ni. "Deep Rib Fracture Instance Segmentation and Classification from CT on the RibFrac Challenge." *arXiv preprint*. 14 February 2024.

[p4] M. Lin, T. Li, Z. Sun, **G. Holste**, Y. Ding, F. Wang, G. Shih, Y. Peng. "Improving Fairness of Automated Chest X-ray Diagnosis by Contrastive Learning." *arXiv preprint*. 25 January 2024.

## Honors/ Awards

**NSF Graduate Research Fellowship (GRFP)** **Mar. 2023-2026**
*National Science Foundation fellowship for outstanding STEM graduate students*

**Dean's Prestigious Fellowship Supplement** **Sep. 2023**
*UT Austin award for graduate students receiving prestigious external scholarships*

**Ram's Horn Best Project Award** **Apr. 2023**
*Best student project in Alan Bovik's EE 381K: Digital Video*

**Charles W. & Margaret A. Tolbert Endowed Scholarship** **Aug. 2021**
*UT Austin Cockrell School of Engineering scholarship for top incoming engineering students*

**Phi Beta Kappa** **May 2020**
*Elected to Kenyon College's chapter of the national honor society*

**Sigma Xi** **Feb. 2020**
*Inducted into the Kenyon-Denison chapter of the national science research honor society*

**Pi Mu Epsilon** **Apr. 2018**
*Elected to the Ohio Pi chapter of the national mathematics society*

**Wendell D. Lindstrom Memorial Prize** **Apr. 2018**
*One of 12 students given prize for outstanding mathematics students at Kenyon College*

**Kenyon College Merit List (8x)** **every semester**

## Oral Presentations

**Long-Tailed Classification of Thorax Diseases on Chest X-Ray: A New Benchmark Study**
*MICCAI Workshop on Data Augmentation, Labelling, & Imperfections, Singapore* **Sep. 2022**

**Multi-class semantic segmentation of pediatric radiographs**
*SPIE Medical Imaging: Image Processing, Houston, TX* **Feb. 2020**

## Scientific Abstracts

**Cross-modal validation of an artificial intelligence video-based approach for the automated risk stratification of aortic stenosis**
E.K. Oikonomou, **G. Holste**, G. Nadkarni, Z. Wang, R. Khera
*American College of Cardiology (ACC) Scientific Session* **Apr. 2024**

**ECG-GPT: Automated Complete Diagnosis Generation From ECG Images Using Novel Vision-Text Transformer Model**
A. Khunte, V. Sangha, **G. Holste**, L.S. Dhingra, A. Aminorroaya, Z. Wang, R. Khera
*American Heart Association (AHA) 2023, Philadelphia, PA* **Nov. 2023**

**Predicting aortic stenosis progression using a video-based deep learning model of aortic stenosis built for single-view two-dimensional echocardiography**
E.K. Oikonomou, **G. Holste**, R.L. Mcnamara, E.J. Velazquez, G.N. Nadkarni, D. Ouyang, H.M. Krumholz, Z. Wang, R. Khera
*European Society of Cardiology (ESC) Congress 2023, London, UK* **Aug. 2023**

**Biometric Contrastive Modeling for Data-Efficient Deep Learning from Electrocardiographic Images**
V. Sangha, A. Khunte, **G. Holste**, B. Mortazavi, Z. Wang, E.K. Oikonomou, R. Khera
*American College of Cardiology (ACC) Scientific Session* **Mar. 2023**

**Long-Tailed Classification of Thorax Diseases on Chest X-Ray**

**G. Holste**, S. Wang, Z. Jiang, T.C. Shen, G. Shih, R.M. Summers, Y. Peng, Z. Wang
*Radiological Soceity of North America (RSNA) 2022, Chicago, IL* **Nov. 2022**

**Automated Detection of Aortic Stenosis From Single-View 2-Dimensional Echocardiography Using a Semi-Supervised, Contrastive Learning Approach**
E.K. Oikonomou, **G. Holste**, B. Mortazavi, Z. Wang, R. Khera
*American Heart Association (AHA) 2022, Chicago, IL* **Nov. 2022**

**Self-Supervised Learning of Echocardiogram Videos Enables Data-Efficient Clinical Diagnosis**
**G. Holste**, E.K. Oikonomou, B. Mortazavi, Z. Wang, R. Khera
*ICML Workshop on Interpretable Machine Learning in Healthcare, Baltimore, MD* **Jul. 2022**

**Rib fracture detection in pediatric radiographs via deep convolutional neural networks**
J. Burkow, **G. Holste**, F. Perez, J. Junewick, A. Zbojniewicz, J. Frost, E. Romberg, S. Menashe, J. Otjen, A. Alessio
*International Pediatric Radiology Congress, Milan, Italy* **Oct. 2021**

**Automatic segmentation of chest radiographs with deep learning**
**G. Holste**, R. Sullivan, N. Nagy, M. Bindschadler, A. Alessio
*Mid-SURE Symposium, East Lansing, MI* **Jul. 2019**

**Deep learning methods for automatic evaluation of lines in chest radiographs**
R. Sullivan, **G. Holste**, A. Alessio
*Mid-SURE Symposium, East Lansing, MI* **Jul. 2019**

## Invited Talks

**Self-supervised learning for echocardiography**
*Cardiovascular Data Science (CarDS) Lab, New Haven, CT* **Jul. 2023**

**Fusing imaging and clinical information for improved automatic breast cancer detection**
*MSU Virtual Imaging Research Symposium, East Lansing, MI* **Feb. 2021**

**Automatic segmentation of pediatric chest radiographs**
*Kenyon College Math Monday, Gambier, OH* **Nov. 2019**

## Service

**Organizer**: CXR-LT 2024, ICCV CVAMD 2023, CXR-LT 2023

**Conference Reviewer**: NeurIPS 2024, ECCV 2024, MICCAI 2024, CVPR 2024, ICML 2024, IEEE ISBI 2024, ICCV CVAMD 2023, NeurIPS 2023, ICML 2023

**Journal Reviewer**: JAMA Cardiology, European Heart Journal, Artificial Intelligence in Medicine, IEEE Journal of Biomedical and Health Informatics, PLoS One, ACM Transactions on Computing for Healthcare