Publication List

Yiming Zhang

Google Citations: 459; H-index: 6

April 28, 2025

Journal Articles

1. **Yiming Zhang**, Ying Weng, and Jonathan Lund, "Application of Explainable Artificial Intelligence in the Diagnosis and Surgery", *Diagnostics*, vol. 12, no. 2, p. 237, 2022. **(ESI Highly Cited Paper, 300+ Citations)**. DOI: **10.3390/diagnostics12020237**

Abstract: In recent years, artificial intelligence (AI) has shown great promise in medicine. However, explainability issues make AI applications in clinical usages difficult. Some research has been conducted into explainable artificial intelligence (XAI) to overcome the limitation of the black-box nature of AI methods. Compared with AI techniques such as deep learning, XAI can provide both decision-making and explanations of the model. In this review, we conducted a survey of the recent trends in medical diagnosis and surgical applications using XAI. We have searched articles published between 2019 and 2021 from PubMed, IEEE Xplore, Association for Computing Machinery, and Google Scholar. We included articles which met the selection criteria in the review and then extracted and analyzed relevant information from the studies. Additionally, we provide an experimental showcase on breast cancer diagnosis, and illustrate how XAI can be applied in medical XAI applications. Finally, we summarize the XAI methods utilized in the medical XAI applications, the challenges that the researchers have met, and discuss the future research directions. The survey result indicates that medical XAI is a promising research direction, and this study aims to serve as a reference to medical experts and AI scientists when designing medical XAI applications.

Journal: Diagnostics (SCI; IF 3.706; JCR Q1; CAS Q3)
First Author: Yiming Zhang
Contribution (80%): Conceptualization, Data Curation, Methodology, Formal analysis, Writing - original draft, Investigation, Visualization

2. **Yiming Zhang**, Ying Weng, and Boding Wang, "CWT-ViT: A Time–Frequency Representation and Vision Transformer-based Framework for Automated Robotic Surgical Skill Assessment", *Expert Systems with Applications*, vol. 258, p. 125064, 2024. DOI: **10.1016/j.eswa.2024.125064**

Abstract: Surgical skill assessment currently hinges on the manual observations of senior surgeons, and the assessment process is inherently time-consuming and subjective. Hence, there is a need to develop machine learning-based automated robotic surgical skill assessment. However, the existing machine learning-based works are only built in either the time domain or frequency domain but have never considered the investigation on the time–frequency domain. To fill the research gap, we explore the representation of the surgery motion data in the time–frequency domain. In this study, we propose a novel automated robotic surgical skill assessment framework called Continuous Wavelet Transform-Vision Transformer (CWT-ViT). We apply continuous wavelet transform, i.e., a time–frequency representation method, to convert robotic surgery kinematic data to synthesis images. Furthermore, by taking advantage of the prior knowledge of the da Vinci surgical system, we design a four branches-based architecture, each branch representing a robotic manipulator. We have conducted extensive experiments and achieved comparable results on the benchmark robotic surgical skill dataset JHU-ISI Gesture and Skill Assessment Working Set (JIGSAWS). Our proposed CWT-ViT framework has demonstrated the feasibility of applying time–frequency representation

for automated robotic surgical skill assessment using kinematic data.

Journal: Expert Systems with Applications (SCI; IF 7.5; JCR Q1; CAS Q1)
First Author: Yiming Zhang
Contribution (80%): Conceptualization, Resources, Methodology, Formal analysis, Writing - original draft, Investigation, Visualization

3. **Yiming Zhang**, Ke Chen, Ying Weng, Zhuo Chen, Juntao Zhang, and Richard Hubbard, "An Intelligent Early Warning System of Analyzing Twitter Data Using Machine Learning on COVID-19 Surveillance in the US", *Expert Systems with Applications*, vol. 198, 116882, 2022. DOI: **10.1016/j.eswa.2022.116882**

Abstract: The World Health Organization (WHO) declared on 11th March 2020 the spread of the coronavirus disease 2019 (COVID-19) a pandemic. The traditional infectious disease surveillance had failed to alert public health authorities to intervene in time and mitigate and control the COVID-19 before it became a pandemic. Compared with traditional public health surveillance, harnessing the rich data from social media, including Twitter, has been considered a useful tool and can overcome the limitations of the traditional surveillance system. This paper proposes an intelligent COVID-19 early warning system using Twitter data with novel machine learning methods. We use the natural language processing (NLP) pre-training technique, i.e., fine-tuning BERT as a Twitter classification method. Moreover, we implement a COVID-19 forecasting model through a Twitter-based linear regression model to detect early signs of the COVID-19 outbreak. Furthermore, we develop an expert system, an early warning web application based on the proposed methods. The experimental results suggest that it is feasible to use Twitter data to provide COVID-19 surveillance and prediction in the US to support health departments' decision-making.

Journal: Expert Systems with Applications (SCI; IF 8.665; JCR Q1; CAS Q1)
First Author: Yiming Zhang
Contribution (70%): Conceptualization, Methodology, Formal analysis, Writing - original draft, Investigation, Visualization

4. Ying Weng(#), **Yiming Zhang**(#), Wenxin Wang, and Tom Dening, "Semi-supervised Information Fusion for Medical Image Analysis: Recent Progress and Future Perspectives", *Information Fusion*, vol. 106, 102263, 2024. (# Equal contribution) DOI: **10.1016/j.inffus.2024.102263**

Abstract: Supervised machine learning requires training on the dataset with annotation. However, fine-grained annotation is very expensive to acquire. In the medical image analysis domain, the sheer volume of data and lack of annotation limit the performance of the model. To address these limitations, semi-supervised information fusion has recently emerged as an important and promising paradigm owing to its ability to exploit labelled and unlabelled data and combine information from multiple sources to obtain a more robust and accurate performance. In this survey, we review the recent progress of semi-supervised information fusion for medical image analysis. Moreover, we categorize the state-of-the-art information fusion applications of semi-supervised learning with in-depth analysis. Finally, we discuss the challenges and outline the future perspective.

Journal: Information Fusion (SCI; IF 18.6; JCR Q1; CAS Q1)
Co-first Author: Yiming Zhang
Contribution (40%): Conceptualization, Methodology, Formal analysis, Writing - original draft, Investigation, Visualization

5. Ke Chen, Ying Weng, Akram Hosseini, Tom Dening, Guokun Zuo and **Yiming Zhang**, "A comparative study of GNN and MLP based machine learning for the diagnosis of Alzheimer's Disease involving data synthesis", *Neural Networks*, 169, 442-452, 2024. DOI: **10.1016/j.neunet.2023.10.040**

Abstract: Alzheimer's Disease (AD) is a neurodegenerative disease that commonly occurs in older people. It is characterized by both cognitive and functional impairment. However, as AD has an unclear pathological cause, it can be hard to diagnose with confidence. This is even more so in

the early stage of Mild Cognitive Impairment (MCI). This paper proposes a U-Net based Generative Adversarial Network (GAN) to synthesize fluorodeoxyglucose - positron emission tomography (FDG-PET) from magnetic resonance imaging - T1 weighted imaging (MRI-T1WI) for further usage in AD diagnosis including its early-stage MCI. The experiments have displayed promising results with Structural Similarity Index Measure (SSIM) reaching 0.9714. Furthermore, three types of classifiers are developed, i.e., one Multi-Layer Perceptron (MLP) based classifier, two Graph Neural Network (GNN) based classifiers where one is for graph classification and the other is for node classification. 10-fold cross-validation has been conducted on all trials of experiments for classifier comparison. The performance of these three types of classifiers has been compared with the different input modalities setting and data fusion strategies. The results have shown that GNN based node classifier surpasses the other two types of classifiers, and has achieved the state-of-the-art (SOTA) performance with the best accuracy at 90.18% for 3-class classification, namely AD, MCI and normal control (NC) with the synthesized fluorodeoxyglucose - positron emission tomography (FDG-PET) features fused at the input level. Moreover, involving synthesized FDG-PET as part of the input with proper data fusion strategies has also proved to enhance all three types of classifiers' performance. This work provides support for the notion that machine learning-derived image analysis may be a useful approach to improving the diagnosis of AD.

Journal: Neural Networks (SCI; IF 7.8; JCR Q1; CAS Q1)
Co-Author: Yiming Zhang
Contribution (10%): Validation, Writing - review & editing

6. Ke Chen, Ying Weng, Yueqin Huang, **Yiming Zhang**, Tom Dening, Akram A. Hosseini, and Weizhong Xiao, "A Multi-View Learning Approach with a Diffusion Model to Synthesize FDG PET from MRI T1WI for the Diagnosis of Alzheimer's Disease," *Alzheimer's & Dementia*, 2024. DOI: **10.1002/alz.14421**

Abstract: Introduction: This study presents a novel multi-view learning approach for machine learning (ML)-based Alzheimer's disease (AD) diagnosis. Methods: A diffusion model is proposed to synthesize the fluorodeoxyglucose positron emission tomography (FDG PET) view from the magnetic resonance imaging T1 weighted imaging (MRI T1WI) view and incorporate two synthesis strategies: one-way synthesis and two-way synthesis. To assess the utility of the synthesized views, we use multilayer perceptron (MLP)-based classifiers with various combinations of the views. Results: The two-way synthesis achieves state-of-the-art performance with a structural similarity index measure (SSIM) at 0.9380 and a peak-signal-to-noise ratio (PSNR) at 26.47. The one-way synthesis achieves an SSIM at 0.9282 and a PSNR at 23.83. Both synthesized FDG PET views have shown their effectiveness in improving diagnostic accuracy. Discussion: This work supports the notion that ML-based cross-domain data synthesis can be a useful approach to improve AD diagnosis by providing additional synthesized disease-related views for multi-view learning.

Journal: Alzheimer's & Dementia (SCI; IF 13.1; JCR Q1; CAS Q1)
Co-Author: Yiming Zhang
Contribution (10%): Validation, Writing - review & editing

7. Chengtai Li, **Yiming Zhang**, Ying Weng, Boding Wang and Zhenzhu Li, "Natural Language Processing Applications for Computer-Aided Diagnosis in Oncology", *Diagnostics*, vol. 13, no. 2, p. 286, 2023. DOI: **10.3390/diagnostics13020286**

Abstract: In the era of big data, text-based medical data, such as electronic health records (EHR) and electronic medical records (EMR), are growing rapidly. EHR and EMR are collected from patients to record their basic information, lab tests, vital signs, clinical notes, and reports. EHR and EMR contain the helpful information to assist oncologists in computer-aided diagnosis and decision making. However, it is time consuming for doctors to extract the valuable information they need and analyze the information from the EHR and EMR data. Recently, more and more research works have applied natural language processing (NLP) techniques, i.e., rule-based, machine learning-based, and deep learning-based techniques, on the EHR and EMR data for computer-aided diagnosis in oncology. The objective of this review is to narratively review the recent progress in the area of NLP applications for computer-aided diagnosis in oncology. Moreover, we intend to

reduce the research gap between artificial intelligence (AI) experts and clinical specialists to design better NLP applications. We originally identified 295 articles from the three electronic databases: PubMed, Google Scholar, and ACL Anthology; then, we removed the duplicated papers and manually screened the irrelevant papers based on the content of the abstract; finally, we included a total of 23 articles after the screening process of the literature review. Furthermore, we provided an in-depth analysis and categorized these studies into seven cancer types: breast cancer, lung cancer, liver cancer, prostate cancer, pancreatic cancer, colorectal cancer, and brain tumors. Additionally, we identified the current limitations of NLP applications on supporting the clinical practices and we suggest some promising future research directions in this paper.

Journal: Diagnostics (SCI; IF 3.992; JCR Q1; CAS Q3)
Co-Author: Yiming Zhang
Contribution (40%): Data Curation, Methodology, Formal analysis, Writing - original draft, Investigation, Visualization

8. Chengtai Li, Ying Weng, **Yiming Zhang** and Boding Wang, "A systematic review of application progress on machine learning-based natural language processing in breast cancer over the past 5 years", *Diagnostics*, vol. 13, no. 3, p. 537, 2023. DOI: **10.3390/diagnostics13030537**

Abstract: Artificial intelligence (AI) has been steadily developing in the medical field in the past few years, and AI-based applications have advanced cancer diagnosis. Breast cancer has a massive amount of data in oncology. There has been a high level of research enthusiasm to apply AI techniques to assist in breast cancer diagnosis and improve doctors' efficiency. However, the wise utilization of tedious breast cancer-related medical care is still challenging. Over the past few years, AI-based NLP applications have been increasingly proposed in breast cancer. In this systematic review, we conduct the review using preferred reporting items for systematic reviews and meta-analyses (PRISMA) and investigate the recent five years of literature in natural language processing (NLP)-based AI applications. This systematic review aims to uncover the recent trends in this area, close the research gap, and help doctors better understand the NLP application pipeline. We first conduct an initial literature search of 202 publications from Scopus, Web of Science, PubMed, Google Scholar, and the Association for Computational Linguistics (ACL) Anthology. Then, we screen the literature based on inclusion and exclusion criteria. Next, we categorize and analyze the advantages and disadvantages of the different machine learning models. We also discuss the current challenges, such as the lack of a public dataset. Furthermore, we suggest some promising future directions, including semi-supervised learning, active learning, and transfer learning.

Journal: Diagnostics (SCI; IF 3.992; JCR Q1; CAS Q3)
Co-Author: Yiming Zhang
Contribution (20%): Data Curation, Validation, Writing - review & editing

9. Ying Weng, and **Yiming Zhang**, "A Survey of Secure Time Synchronization", **Applied Sciences-Basel**, vol. 13, no. 6, p. 3923, 2023. DOI: **10.3390/app13063923**

Abstract: Today, the use of wireless sensor networks has grown rapidly; however, wireless sensor networks are prone to receiving cyber-physical attacks. Time synchronization is a fundamental requirement for protocols in wired and wireless sensor network applications; hence, secure time synchronization is also crucial. This paper presents an introduction to time synchronization, including the concepts, challenges, and requirements of time synchronization protocols. The scope of the paper includes both software- and hardware-based protocols. Then, different time synchronization methods are analyzed. Moreover, research progress in secure time synchronization is reviewed. The survey also discusses the weaknesses of current secure time synchronization protocols and provides suggestions for future research directions. This survey aims to highlight research progress and trends in time synchronization and secure time synchronization.

Journal: Applied Sciences-Basel (SCI; IF 2.838; JCR Q1; CAS Q4)
Co-Author: Yiming Zhang
Contribution (30%): Validation, Writing - review & editing

Conference Proceedings

1. Ran Fei, Ying Weng, **Yiming Zhang**, and Jonathan Lund, "Curve based Fast Detail Enhancement for Biomedical Images", *16th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications*, 8-10 February 2021, Virtual Conference. DOI: **10.5220/0010250203370344**

   Abstract: Biomedical images are widely collected from various applications, which are used for patients' screening, diagnosis and treatment. The dark regions of biomedical images may play as an important role as the bright regions. The enhanced details in the dark regions of biomedical images simultaneously maintain the quality of the rest of the images and reveal more information for doctors and surgeons in medical procedures. This paper proposes a fast method to adaptively enhance the details in the dark regions of biomedical images, including X-rays, video frames of laparoscopy in minimally invasive surgery (MIS).

   Conference: VISAPP 2021 (EI)
   Co-Author: Yiming Zhang
   Contribution (20%): Validation, Writing - review & editing

Patents

1. Ying Weng, Ke Chen, **Yiming Zhang**, "A method and system for rating surgical skills based on explainable artificial intelligence", Chinese patent **granted** on 11th November 2024 (Patent no: 202111287603.0).

PhD Thesis

1. **Yiming Zhang** (2025). Deep learning-based automated and objective assessment of operative skill in surgery. **University of Nottingham**.

   Abstract: Surgical skill assessment traditionally relies on expert observations, but there is increasing demand for automated, objective methods that can accurately assess surgeon expertise and improve training. This thesis presents novel contributions, including a time-frequency domain framework (CWT-ViT) using deep learning and Explainable AI (XAI) to enhance robotic surgical skill assessment, overcoming dataset limitations and improving accuracy. Additionally, an XAI framework integrating multi-view time series feature fusion and case-based reasoning is proposed to enhance interpretability and provide feedback for surgeons.

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