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Han Liu

Curriculum Vitae

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Education

Vanderbilt University
Ph.D. in *Computer Science*
2019-2024

Yale University
M.S. in *Biomedical Engineering*
2016-2017

Rensselaer Polytechnic Institute
B.S. in *Biomedical Engineering*
dual major in *Electrical Engineering*
2012-2016

Overview

Han is a highly self-motivated researcher and passionate about improving healthcare with medical AI. He has strong theoretical and practical background in machine learning, especially deep learning. His expertise lies in medical image computing with heterogenous, multi-modality data, such as developing (1) generative models for image synthesis, (2) self-adaptive models for missing modality problem, and (3) unified, foundation models by leveraging partially labeled datasets. He has solid hands-on experience in a broad range of medical image analysis tasks, including segmentation, synthesis, diagnosis, registration, etc., especially for 3D medical images. This can be evidenced by his strong publication records in the medical imaging field and a 1st place achievement in the MICCAI challenge CrossMoDA 2023.

Skills

Programming Languages: Python, MATLAB, C++, HTML
Image Processing Software: PyTorch, MONAI, SimpleITK, ANTs, ITK-SNAP, 3D Slicer, etc.
Communication: 4+ years' experience working closely with doctors and surgeons.

Research Experience

Siemens Healthineers, Princeton, NJ
Research Internship, May 2022-Dec 2022
Mentor: Zhoubing Xu

- Improved the segmentation framework by (1) optimizing the training strategy, (2) fine-tuning from the pretrained models by self/weakly-supervised learning, and (3) distilling knowledge from larger models.
- Developed a novel method to train a unified segmentation model by leveraging partially labeled CT datasets. The proposed method leads to faster inference speed, better flexibility for training, and better segmentation performance.

Medical Image Computing Laboratory (MedICL), Vanderbilt University, Nashville, TN
Research Assistant, 2021-Present
Mentor: Ipek Oguz

- Developed a novel 3D exemplar-based generative model with controllable style synthesis for MRI cross-modality unpaired image translation.
- Developed a novel 3D generative model for unsupervised domain adaptation and the proposed method achieved the 1st place in the CrossMoDA 2023 challenge.
- Established a benchmark for cold-start active learning for 3D medical image segmentation.
- Developed a novel self-adaptive model to tackle the missing modality problem for multi-modality MRI scans for multiple sclerosis lesion segmentation.

Medical Image Processing Laboratory (MIP), Vanderbilt University, Nashville, TN
Research Assistant, 2019-2021
Mentor: Benoit M. Dawant

- Developed a deep-learning based method using 3D conditional Generative Adversarial Networks to generate synthetic CT skull from T1-weighted MRI for Transcranial MR Imaging–Guided Focused Ultrasound Interventions.
- Performed an extensive comparative study to explore the effectiveness of various localization algorithms for Deep Brain Stimulation as well as intra- and inter-rater variability analysis.
- Developed a deep learning-based method for automatic target localization in Deep Brain Stimulation procedures for epilepsy patients. Uncertainty estimation was performed to detect unreliable predictions during inference phase.

Imaging Research Lab, Pittsburgh University**,** Pittsburgh, PA
Research Associate, Sep 2017-Jun 2019
Mentor: Jiantao Pu

- Developed a novel deep learning-based thoracic disease classification method which improved the classification performances consistently for 14 thoracic diseases and provided better interpretability compared to the previous state-of-the-art method.
- Developed an automatic object detection method for pneumonia detection.
- Assisted in developing an automatic optic disc/cup segmentation algorithm and a glaucoma severity assessment method in colored fundus images.

Image Processing and Analysis Group, Yale University, New Haven, CT
Research Assistant, Sep 2016-May 2017
Mentor: James S. Duncan

- Developed a dictionary learning method for segmentation of myocardium and blood pool in left ventricle from echocardiography.
- Developed a Gaussian Mixture Model for liver tumor segmentation in multiparametric MR images.

Publications

Conference proceedings

1. **Liu, H.,** Li, H., Yao, X., Fan, Y., Hu, D., Dawant, B. M., Nath, V., Xu, Z. and Oguz. I., 2023, October, COLosSAL: A Benchmark for Cold-start Active Learning for 3D Medical Image Segmentation. **MICCAI 2023**.

2. **Liu, H.,** Fan, Y., Li, H., Wang, J., Hu, D., Cui, C., Lee, H.H., Zhang, H. and Oguz, I., 2022, September. Moddrop++: A dynamic filter network with intra-subject co-training for multiple sclerosis lesion segmentation with missing modalities. **MICCAI 2022 (Early accept)**.

3. **Liu, H.,** Fan, Y., Oguz, I., & Dawant, B. M. (2022). Enhancing Data Diversity for Self-training Based Unsupervised Cross-modality Vestibular Schwannoma and Cochlea Segmentation. **BrainLes 2022 MICCAI Workshop.**

4. **Liu, H.**, Fan, Y., Cui, C., Su, D., McNeil, A., & Dawant, B. M. (2022). Unsupervised Domain Adaptation for Vestibular Schwannoma and Cochlea Segmentation via Semi-supervised Learning and Label Fusion. **BrainLes 2021 MICCAI Workshop.**

5. **Liu, H.**, Holloway, K. L., Englot, D. J., & Dawant, B. M. (2022). A Multi-rater Comparative Study of Automatic Target Localization Methods for Epilepsy Deep Brain Stimulation Procedures. **SPIE Medical Imaging 2022.**

6. **Liu, H.**, Sigona, M. K., Chen, L., Caskey, C. F., & Dawant, B. M. (2022). Synthetic CT Skull Generation for Transcranial MR Imaging–Guided Focused Ultrasound Interventions with Conditional Adversarial Networks. **SPIE Medical Imaging 2022.**

7. **Liu, H.**, Cui, C., Englot, D. J., & Dawant, B. M. (2020). Uncertainty Estimation in Medical Image Localization: Towards Robust Anterior Thalamus Targeting for Deep Brain Stimulation. **MIL3ID 2020 MICCAI Workshop**.

8. Cui, C., **Liu, H.**, Liu, Q., Deng, R., Asad, Z., Wang, Y., ... & Huo, Y. (2022, September). Survival Prediction of Brain Cancer with Incomplete Radiology, Pathology, Genomic, and Demographic Data. **MICCAI 2022.**

9. Fan, Y., Jianing W., Zhao Y., Li, R., **Liu, H.,** Labadie, R., Noble, J., & Dawant, B. M. A Unified Deep-Learning-Based Framework for Cochlear Implant Electrode Array Localization. **MICCAI 2023**.

10. Li, H., **Liu, H.**, Hu, D., Wang, J., Johnson, H., Sherbini, O., ... & Oguz, I. (2022, September). Self-supervised Test-Time Adaptation for Medical Image Segmentation. **MLCN 2022 MICCAI Workshop**.

11. Fan, Y., Khan, M. M., **Liu, H.**, Noble, J. H., Labadie, R. F., & Dawant, B. M. (2023, April). Temporal bone CT synthesis for MR-only cochlear implant preoperative planning. **SPIE Medical Imaging 2023**.

12. Hu, D., Li, H., **Liu, H.**, Yao, X., Wang, J., & Oguz, I. (2023, October). MAP: Domain Generalization via Meta-Learning on Anatomy-Consistent Pseudo-Modalities. **MedAGI 2023 MICCAI Workshop**.

13. Wang, J., Li, H., **Liu, H.**, Hu, D., Lu, D., Yoon, K., ... & Oguz, I. (2023, April). SSL2: Self-Supervised Learning meets semi-supervised learning: multiple sclerosis segmentation in 7T-MRI from large-scale 3T-MRI. **SPIE Medical Imaging 2023.**

14. Yao, X., Lou, A., Li, H., Hu, D., Lu, D., **Liu, H.**, ... & Oguz, I. (2023, April). Novel application of the attention mechanism on medical image harmonization. **SPIE Medical Imaging 2023**.

15. Hu, D., Li, H., **Liu, H.**, & Oguz, I. (2022, December). Domain generalization for retinal vessel segmentation with vector field transformer. **MIDL 2022**.

16. Li, H., Hu, D., **Liu, H.**, Wang, J., & Oguz, I. (2022, March). Cats: Complementary cnn and transformer encoders for segmentation. **ISBI 2022**.

17. Cui, C., **Liu, H.**, Englot, D. J., & Dawant, B. M. (2021, February). Brain vessel segmentation in contrast-enhanced T1-weighted MR Images for deep brain stimulation of the anterior thalamus using a deep convolutional neural network. **SPIE Medical Imaging 2021**.

18. Wang, L., **Liu, H.**, Zhang, J., Chen, H., & Pu, J. (2019, March). Computerized assessment of glaucoma severity based on color fundus images. **SPIE Medical Imaging 2019**.

19. Wang, L., **Liu, H.**, Zhang, J., Chen, H., & Pu, J. (2019, March). Automated segmentation of the optic disc using the deep learning. **SPIE Medical Imaging 2019**.

Journal Articles

1. **Liu, H.,** Xu, Z., Gao, R., Li, H., Wang, J., Chabin, G., Oguz, I. and Grbic. S., (2024), COSST: Multi-organ Segmentation with Partially Labeled Datasets Using Comprehensive Supervisions and Self-training. **IEEE Transactions on Medical Imaging.**

2. **Liu, H.,** Sigona, M. K., Manuel, T. J., Chen, L. M., Dawant, B. M., & Caskey, C. F. (2022). Evaluation of Synthetically Generated CT for use in Transcranial Focused Ultrasound Procedures. **Journal of Medical Imaging**.

3. **Liu, H.**, Wang, L., Nan, Y., Jin, F., Wang, Q., & Pu, J. (2019). SDFN: Segmentation-based deep fusion network for thoracic disease classification in chest X-ray images. **Computerized Medical Imaging and Graphics**, 75, 66-73.

4. Dorent, R., Kujawa, A., Ivory, M., Bakas, S., Rieke, N., Joutard, S., **Liu, H.,** ... & Vercauteren, T. (2023). CrossMoDA 2021 challenge: Benchmark of cross-modality domain adaptation techniques for vestibular schwannoma and cochlea segmentation. **Medical Image Analysis**.

5. Zhao, W., **Liu, H.**, Leader, J. K., Wilson, D., Meng, X., Wang, L., ... & Pu, J. (2019). Computerized identification of the vasculature surrounding a pulmonary nodule. **Computerized Medical Imaging and Graphics**, 74, 1-9.

6. Wang, L., **Liu, H.**, Lu, Y., Chen, H., Zhang, J., & Pu, J. (2019). A coarse-to-fine deep learning framework for optic disc segmentation in fundus images. **Biomedical signal processing and control**, 51, 82-89.

Book chapters

1. **Liu, H.**, Hu, D., Li, H., & Oguz, I. (2023). Medical image segmentation using deep learning. **Machine Learning for Brain Disorders**, 391-434.

Preprint & Technical Reports

1. **Liu, H.**, Fan, Y., Xu, Z., Dawant, B. M., & Oguz, I. (2023). Learning Site-specific Styles for Multi-institutional Unsupervised Cross-modality Domain Adaptation. arXiv:2311.12437.

2. Li, H., **Liu, H.**, Hu, D., Wang, J., & Oguz, I. (2023). Promise: Prompt-driven 3D Medical Image Segmentation Using Pretrained Image Foundation Models. arXiv:2310.19721.

3. Li, H., **Liu, H.**, Hu, D., Wang, J., & Oguz, I. (2023). Assessing Test-time Variability for Interactive 3D Medical Image Segmentation with Diverse Point Prompts. arXiv:2311.07806.

4. Li, H., **Liu, H.**, Hu, D., Yao, X., Wang, J., & Oguz, I. (2023). CATS v2: Hybrid encoders for robust medical segmentation. arXiv:2308.06377.

5. Yao, X., **Liu, H.**, Hu, D., Lu, D., Lou, A., Li, H., ... & Oguz, I. (2023). False negative/positive control for sam on noisy medical images. arXiv:2308.10382.

6. Hu, D., Li, H., **Liu, H.**, Yao, X., Wang, J., & Oguz, I. (2023, July). VesselMorph: Domain-Generalized Retinal Vessel Segmentation via Shape-Aware Representation. arXiv:2307.00240.

7. Fan, Y., **Liu, H.**, Oguz, I., & Dawant, B. M. CT Synthesis with Modality-, Anatomy-, and Site-Specific Inference. Technical Report at SASHIMI workshop.

Honors & Awards

10/08/2023 MICCAI challenge CrossMoDA 2023 championship

2019-2023 IBM fellowship
2012-2015 Dean's List, Rensselaer Polytechnic Institute

Professional Activities

Journal Reviewer

- Medical Image Analysis (MedIA)
- IEEE Journal of Biomedical and Health Informatics (JBHI)
- The Journal of Machine Learning for Biomedical Imaging (MELBA)
- Computers in Biology and Medicine (CIBM)
- Computerized Medical Imaging and Graphics (CMIG)
- Neurocomputing
- Multidimensional Systems & Signal Process (MULT)
- BioMed Research International
- IEEE Transactions on Neural Networks and Learning Systems

Conference Reviewer

- International Symposium on Biomedical Imaging (ISBI) 2024
- Medical Imaging Meets NeurIPS 2023
- Medical Image Computing and Computer Assisted Interventions (MICCAI) 2023
- Medical Imaging with Deep Learning (MIDL) 2023
- Medical Image Computing and Computer Assisted Interventions (MICCAI) 2022
- Knowledge Discovery and Data Mining (KDD) 2021

Guest Lecture

- 2023 Fall: [CS-6357] Open Source Programming for Medical Image Analysis
- 2022 Fall: [CS-8395] Open Source Programming for Medical Image Processing

Teaching Assistant

Sep 2019-2021

- Achieved an overall TA score of 4.83 out of 5.0, where the average score for TAs is 4.08.
- Courses:
    - Intermediate Software Design (C++)
    - Prog. and Prob. Solv. with Python (Python)
    - Advanced Medical Image Processing (MATLAB)
    - Foundations of Machine Learning (Python)
    - Projects in Machine Learning (Python)