Shuyue Guan

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Education

The George Washington University (GWU) Washington, DC USA
Ph.D. in Biomedical Engineering 5/2022

- Advisor: Murray H. Loew
- Dissertation: "Toward Explainability of Machine Learning in Medical Imaging: Generalizability, Separability, and Learnability"

The George Washington University Washington, DC USA
M.S. in Computer Science 12/2016

- Advisor: Claire Monteleoni

Northeast Forestry University (NEFU) Harbin, China
M.S. in Biophysics 6/2013

- Advisor: Dawei Qi
- Thesis: "Non-destructive Testing of Composite Panel Internal Defect" (in Chinese)

Northeast Forestry University Harbin, China
B.S. in Physics 6/2010

Employment

U.S. Food and Drug Administration Silver Spring, MD
Visiting Scientist 8/2022–Present
ORISE Research Fellow 9/2021–7/2022

The George Washington University Washington, DC
Graduate Teaching Assistant 1–12/2016, 1/2018–8/2021
Graduate Research Assistant 1–12/2017

Publications

Journal Articles

10. A. Badano, M. Lago, E. Sizikova, J. Delfino, **S. Guan**, M. A. Anastasio, and B. Sahiner, "The stochastic digital human is now enrolling for in silico imaging trials–methods and tools for generating digital cohorts", *Progress in Biomedical Engineering*, vol. 5, no. 4, p. 042 002, 2023. DOI: 10.1088/2516-1091/ad04c0.
9. A. Lou, **S. Guan**, and M. Loew, "Caranet: Context axial reverse attention network for segmentation of small medical objects", *Journal of Medical Imaging*, vol. 10, no. 1, pp. 014 005–014 005, 2023. DOI: 10.1117/1.JMI.10.1.014005.

8. A. Lou, **S. Guan**, and M. Loew, "Cfpnet-m: A light-weight encoder-decoder based network for multimodal biomedical image real-time segmentation", *Computers in Biology and Medicine*, vol. 154, p. 106 579, 2023. DOI: 10.1016/j.compbiomed.2023.106579.
7. **S. Guan** and M. Loew, "A distance-based separability measure for internal cluster validation", *International Journal on Artificial Intelligence Tools*, vol. 31, no. 07, p. 2 260 005, 2022. DOI: 10.1142/S0218213022600053.
6. **S. Guan** and M. Loew, "A novel intrinsic measure of data separability", *Applied Intelligence*, vol. 52, no. 15, pp. 17 734–17 750, Dec. 2022, ISSN: 1573-7497. DOI: 10.1007/s10489-022-03395-6.
5. **S. Guan** and M. Loew, "A novel measure to evaluate generative adversarial networks based on direct analysis of generated images", *Neural Computing and Applications*, vol. 33, no. 20, pp. 13 921–13 936, 2021. DOI: 10.1007/s00521-021-06031-5.
4. **S. Guan** and M. Loew, "Breast cancer detection using synthetic mammograms from generative adversarial networks in convolutional neural networks", *Journal of Medical Imaging*, vol. 6, no. 3, pp. 031 411–031 411, Jul. 2019. DOI: 10.1117/1.JMI.6.3.031411.
3. H. Asfour, **S. Guan**, N. Muselimyan, L. Swift, M. Loew, and N. Sarvazyan, "Optimization of wavelength selection for multispectral image acquisition: A case study of atrial ablation lesions", *Biomedical Optics Express*, vol. 9, no. 5, pp. 2189–2204, May 2018. DOI: 10.1364/BOE.9.002189.
2. **S. Guan**, H. Asfour, N. Sarvazyan, and M. Loew, "Application of unsupervised learning to hyperspectral imaging of cardiac ablation lesions", *Journal of Medical Imaging*, vol. 5, no. 4, pp. 046 003–046 003, Oct. 2018. DOI: 10.1117/1.JMI.5.4.046003.
1. H. Mu, M. Zhang, D. Qi, **S. Guan**, and H. Ni, "Wood defects recognition based on fuzzy BP neural network", *International Journal of Smart Home*, vol. 9, no. 5, pp. 143–152, 2015. DOI: 10.14257/ijsh.2015.9.5.14.

Conference Papers

19. **S. Guan**, R. K. Samala, S. M. M. Kahaki, and W. Chen, "Restorable synthesis: Average synthetic segmentation converges to a polygon approximation of an object contour in medical images", in *2024 IEEE Southwest Symposium on Image Analysis and Interpretation (SSIAI)*, 2024, pp. 77–80. DOI: 10.1109/SSIAI59505.2024.10508669.
18. A. Arab, V. Garcia, **S. Guan**, B. D. Gallas, B. Sahiner, N. Petrick, and W. Chen, "Effect of color-normalization on deep learning segmentation models for tumor-infiltrating lymphocytes scoring using breast cancer histopathology images", in *Medical Imaging 2023: Digital and Computational Pathology*, SPIE, vol. 12471, 2023, pp. 390–394. DOI: 10.1117/12.2653989.
17. **S. Guan** and M. Loew, "The training accuracy of two-layer neural networks: Its estimation and understanding using random datasets", in *2023 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, 2023, pp. 1–9. DOI: 10.1109/AIPR60534.2023.10440662.
16. **S. Guan**, R. K. Samala, A. Arab, and W. Chen, "Miss-tool: Medical image segmentation synthesis tool to emulate segmentation errors", in *Medical Imaging 2023: Computer-Aided Diagnosis*, SPIE, vol. 12465, 2023, pp. 273–281. DOI: 10.1117/12.2653650.
15. **S. Guan**, R. K. Samala, and W. Chen, "Informing selection of performance metrics for medical image segmentation evaluation using configurable synthetic errors", in *2022 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, IEEE, 2022, pp. 1–8. DOI: 10.1109/AIPR57179.2022.10092203.
14. A. Lou, **S. Guan**, H. Ko, and M. H. Loew, "CaraNet: context axial reverse attention network for segmentation of small medical objects", in *Medical Imaging 2022: Image Processing*, International Society for Optics and Photonics, vol. 12032, SPIE, 2022, pp. 81–92. DOI: 10.1117/12.2611802.

13. **S. Guan** and M. Loew, "A sneak attack on segmentation of medical images using deep neural network classifiers", in *2021 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, 2021, pp. 1–8. DOI: 10.1109/AIPR52630.2021.9762077.
12. A. Lou, **S. Guan**, and M. H. Loew, "DC-UNet: rethinking the U-Net architecture with dual channel efficient CNN for medical image segmentation", in *Medical Imaging 2021: Image Processing*, International Society for Optics and Photonics, vol. 11596, SPIE, 2021, pp. 749–759. DOI: 10.1117/12.2582338.
11. **S. Guan** and M. Loew, "An internal cluster validity index using a distance-based separability measure", in *2020 IEEE 32nd International Conference on Tools with Artificial Intelligence (ICTAI)*, 2020, pp. 827–834. DOI: 10.1109/ICTAI50040.2020.00131.
10. **S. Guan** and M. Loew, "Analysis of generalizability of deep neural networks based on the complexity of decision boundary", in *2020 19th IEEE International Conference on Machine Learning and Applications (ICMLA)*, 2020, pp. 101–106. DOI: 10.1109/ICMLA51294.2020.00025.
9. **S. Guan** and M. Loew, "Understanding the ability of deep neural networks to count connected components in images", in *2020 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, 2020, pp. 1–7. DOI: 10.1109/AIPR50011.2020.9425331.
8. **S. Guan** and M. Loew, "Evaluation of generative adversarial network performance based on direct analysis of generated images", in *2019 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, 2019, pp. 1–5. DOI: 10.1109/AIPR47015.2019.9174595.
7. **S. Guan** and M. Loew, "Using generative adversarial networks and transfer learning for breast cancer detection by convolutional neural networks", in *Medical Imaging 2019: Imaging Informatics for Healthcare, Research, and Applications*, vol. 10954, SPIE, 2019, pp. 306–318. DOI: 10.1117/12.2512671.
6. A. Lou, **S. Guan**, N. Kamona, and M. Loew, "Segmentation of infrared breast images using MultiResUnet neural networks", in *2019 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, 2019, pp. 1–6. DOI: 10.1109/AIPR47015.2019.9316541.
5. **S. Guan**, N. Kamona, and M. Loew, "Segmentation of thermal breast images using convolutional and deconvolutional neural networks", in *2018 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, 2018, pp. 1–7. DOI: 10.1109/AIPR.2018.8707379.
4. **S. Guan**, M. Loew, H. Asfour, N. Sarvazyan, and N. Muselimyan, "Lesion detection for cardiac ablation from auto-fluorescence hyperspectral images", in *Medical Imaging 2018: Biomedical Applications in Molecular, Structural, and Functional Imaging*, vol. 10578, SPIE, 2018, pp. 389–403. DOI: 10.1117/12.2293652.
3. **S. Guan** and M. Loew, "Breast cancer detection using transfer learning in convolutional neural networks", in *2017 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, 2017, pp. 1–8. DOI: 10.1109/AIPR.2017.8457948.
2. Y. Han, D. Qi, and **S. Guan**, "Application of computed tomography in wood-polymer composites density detection", in *Materials Science and Engineering Technology (ISMSET)*, ser. Advanced Materials Research, vol. 428, Feb. 2012, pp. 57–60. DOI: 10.4028/www.scientific.net/AMR.428.57.
1. **S. Guan**, D. Qi, and Y. Han, "Automatic fiberboard density testing based on application of computed tomography", in *International Conference on Information and Business Intelligence*, Springer, 2011, pp. 614–620. DOI: 10.1007/978-3-642-29084-8_95.

Academic Reports

4. T. Serani, C. Kang, G. Saab, **S. Guan**, N. H. Choe, and M. Loew, "Portable and affordable ophthalmic disease detection system", in *International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 2021, Paper ThDT1.16.
3. **S. Guan** and D. Qi, "Defect edge detection in blockboard x-ray images by Shannon entropy", in *Advances in Information Sciences and Service Sciences*, vol. 5, 2013, pp. 988–996.
2. **S. Guan** and D. Qi, "Defects description in blockboard by Hough transform and minimum-perimeter polygons", in *International Journal of Advancements in Computing Technology*, 23, vol. 4, 2012, pp. 365–375.
1. **S. Guan** and D. Qi, "Multifractal analysis of blockboard x-ray images for the defect detection", in *Advances in Information Sciences and Service Sciences*, 18, vol. 4, 2012, pp. 149–156.

Manuscripts

1. **S. Guan** and W. Chen, "Restorable segmentation synthesis using fourier descriptors: average synthetic segmentation converges to an object contour in medical images", accepted by *SPIE Medical Imaging: Image Processing*, 2025.

Academic Service

Reviewer for Journals Reviewed journal papers: 67

- IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)
- IEEE Transactions on Neural Networks and Learning Systems (TNNLS)
- IEEE Transactions on Evolutionary Computation (TEVC)
- IEEE Transactions on Medical Imaging (TMI)
- IEEE Transactions on Big Data (TBD)
- IEEE Internet of Things (IoT)
- IEEE Access
- SPIE Journal of Medical Imaging (JMI)
- ACM Transactions on Knowledge Discovery from Data (TKDD)
- Pattern Recognition (PR), Elsevier
- Pattern Recognition Letters (PRL), Elsevier
- International Journal of Medical Informatics, Elsevier
- Expert Systems with Applications, Elsevier
- Chaos, Solitons & Fractals, Elsevier
- Journal of Ambient Intelligence and Humanized Computing, Springer
- Computational Intelligence and Neuroscience, Hindawi
- Mathematical Problems in Engineering, Hindawi
- Computational Intelligence, Wiley
- Biomedical Engineering (Applications, Basis and Communications), World Scientific

Reviewer for Conferences

- 2024/2025 SPIE Medical Imaging
- 2021-2024 IEEE Winter Conference on Applications of Computer Vision (WACV)

- 2023 IEEE International Symposium on Biomedical Imaging (ISBI)
- 24th International Conference on Artificial Intelligence and Statistics (AISTATS 2021)

Other Service

- **Program Committee** of 2024/2025 SPIE Medical Imaging - Image Processing Conference
- **Committee Member** of AIPR 2025: 53rd Applied Imagery Pattern Recognition Workshop
- **Guest Editor** of the Special Issue on *Informatics* (ISSN 2227-9709): Innovative AI-Based Approaches to Image Segmentation
- **Guest Editor** of the Special Issue on *Diagnostics* (ISSN 2075-4418): Deep Learning in Medical and Biomedical Image Processing
- **Session Chair** for 2024 SPIE Medical Imaging - Image Processing Conference: Session 9 (Explainable and Trustworthy AI), San Diego CA. (February 2024)
- **Session Chair** for 2022 SPIE Medical Imaging - Image Processing Conference: Session 4 (Classification and Detection) and Session 7 (Segmentation II), San Diego CA. (February 2022)

Research Experience

Research Areas: Machine Learning, Deep Learning, Image Processing, Computer Vision, and their applications in Medical Imaging

Evaluation of Medical Image Segmentation 9/2021–Present
Division of DIDSR at FDA, Silver Spring, MD. Project Leader: Weijie Chen

- Develop a framework including methodologies and tools for the assessment of segmentation performance metrics, annotation fusing methods, and medical image segmentation algorithms.
- Generate synthetic segmentations (contours) from a reference segmentation.
- Extract manual segmentations of tumors or lesions from DICOM data files and combine inter-observers' segmentations.

Transparent Deep Learning 6/2018–12/2023
Department of Biomedical Engineering at GWU, Washington, DC. Advisor: Murray H. Loew

- Examining the learnability of deep learning models by studying the subitizing ability of Convolutional Neural Networks and the training accuracy bound for two-layer Fully-Connected Neural Networks.
- Created a score to define and measure the complexity of decision boundaries of deep neural networks; the measure can be used to analyze the generalizability of deep learning models.
- Created the Distance-based Separability Index (DSI), which is independent of the classifier model, to measure the separability of datasets.
- Characterized the performance of a good Generative Adversarial Network (GAN) according to its Creativity, Inheritance, and Diversity; then, applied the data separability measure based on the three aspects to evaluate the performances of GANs.

Deep Learning Applications on Medical Images 6/2017–6/2023
Department of Biomedical Engineering at GWU, Washington, DC. Advisor: Murray H. Loew

- Segmented breast areas from thermal breast images by using neural network-based segmentation models, such as the autoencoder-like and U-Net-like models.
- Improved the performance of breast cancer detection via applying transfer learning and the Generative Adversarial Network with the Convolutional Neural Networks to provide additional training data.

Hyperspectral Images-based Cardiac Ablation Lesion Detection 10/2016–5/2018
Department of Biomedical Engineering at GWU, Washington, DC. Advisor: Murray H. Loew

– Designed processes to detect cardiac lesions in auto-fluorescence-based hyper-spectral images by using k-means clustering and to select the essential spectral bands to optimize the process of multi-spectral image acquisition.

Climate (Frost Point) Data Collection and Analysis 5/2016–9/2016

Department of Computer Science at GWU, Washington, DC. Advisor: Claire Monteleoni

– Developed a program in the R language to download, extract, and merge global climate data (*e.g.*, temperature, pressure, and humidity) from two resources (netCDF-4 and GRIB-1) and compute the global frost points distributions beginning from 1948.

Scene Image Identification and Positioning 7/2014–9/2014

Department of Computer Science at Harbin Institute of Technology, Harbin, China. Advisor: Dongjie Zhu

– Applied the Maximally Stable Extremal Regions (MSER) to scene text extraction for scene image identification and positioning.

Non-destructive Testing for Wooden Materials 5/2011–5/2013

College of Science at NEFU, Harbin, China. Advisor: Dawei Qi

– Created a line-based description by using Hough transform and Minimum-Perimeter Polygons (MPP) for defects description in blockboard.

– Applied multi-fractal analysis for defects recognition of blockboard X-ray images.

– Analyzed the relationship between fiberboard density and its Computed Tomography (CT) number by linear regression for automatic fiberboard density testing.

Design of Chinese Medicine Ultrasonic Extraction Machine 2/2009–5/2009

College of Science at NEFU, Harbin, China. Adviser: Runzhou Su

– Joined the undergraduate innovative experimental projects of NEFU.

– Explored using the cavitation of ultrasound to improve the extraction efficiency and concentration of active ingredients from traditional Chinese medicine.

Presentations

Invited Talks

– Invited Speaker, FDA/CDRH/OSEL/DIDSR AI/ML Seminar, "A Novel Intrinsic Measure of Data Separability – the Distance-based Separability Index (DSI) and its Applications", Online. (December 6, 2021)

– Invited Graduate Presentation for the GW BME Day, "Introduce to an Intrinsic Measure of Data Separability – the Distance-based Separability Index (DSI)", Washington DC. (November 1, 2021)

– Invited Speaker, FDA/CDRH/OSEL/DIDSR Q&A and Special Topics, "Analysis of Generalizability of Deep Neural Networks Based on the Complexity of Decision Boundary", Online. (May 27, 2021)

Conferences

– 2024 IEEE Southwest Symposium on Image Analysis and Interpretation (SSIAI), "Restorable synthesis: average synthetic segmentation converges to a polygon approximation of an object contour in medical images", Santa Fe, New Mexico (March 2024)

– 52th IEEE Applied Imagery Pattern Recognition (AIPR), "The training accuracy of two-layer neural networks: its estimation and understanding using random datasets", St. Louis, Missouri (September 2023)

– 51th IEEE Applied Imagery Pattern Recognition (AIPR), "Informing selection of performance metrics for medical image segmentation evaluation using synthetic segmentations", Washington DC. (October 2022)

– 50th IEEE Applied Imagery Pattern Recognition (AIPR), "A Sneak Attack on Segmentation of Medical Images Using Deep Neural Network Classifiers", Online. (October 2021)
– 19th IEEE International Conference on Machine Learning and Applications (ICMLA), "Analysis of Generalizability of Deep Neural Networks Based on the Complexity of Decision Boundary", Online. (December 2020)
– 32th IEEE International Conference on Tools with Artificial Intelligence (ICTAI), "An Internal Cluster Validity Index Using a Distance-based Separability Measure", Online. (November 2020)
– 49th IEEE Applied Imagery Pattern Recognition (AIPR), "Understanding the Ability of Deep Neural Networks to Count Connected Components in Images", Online. (October 2020)
– 48th IEEE Applied Imagery Pattern Recognition (AIPR), "Evaluation of Generative Adversarial Network Performance Based on Direct Analysis of Generated Images", Washington DC. (October 2019)
– 2019 SPIE Medical Imaging Conference, "Using Generative Adversarial Networks and Transfer Learning for Breast Cancer Detection by Convolutional Neural Networks", San Diego CA. (February 2019)
– 47th IEEE Applied Imagery Pattern Recognition (AIPR), "Segmentation of Thermal Breast Images Using Convolutional and Deconvolutional Neural Networks", Washington DC. (October 2018)
– 14th International Workshop on Breast Imaging (IWBI), "Breast Cancer Detection Using Synthetic Mammograms from Generative Adversarial Networks in Convolutional Neural Networks", Atlanta GA. (July 2018)
– 15th IEEE International Symposium on Biomedical Imaging (ISBI), "Breast Cancer Detection Using Transfer Learning in Convolutional Neural Networks", Washington DC. (April 2018)
– 2018 SPIE Medical Imaging Conference, "Lesion Detection for Cardiac Ablation from Auto-fluorescence Hyperspectral Images", Houston TX. (February 2018)
– 46th IEEE Applied Imagery Pattern Recognition (AIPR), "Breast Cancer Detection Using Transfer Learning in Convolutional Neural Networks", Washington DC. (October 2017)

Others

– GW SEAS R&D Showcase, "A Novel Intrinsic Measure of Data Separability". (April 2022)
– Special Topic Lecture in Lab Meeting, "Optimization and Troubleshooting in Machine Learning". (April 2022)
– GW Research Showcase, "A Novel Intrinsic Measure of Data Separability". (April 2022)
– Special Topic Lecture in Pattern Recognition and Machine Learning course, "Software Tools for Machine Learning & Deep Learning". (September 2021)
– GW Research Showcase, "A Novel Measure to Evaluate Generative Adversarial Networks Based on Direct Analysis of Generated Images". (April 2021)
– Special Topic Lecture in Lab Meeting, "High Performance Computing in GWU". (November 2020)
– GW BME Day, "Evaluation of Generative Adversarial Network Performance Based on Direct Analysis of Generated Images". (November 2019)
– GW SEAS R&D Showcase, "Evaluation of Generative Adversarial Network Performance Based on Direct Analysis of Generated Images". (October 2019)
– GW Research Showcase, "Can a Convolutional Neural Network Implement Histogram Equalization in Image Analysis?". (April 2019)
– GW BME Day, "Segmentation of Thermal Breast Images Using Convolutional and Deconvolutional Neural Networks". (November 2018)

- GW Research Showcase, "Breast Cancer Detection Using Transfer Learning in Convolutional Neural Networks". (April 2018)
- GW SEAS R&D Showcase, "Breast Cancer Detection Using Transfer Learning in Convolutional Neural Networks". (February 2018)
- GW Research Showcase, "Toward Real-time Lesion Detection for Cardiac Ablation from Auto-fluorescence Hyperspectral Images". (April 2017)
- GW SEAS R&D Showcase, "Lesion Detection for Cardiac Ablation from Auto-fluorescence Hyperspectral Images". (February 2017)

Teaching Assistant

- Biomedical Engineering Capstone Project Lab — Spring 2021, Spring 2018
  BME 4925W, BME 3915W (Senior Undergraduate Courses at GWU)
- Computer Vision — Fall 2020, Spring 2018
  BME/ECE 6885 (Graduate Course at GWU)
- Biomedical Engineering MATLAB Programming — Spring 2020, Fall 2019, Spring 2019
  BME 2820 (Undergraduate Course at GWU)
- Biomedical Engineering C Programming — Fall 2019
  BME 2825 (Undergraduate Course at GWU)
- Pattern Recognition — Fall 2018, Fall 2017
  BME/ECE 6850 (Graduate Course at GWU)
- Digital Image Processing — Spring 2017
  BME/ECE 6840 (Graduate Course at GWU)
- Design and Analysis of Algorithms — Fall 2016
  CSCI 6212 (Graduate Course at GWU)
- Probability for Computer Science — Spring 2016
  CSCI 3362/6362 (Undergraduate/Graduate Course at GWU)

Volunteer

- International Conference on Artificial Intelligence and Statistics (AISTATS) — 4/2021
- IEEE Applied Imagery Pattern Recognition (AIPR) Workshop — 10/2016–2019
- IEEE International Symposium on Biomedical Imaging (ISBI) Conference — 4/2018
- AIESEC (International Students Exchange Activity) — Winter 2013, Winter 2012
  "Green Power Now!"
- AIESEC (International Students Exchange Activity) — Summer 2013, Summer 2012
  "Dare to Dream"