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EDUCATION

The George Washing 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 Washing 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 Network.
- Created a decision boundary complexity score to define and measure the complexity of decision boundary of deep neural networks, and his 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 solve the shortage of training data or labeled 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 by 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 the 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

4. **S. Guan** and M. Loew, “A distance-based separability measure for internal cluster validation”, under review in *International Journal on Artificial Intelligence Tools*, 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”, to be submitted to *Medical Image Analysis*, 2021.
1. **S. Guan**, M. Loew, and H. Ko, “Data separability for neural network classifiers and the development of a separability index”, arXiv preprint *arXiv:2005.13120*, 2020.

ACADEMIC SERVICE

Reviewer for Journals

- 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
- Journal of Ambient Intelligence and Humanized Computing, Springer
- Computational Intelligence, Wiley

Reviewer for Conferences

- 2021 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”