Chaoqin Huang

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Education

NUS-SJTU Joint Ph.D. of Computer Vision April 2021 – Present

Electrical & Computer Engineering, National University of Singapore (NUS), Singapore
Information and Communication Engineering, Shanghai Jiao Tong University (SJTU), Shanghai, China

Master of Information and Communication Engineering Sept. 2019 – March 2021

Shanghai Jiao Tong University (SJTU), Shanghai, China

Bachelor of Computer Science Sept. 2015 – July 2019

Shanghai Jiao Tong University (SJTU), Shanghai, China

Research Interests

- Research Area: Computer Vision, Machine Learning
- Application: Anomaly Detection on Industrial Defect Detection and Medical Diagnosis

Publication (Journal)

- **Self-Supervised Masking for Unsupervised Anomaly Detection and Localization**
  Chaoqin Huang, Qinwei Xu, Yanfeng Wang, Yu Wang, Ya Zhang
  IEEE Transactions on Multimedia **(TMM 2022, SCI District 1 Top)**
  We proposed a self-supervised learning approach named *Self-Supervised Masking* (SSM) for unsupervised anomaly detection and localization. SSM not only enhances the training of the inpainting network but also leads to great improvement in the efficiency of mask prediction at inference. We proposed a progressive mask refinement approach that progressively uncovers the normal regions and locates the anomalous regions. The proposed method outperforms several state-of-the-arts, achieving 98.3% AUC on Retinal-OCT (medical diagnosis) and 93.9% AUC on MVTec AD (industrial defect detection), respectively.
- **Attribute Restoration Framework for Anomaly Detection**
  Fei Ye*, **Chaoqin Huang***, Jinkun Cao, Maosen Li, Ya Zhang, Cewu Lu (* equal contribution)
  IEEE Transactions on Multimedia **(TMM 2022, SCI District 1 Top, ESI Highly Cited Paper)**
  We proposed to erase selected attributes from the original data and reformulate the anomaly detection task as a restoration task in the self-supervised learning paradigm, where the normal and the anomalous data are expected to be distinguishable based on restoration errors. By forcing the network to restore the original image, the semantic feature embeddings related to the erased attributes are learned by the network. The proposed method significantly outperforms several state-of-the-arts on multiple benchmark datasets, especially on ImageNet, increasing the AUC of the top-performing baseline by 10.1%.
- **Self-supervised Tumor Segmentation with Sim2Real Adaptation**
  Xiaoman Zhang, Weidi Xie, **Chaoqin Huang**, Ya Zhang, Xin Chen, Qi Tian, Yanfeng Wang
  IEEE Journal of Biomedical and Health Informatics **(JBHI 2023, SCI District 1 Top)**
  We proposed a two-stage Sim2Real training regime for unsupervised tumor segmentation, where we first pre-train a model with simulated tumors and then adopt a self-training strategy for downstream data adaptation. When evaluating on BraTS2018 for brain tumor segmentation and LiTS2017 for liver tumor segmentation, we achieve state-of-the-art segmentation performance under the unsupervised setting.
- (under review) **Few-Shot Anomaly Detection via Category-Agnostic Registration Learning**
  Chaoqin Huang, Haoyan Guan, Aofan Jiang, Yanfeng Wang, Michael Spratling, Xinchao Wang, Ya Zhang
  IEEE Transactions on Pattern Analysis and Machine Intelligence **(T-PAMI, SCI District 1 Top)**
  Existing anomaly detection methods require a dedicated model for each category. Such a paradigm is computationally expensive and inefficient. This paper proposes the first FSAD method that requires no model fine-tuning for novel categories: enabling a single model to be applied to all categories. It improves the current state-of-the-art for FSAD by 11.3% and 8.3% on the MVTec and MPDD benchmarks, respectively.

Publication (Conference)

- **Multi-scale Cross-restoration Framework for Electrocardiogram Anomaly Detection**
  Aofan Jiang*, **Chaoqin Huang***, Qing Cao, Shuang Wu, Zi Zeng, Xinchao Wang, Kang Chen, Ya Zhang
  International Conference on Medical Image Computing and Computer-Assisted Intervention **(MICCAI 2023, Early accepted)**
  Detecting anomalies in Electrocardiogram (ECG) data is particularly challenging due to the substantial inter-individual differences and the presence of anomalies in both global rhythm and local morphology. Imitating the diagnostic process followed by experienced cardiologists, we proposed a novel multi-scale cross-restoration framework for ECG anomaly detection and localization, achieving state-of-the-art performance on our proposed large-scale ECG benchmark and two other well-known ECG datasets.
- **Registration based Few-Shot Anomaly Detection**
  Chaoqin Huang, Haoyan Guan, Aofan Jiang, Ya Zhang, Michael Spratling, Yanfeng Wang
  European Conference on Computer Vision **(ECCV 2022, oral presentation, Top 2.5%)**
  We considered few-shot anomaly detection (FSAD), a practical yet under-studied setting for anomaly detection, where only a limited number of normal images are provided for each category at training. Inspired by how humans detect anomalies, *i.e.,* comparing an image in question to normal images, we leveraged registration, an image alignment task that is inherently generalizable across categories, as the proxy task, to train a category-agnostic anomaly detection model. During testing, the anomalies are identified by comparing the registered features of the test image and its corresponding support (normal) images. Experimental results have shown that the proposed method outperforms the state-of-the-art FSAD methods by 3%-8% in AUC on the MVTec and MPDD benchmarks.
- **ESAD: End-to-end Deep Semi-supervised Anomaly Detection**
  Chaoqin Huang, Fei Ye, Peisen Zhao, Ya Zhang, Yanfeng Wang, Qi Tian
  The British Machine Vision Conference **(BMVC 2021)**
  We proposed a new KL-divergence-based objective function and show that two factors: the mutual information, and the entropy, constitute an integral objective function for anomaly detection. Extensive experiments have revealed that the proposed method significantly outperforms several state-of-the-arts on multiple benchmark datasets, including medical diagnosis and several classic anomaly detection benchmarks.
- **Semi-Supervised Domain Generalization for Medical Image Analysis**
  Ruipeng Zhang, Qinwei Xu, **Chaoqin Huang**, Ya Zhang, Yanfeng Wang
  IEEE International Symposium on Biomedical Imaging **(ISBI 2021)**
  We introduced a general regularization-based semi-supervised domain generalization method, where the stability and orthogonality of the learned features are introduced as two regularization factors of the learning objective. Both regularization factors can be applied to both labeled and unlabelled data.
- **Deep Unsupervised Image Anomaly Detection: An Information Theoretic Framework**
  Fei Ye, Huangjie Zheng, **Chaoqin Huang**, Ya Zhang
  IEEE International Conference on Image Processing **(ICIP 2021)**
  We proposed an objective function for anomaly detection with information theory, which maximizes the distance between normal and anomalous data in terms of the joint distribution of images and their representation. We managed to find its lower bound which weights the trade-off between mutual information and entropy, which leads to a novel information theoretic framework for unsupervised image anomaly detection.
- **DrivingStereo: A Large Dataset to Make Sense of Stereo Matching for Auto-Driving**
  Guorun Yang, Xiao Song, **Chaoqin Huang**, Zhidong Deng, Jianping Shi, Bolei Zhou
  IEEE/CVF Computer Vision and Pattern Recognition Conference **(CVPR 2019)**
  We constructed a novel large-scale stereo dataset named DrivingStereo. It contains over 100k images covering a diverse set of driving scenarios. High-quality labels of disparity are produced by a model-guided filtering strategy from multi-frame LiDAR points.
- **Recurrent Residual Module for Fast Inference in Videos**
  Bowen Pan, Wuwei Lin, Xiaolin Fang, **Chaoqin Huang**, Bolei Zhou, Cewu Lu
  IEEE/CVF Computer Vision and Pattern Recognition Conference **(CVPR 2018)**
  We proposed a framework called Recurrent Residual Module (RRM) to accelerate the CNN inference for video recognition tasks. This framework has a novel design of using the similarity of the intermediate feature maps of two consecutive frames, to largely reduce the redundant computation.

Research Experiences

Machine Vision and Intelligence Group, Shanghai Jiao Tong University Shanghai, China
Research Assistant | Supervised by: Prof. Cewu Lu May 2017 - June 2019
Research Institute, SenseTime Shanghai, China
Research Intern | Supervised by: Dr. Jianping Shi March 2018 - April 2019
Cooperative Medianet Innovation Center, Shanghai Jiao Tong University Shanghai, China
Ph.D. Student | Supervised by: Prof. Ya Zhang Sept 2019 - Present
Shanghai Artificial Intelligence Laboratory Shanghai, China
Research Intern | Supervised by: Prof. Ya Zhang April 2021 - July 2022
Learning and Vision Lab, ECE, National University of Singapore Singapore
Ph.D. Student | Supervised by: Prof. Xinchao Wang July 2022 - Present

Services

Conference Reviewer: NeruIPS, CVPR, ICCV, ECCV, MICCAI
Journal Reviewer: TMM

Honors and Awards

National Scholarship of China December 2022
Outstanding Graduate of Shanghai Jiao Tong University June 2019
1st Outstanding Graduation Thesis Award of Computer Science in SJTU June 2019
SenseTime Scholarship December 2018
Shanghai Jiao Tong University WISH Scholarship May 2018
Meritorious Winner of Mathematical Contest In Modeling 2018 April 2018
Shanghai Jiao Tong University Academic Excellent Scholarship 2017 - 2022