Lingkai Hu

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EDUCATION

Guangzhou University **09/2021 – Present**

- **Major:** Mechanical Engineering (ME)
- **GPA:** 83.03/100
- **IELTS:** 6.5
- **Research Direction:** *Deep learning algorithm, Natural Language Processing, Large Language Models, Computer Vision, Industrial Defect Detection, Digital Signal Processing, Few-Shot Learning*

RESEARCH INTERESTS

My research expertise lies in the field of artificial intelligence technology. I have a strong background in designing and implementing algorithms for artificial intelligence, computer vision, and digital signal processing. In addition to producing numerous theoretical contributions to artificial intelligence, I have also collaborated with diverse individuals and teams across various research fields, such as medical image processing, soft robotics, civil engineering, industrial defect detection, and so on. I am also open to exploring new research areas if given the opportunity.

PUBLICATION

1. **Lingkai Hu**, Feng Zhan, Wenkai Huang, Weiming Gan, "Weird-Net: Weighted Relative Distance Attention for Efficient and Robust Sequence Processing", *IEEE Transactions on Neural Networks and Learning Systems*, (Resubmit [First Author]) [link]
2. **Lingkai Hu**, Feng Zhan, Wenkai Huang, Yikai Dong, Kunbo Han, "Category Knowledge-Guided Few-Shot Bearing Fault Diagnosis", *Engineering Applications of Artificial Intelligence.* (Major Revise [Co-First Author]) [link]
3. **Lingkai Hu**, Wenkai Huang, Weiming Gan, Feng Zhan, Kunbo Han, "Cuneate Recurrent Neural Network", *IEEE Transactions on Artificial Intelligence*. (Under Review [First Author]) [link]
4. **Lingkai Hu**, Feng Zhan, Wenkai Huang, Weiming Gan, "Ultron: A High-Performance Sequence-Processing Model Based on the Composite Mapping Layer", *Neural Networks*. (Under Review [First Author]) [link]
5. Collaborative Network of Multi-view Graph Disentanglement for PCB Defect Classification (Preparing [Second Author])
6. Wenkai Huang, Jiafu Wen, Weiming Gan, **Lingkai Hu**, Bingjun Luo, "Neighborhood Correlation Enhancement Network for PCB Defect Classification", *IEEE Transactions on Instrumentation and Measurement*, 2023. (Accepted [Third Student Author]) [link]
7. Zhuangcheng Fang, **Lingkai Hu**, Haibo Jiang, Shu Fang, Guifeng Zhao, Yuhong Ma, "Shear performance of high-strength friction-grip bolted shear connector in prefabricated steel-UHPC composite beams: Finite element modelling and parametric study", *Case Studies In Construction Materials*, 2023. (Accepted [First Student Author]) [link]
8. Zefeng Xu, **Lingkai Hu**, Yitong Zhou, "Pneumatic Soft Robotic Crawler Integrated With a Precurved Actuator Enables Fast Locomotion", *2022 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, 2022. (Accepted [Second Author]) [link]
9. Zefeng Xu, **Lingkai Hu**, Yitong Zhou, "A soft gripper integrated with mechanically-prestressed soft actuators", *2022 IEEE International Conference on Sensing, Diagnostics, Prognostics, and Control (SDPC)*, 2022. (Accepted [Second Author]) [link]

RESEARCH EXPERIENCE

Project: Weird-Net: Weighted Relative Distance Attention for Efficient and Robust Sequence Processing
Research leader **03/2023-06/2023**

- I examined self-attention mechanisms and the challenges they face in terms of complexity and robustness. To address these challenges, I proposed and designed a Weighted Relative Distance (Weird) Attention algorithm and a Weird-Net model that can capture positional inductive relationships with lower complexity and higher robustness than Transformer-based models. I evaluated the performance of Weird-Net on five datasets and demonstrated its superiority over Transformer-based models in accuracy, complexity, and robustness.

Project: Category Knowledge-Guided Few-Shot Bearing Fault Diagnosis
Project Leader **02/2023-Present**

- I proposed a novel framework, Category Knowledge as a Guide (CKG), for cross-domain fault diagnosis and early fault detection of rotating machinery. The CKG framework can extract category features from few-shot data and classify them into different domains. I designed and evaluated an algorithm based on the CKG framework and verified its performance experimentally.

Project: Cuneate Recurrent Neural Network
Research leader **10/2022 – 08/2023**

- I proposed and developed the Cuneate Recurrent Neural Network (CRNN), a novel model that adds a cuneate layer to the Recurrent Neural Network (RNN) to enhance information extraction and reduce memory decay. I demonstrated that CRNN can handle long signal sequence lengths better than other RNN models, by conducting experiments on various datasets involving music, image, text, and bearing classification.

Project: Ultron: A High-Performance Sequence-Processing Model Based on the Composite Mapping Layer
Research leader **06/2023 – 09/2023**

- I designed and implemented Ultron, a novel sequence-processing model that efficiently handles long-range dependencies by using a composite mapping function with $O(L \log_2 L)$ complexity. I conducted experiments on four datasets to compare Ultron with other Transformer-based models and demonstrate its advantages in terms of accuracy, generalization, efficiency, and memory consumption.

Project: Neighborhood Correlation Enhancement Network for PCB Defect Classification,
Collaborative Network of Multi-view Graph Disentanglement for PCB Defect Classification
Project Leader **09/2021–Present**

- I developed a visual matching algorithm that aligned defect maps and standard maps of PCBs with pixel accuracy. I proposed a Collaborative Network of Multi-view Graph Disentanglement for PCB Defect Classification, which was designed to reduce computational complexity and improve the detection of similarities between functional and non-functional defect textures, as well as small defects.

Project: Shear performance of high-strength friction-grip bolted shear connector in prefabricated steel-UHPC composite beams: Finite element modelling and parametric study
Project Leader **04/2022-01/2023**

- I performed finite element analysis on the mechanical behavior and performance of high-strength friction-grip bolts (HSFGBs) and prefabricated ultra-high performance concrete (UHPC) slabs. I applied data analysis techniques to assess the outcomes and contrast them with existing methods.

Project: Pneumatic Soft Robotic Crawler Integrated With a Precurved Actuator Enables Fast Locomotion
Project Leader **12/2021-Present**

- I developed a 3D surface fitting algorithm to measure the curvature of a soft robotic crawler on various surfaces. I also visualized the data and authored a research paper on the project's methodology, findings, and implications.

Project: A soft gripper integrated with mechanically-prestressed soft actuators
Project Leader **09/2021-Present**

- I developed a computer vision algorithm to measure the radius of the robot gripper and examined how it varied under different pressures. I also visualized the data and authored a research paper on the methods, results, and implications of the project.

SOFTWARE & LANGUAGE SKILLS

- Python, C, Matlab, LaTeX, Markdown
- PyTorch, Tensorflow, Opencv