ZUWEI GUO

Machine Learning | Computer Vision | Medical Imaging | Data Science

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https://github.com/jlianglab/StepwisePretraining

PROFILE

- Passionate, self-motivated and versatile software engineer with extensive experience in medical imaging classification/segmentation, anomaly detection, image action recognition, and objection detection.
- Demonstrated deep neural networks experience, including CNN, RNN, U-Net, GAN, and transformer. Possesses inherent ability and technical understanding in multiple technologies to provide new insights and procedures.
- Forward thinking with focus on new and leading-edge technologies, collaborating across multiple teams and organizations, providing superior service efficiency while maintaining goals.

AWARDS AND HONORS

- President's Awards for Innovation, Arizona State University | Oct. 2024
- 1st place in CXR-LT 2024 challenge task 1 | Sep. 2024

EDUCATION

Ph.D. in Computer Engineering
Arizona State University
Jan. 2017 – current

M.Sc. in Computer Engineering
Arizona State University
Jan. 2014 – Dec. 2015

SKILLS

Languages

Python | C | C++ | C# | SQL | Matlab | Git

Software

Visual Studio | Anaconda | Docker | Jupyter

Technologies

Linux | TensorFlow | Keras | PyTorch | REST | SOAP

PROJECTS

Debiasing Machine Learning Models for Skin Lesion Detection Using Contrastive Debiasing

- Proposed a method to debias machine learning models using skin color contrast, ensuring consistent performance across all skin tones.
  - Designed a supervised contrastive debiasing algorithm that pulls images of different skin colors with the same lesion label closer in the feature space while pushing them apart if their lesion labels differ.
  - Innovatively utilized a student-teacher network framework to preserve the performance of a pretrained lesion classification model while alleviating performance gaps across different skin tones.
- Designed experiments to demonstrate the effectiveness of the proposed method across different datasets and adoption strategies.
  - Collected a diverse set of skin lesion datasets from different organizations, collection methods, and demographic groups, covering a wide range of disease labels.
  - Achieved an average AUC of **84.53%** on the **Fitzpatrick17k** dataset, outperforming the supervised pretrained method (**78.65%**) and the adversarial debiasing counterpart (**81.54%**).
  - Improved the average AUC on the **challenging DDI dataset** from **67%** to **71%**, with performance across different skin tones (**T12, T34, and T56**) being **71.28%**, **71.42%**, and **70.53%**, respectively, successfully alleviating the performance gap between different skin tones.

Uniting Self-Supervised Learning with Stepwise Incremental Pretraining

- Proposed a unified self-supervised learning model that integrates discriminative, restorative, and adversarial learning.
  - Designed a stepwise incremental pretraining strategy to stabilize training and enhance the synergistic effects of the three self-supervised learning components.
  - Collected pretrained unified models that incorporate discriminative, restorative, and adversarial learning into a single framework for **3D medical imaging tasks**, including both classification and segmentation.
- Designed experiments to demonstrate the superiority of stepwise incremental pretraining for the unified model.
  - Achieved an average **IoU of 70%** on the **brain tumor segmentation task**, which is **11.1%** better than the baseline random initialization method and **1.2%** better than the unified model trained without stepwise incremental pretraining.
  - Achieved an average **AUC of 87%** on the **pulmonary embolism false positive reduction task**, **7%** better than the baseline random initialization method and **2.8%** better than the unified model trained without stepwise incremental pretraining.

Lung Disease Classification with Distance Learning

- Proposed a novel self-supervised technique to train a **generative adversarial network (GAN)** for pathology classification on chest X-rays.
  - Designed a method to define a pretext task using patch classification and reconstruction.
  - Trained a network to classify the distance between two patches extracted from the same X-ray image.
  - Trained a network for image-to-image translation.
- Developed a new algorithm that does not require labeled data for training.
  - Achieved an average **AUC of 81%** on classification with the newly proposed network.
  - Provided a clear direction for solving challenging problems.
  - Improved the discriminator component of the GAN for pathology classification.

Brain Lesion Detection Using GAN

- Developed signal processing and machine learning algorithms for computer vision.
- Enhanced traditional machine learning algorithms that do not generalize well to MRI images.
- Trained a **DCGAN** for patch-based detection and localization of brain lesions.
- Achieved a **whole tumor Dice score of 0.69**, outperforming the previous score of **0.647**.

Polyp Detection for Colonoscopy

- Collaborated with a team to develop an **automatic polyp detection** system for colonoscopy images.
- Extracted features using the **Daisy algorithm**, clustered and categorized them using **K-means clustering** and **Bag of Visual Words**, and used a **Random Forest model** for classification.
- Trained a **three-layer CNN model** for polyp detection, achieving an **AUC of 95.72%** with an **accuracy of 93.87%**.
- Designed and developed a **MATLAB GUI application** to integrate the models and visualize results.

PUBLICATIONS

- Guo, Zuwei, Nahid Ul Islam, and Jianming Liang (Jan. 2025). *Systems, methods, and apparatuses for implementing stepwise incremental pre-training for integrating discriminative, restorative, and adversarial learning into an ai model*. US Patent App. 18/776,010.
- Lin, Mingquan, Gregory Holste, Song Wang, Yiliang Zhou, Yishu Wei, Imon Banerjee, Pengyi Chen, Tianjie Dai, Yuexi Du, Nicha C Dvornek, et al. (2025). "CXR-LT 2024: A MICCAI challenge on long-tailed, multi-label, and zero-shot disease classification from chest X-ray". In: *Medical Image Analysis*, p. 103739.
- Guo, Zuwei, Nahid Ul Islam, Michael B Gotway, and Jianming Liang (2024). "Stepwise incremental pretraining for integrating discriminative, restorative, and adversarial learning". In: *Medical Image Analysis* 95, p. 103159.
- Guo, Zuwei, Nahid UI Islam, Michael B Gotway, and Jianming Liang (2022). "Discriminative, restorative, and adversarial learning: Stepwise incremental pretraining". In: *MICCAI Workshop on Domain Adaptation and Representation Transfer*. Springer, pp. 66–76.
- Tu, Zhigang, Zuwei Guo, Wei Xie, Mengjia Yan, Remco C Veltkamp, Baoxin Li, and Junsong Yuan (2017). "Fusing disparate object signatures for salient object detection in video". In: *Pattern Recognition* 72, pp. 285–299.