Shuyue Guan

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Education

The George Washington University (GWU) Washington, DC USA
Ph.D. in Biomedical Engineering Expected 12/2021

- Advisor: Murray H. Loew
- Proposed Thesis: "Medical Image Analysis Using Explainable Deep Learning"

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"

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

Research Experience

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

Transparent Deep Learning 6/2018–Present
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–Present
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.

Publications

Journal Articles

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*, 2021, in press. 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

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

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

5. **S. Guan** and M. Loew, "A distance-based separability measure for internal cluster validation", under review in *International Journal on Artificial Intelligence Tools*, 2021.
4. **S. Guan** and M. Loew, "A novel intrinsic measure of data separability", under review in *Applied Intelligence*, 2021.
3. **S. Guan** and M. Loew, "The estimation of training accuracy for two-layer neural networks on random datasets without training", under revision in *Applied Intelligence*, 2021.
2. A. Lou, **S. Guan**, and M. Loew, "A real-time deep neural network for medical image segmentation", under review in *Medical Image Analysis*, 2021.
1. A. Lou, **S. Guan**, and M. Loew, "Caranet: Context axial reverse attention network for segmentation of small medical objects", under review in *2022 SPIE Medical Imaging*, 2021.

Academic Service

Reviewer for Journals Reviews: 35

- IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)
- 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 Access
- SPIE Journal of Medical Imaging (JMI)
- ACM Transactions on Knowledge Discovery from Data (TKDD)
- Pattern Recognition, Elsevier
- International Journal of Medical Informatics, Elsevier
- Expert Systems with Applications, Elsevier
- Journal of Ambient Intelligence and Humanized Computing, Springer
- Computational Intelligence, Wiley

Reviewer for Conferences Reviews: 6

- 2021/2022 IEEE Winter Conference on Applications of Computer Vision (WACV)
- 24th International Conference on Artificial Intelligence and Statistics (AISTATS 2021)

Presentations

Talks

- 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

- 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)

Awards and Honors

- Collins Distinguished Doctoral Award 2020
- Honorable Mention Poster Award, SPIE Medical Imaging Conference 2019
- Gail E. Boggs Graduate Engineering Endowment Scholarship 2019
- Tyler Wean Scholarship 2019
- 125th Anniversary Endowment Scholarship 2019
- Timothy Tong Endowment Fellowship 2019
- Harriet Green Tischler Endowment Scholarship 2019
- IWBI 2018 Student Scholar Travel Grant 2018
- Provincial Excellent Graduate, Heilongjiang China 2013
- Excellent Graduate, NEFU 2013

- National Graduate Fellowship, China 2012
- Graduate Technology Innovation Project Fund, NEFU 2010
- Excellent Undergraduate Thesis, NEFU 2010
- Successful Participant, Mathematical Contest in Modeling 2010

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
  "Dear to Dream"