Linwei Chen 陈林蔚

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Education

Beijing Institute of Technology, School of Computer Science, Electronic Information, *Ph.D.*
(Supervisor: Prof. Ying Fu) 2021.9 - 2025.6

- Research Interests: Object Detection, Image Segmentation, Low-light Enhancement, Remote Sensing, Medical LLMs, Medical Image Processing

Beijing Institute of Technology, School of Computer Science, Software Engineering, *M.S.*
(Supervisor: Prof. Ying Fu) 2019.9 - 2021.6

China University of Geosciences (Beijing), School of Engineering and Technology, Mechanical Design, Manufacturing and Automation, *B.S.* 2014.9 - 2019.6

Publications

1. **Linwei Chen**, Ying Fu*, Lin Gu, Chenggang Yan, Tatsuya Harada, and Gao Huang. Frequency-aware Feature Fusion for Dense Image Prediction. IEEE Transactions on Pattern Analysis and Machine Intelligence (**TPAMI**). (Optimization of feature fusion representation; Impact Factor: 20.8, **CCF-A**, Top-tier international journal in computer vision)
2. **Linwei Chen**, Ying Fu*, Lin Gu, Dezhi Zheng, Jifeng Dai. Spatial Frequency Modulation for Semantic Segmentation. IEEE Transactions on Pattern Analysis and Machine Intelligence (**TPAMI**). (Optimization of downsampling; Recently accepted, Impact Factor: 20.8, **CCF-A**, Top-tier international journal in computer vision)
3. **Linwei Chen**, Ying Fu*, Kaixuan Wei, Dezhi Zheng, Felix Heide. Instance Segmentation in the Dark. International Journal of Computer Vision (**IJCV**) 2023. (Understanding complex scenes in low light; Impact Factor: 15.5, **CCF-A**, Top-tier international journal in computer vision)
4. **Linwei Chen**, Lin Gu, Dezhi Zheng, Ying Fu*. Frequency Adaptive Dilated Convolution for Semantic Segmentation. IEEE Conference on Computer Vision and Pattern Recognition (**CVPR**) 2024. (**Highlight**, top 2.8%, Optimization of dilated convolution representation; **CCF-A**, Top-tier international conference in computer vision)
5. **Linwei Chen**, Lin Gu, Liang Li, Chenggang Yan, Ying Fu*. Frequency Dynamic Convolution for Dense Image Prediction. IEEE Conference on Computer Vision and Pattern Recognition (**CVPR**) 2025. (Optimization of dynamic convolution; **CCF-A**, Top-tier international conference in computer vision)
6. **Linwei Chen**, Lin Gu, Ying Fu*. Frequency-Dynamic Attention Modulation for Dense Prediction. International Conference on Computer Vision (**ICCV**) 2025. (Optimization of attention mechanism representation in Transformer architecture; Recently accepted, **CCF-A**, Top-tier international conference in computer vision)
7. **Linwei Chen**, Lin Gu, Ying Fu*. When Semantic Segmentation Meets Frequency Aliasing. The International Conference on Learning Representations (**ICLR**) 2024. (Analysis of hard pixel samples; Top-tier international conference in computer vision, **Class A** top conference in artificial intelligence)
8. Songlin Liu†, **Linwei Chen**†, Li Zhang, Jun Hu, Ying Fu*. A large-scale climate-aware satellite image dataset for domain adaptive land-cover semantic segmentation. ISPRS Journal of Photogrammetry and Remote Sensing, 2023. (Exploration of the impact of climate on remote sensing segmentation; Co-first author, Impact Factor: 12.7, **CAS Q1 Top Journal**)
9. **Linwei Chen**, Ying Fu*, Shaodi You, Hongzhe Liu. Hybrid supervised instance segmentation by learning label noise suppression. Neurocomputing, 2022. (Weakly supervised instance segmentation; First author, Impact Factor: 6, CCF-C)
10. **Linwei Chen**, Zheng Fang, and Ying Fu*. Consistency-Aware Map Generation at Multiple Zoom Levels Using Aerial Image. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (IEEE J-Stars), 2022. (Remote sensing image generation; First author, Impact Factor: 5.5, CAS Q2)
11. **Linwei Chen**, Ying Fu*, Shaodi You, Hongzhe Liu. Efficient Hybrid Supervision for Instance Segmentation in Aerial Images. Remote Sensing, 2021. (Weakly supervised remote sensing image segmentation; Impact

Factor: 5.6, CAS Q2)

12. Ying Fu*, Zheng Fang, **Linwei Chen**, Tao Song and Defu Lin. Level-Aware Consistent Multi-level Map Translation From Satellite Imagery. IEEE Transactions on Geoscience and Remote Sensing (TGRS), 2022. (Remote sensing image generation; Impact Factor: 8.8, Top-tier journal in remote sensing, CAS Q1)
13. Ying Fu*, Yang Hong, **Linwei Chen**, Shaodi You. LE-GAN: Unsupervised low-light image enhancement network using attention module and identity invariant loss. Knowledge-Based Systems, 2022. (Low-light enhancement; Impact Factor: 8.8, Top-tier journal in artificial intelligence, CAS Q1)
14. Yang Hong, Kaixuan Wei, **Linwei Chen**, Ying Fu*. Crafting Object Detection in Very Low Light. British Machine Vision Conference, 2021. (Object detection in very low light; Important conference in computer vision, CCF-C)
15. 8 pending national patents, with 2 granted.

Awards and Honors

1. 2021 Rocket Force "Intelligent Arrow - Fire Eye" AI Challenge, Task 4: Image-Based Search (Remote Sensing Ship Detection), 7th Place Nationally, Excellence Award.
2. 2022 Beijing Institute of Technology Doctoral Special Scholarship
3. CVPR 2024 PBDL International Challenge, Low-Light Detection and Segmentation Track: 2nd Place (Segmentation), 3rd Place (Detection).
4. 2024 China National Scholarship for Doctoral Students, Ministry of Education of the People's Republic of China
5. BMVC 2024 Outstanding Reviewer.

Research Details

1. **Linwei Chen**, Ying Fu*, Lin Gu, Chenggang Yan, Tatsuya Harada, and Gao Huang. Frequency-aware Feature Fusion for Dense Image Prediction. IEEE Transactions on Pattern Analysis and Machine Intelligence (**TPAMI**). Accepted on 2024/08. (First author, Impact Factor: 20.8, **CCF-A**, Top international computer vision journal)

   Research Content: *In dense image prediction tasks such as detection and segmentation, distinct class information and precise spatial boundary details are crucial. Modern multi-scale models typically use feature fusion techniques, directly adding deep coarse features with low-level high-resolution features, to achieve this. This study observes that features obtained through common standard feature fusion techniques suffer from: 1) intra-class inconsistency caused by high-frequency information within objects; and 2) blurred boundaries and boundary displacement due to a lack of precise high-frequency information. Based on these observations, we propose a novel feature fusion method called FreqFusion, which addresses these issues from a frequency perspective. By adaptively smoothing high-level features, resampling nearby class-consistent features, and enhancing the high-frequency information of low-level features, FreqFusion effectively improves feature consistency and boundary sharpness, significantly enhancing the quality of fused features. Extensive experiments validate its effectiveness in dense prediction tasks such as semantic segmentation, object detection, instance segmentation, and panoptic segmentation, surpassing previous state-of-the-art methods.*

   Research Contributions: *This research not only robustly improves the fundamental technique of feature fusion but also quantitatively measures intra-class inconsistency and boundary displacement problems through feature similarity analysis, providing new perspectives and tools for the development of feature fusion technology and advancements in related fields.*

2. **Linwei Chen**, Ying Fu*, Kaixuan Wei, Dezhi Zheng, Felix Heide. Instance Segmentation in the Dark. International Journal of Computer Vision (**IJCV**), 2023. (Instance segmentation in low-light conditions, First author, Impact Factor: 15.5, **CCF-A**, Top international computer vision journal)

   Research Content: *Existing instance segmentation techniques, primarily designed for high-quality, normally lit images, suffer significant performance degradation in extremely low-light environments. This work thoroughly investigates the challenges of instance segmentation in extreme darkness and introduces several techniques that markedly improve inference accuracy under low-light conditions. Our research is motivated by the observation that noise in low-light images introduces high-frequency interference into the feature maps of neural networks, thereby significantly degrading performance. To suppress this "feature noise," we propose a novel learning approach comprising an adaptive weighted downsampling layer, a smoothness-guided convolution block, and interference suppression learning. These methods effectively reduce high-frequency feature noise, enabling the model to learn interference-resistant features. Furthermore, we find that high-bit-depth*

RAW images preserve richer scene information under low-light conditions compared to typical camera sRGB outputs. Consequently, we use RAW images as input, and our analysis indicates that high bit depth is crucial for low-light instance segmentation. To mitigate the scarcity of RAW datasets for instance segmentation, we leverage a low-light RAW synthesis pipeline to generate realistic low-light data. Additionally, to foster further research in this direction, we collected a real-world low-light instance segmentation RAW dataset, LIS, containing over two thousand pairs of low/normal light images, with pixel-level object class annotations. Notably, without any image preprocessing, we achieve satisfactory performance in extremely low light, and our dataset and methods have become foundational for low-light detection and segmentation, opening new avenues for future research.

Research Contributions: *This study systematically explores the problem of instance segmentation in low-light environments for the first time, identifying high-frequency interference caused by image noise as the primary challenge. Based on this, we developed a preprocessing-free low-light instance segmentation method and constructed a real-world low-light RAW dataset with instance segmentation annotations, providing a research foundation and new opportunities for future low-light detection and segmentation research.*

3. **Linwei Chen**, Lin Gu, Dezhi Zheng, Ying Fu*. Frequency Adaptive Dilated Convolution for Semantic Segmentation. IEEE Conference on Computer Vision and Pattern Recognition 2024 (**CVPR highlight**, top 2.8%, **CCF-A**)

   Research Content: *Dilated Convolution, a technique that expands the receptive field by inserting gaps between consecutive elements of a convolutional kernel, is widely used in computer vision tasks such as semantic segmentation and object detection. However, our analysis reveals that traditional dilated convolution, while enlarging the receptive field, sacrifices the response to high-frequency components, leading to limited performance in processing high-frequency information. This paper proposes a method called Frequency-Adaptive Dilated Convolution (FADC), which improves various stages of dilated convolution from a spectral analysis perspective. FADC incorporates three key strategies: Adaptive Dilation Rate (AdaDR), Adaptive Kernel (AdaKern), and Frequency Selection (FreqSelect). AdaDR dynamically adjusts the dilation rate based on local frequency components, AdaKern adjusts the high and low-frequency proportions of the convolution kernel, and FreqSelect modifies the frequency distribution of input features to encourage receptive field expansion. These strategies work synergistically, enabling FADC to enlarge the receptive field while preserving high-frequency information, thereby enhancing semantic segmentation performance. Extensive experiments on semantic segmentation tasks consistently demonstrate that our method can stably and effectively improve segmentation accuracy. Furthermore, the proposed AdaKern and FreqSelect, when integrated with deformable convolution and dilated attention, also prove effective in object detection and instance segmentation tasks.*

   Research Contributions: *By employing spectral analysis, this work deeply explores dilated convolution, treating the dilation rate allocation problem as a trade-off between effective bandwidth and receptive field. It proposes FADC, which adaptively adjusts the dilation rate of convolutions to balance the capture of frequency components and the size of the receptive field, improving the performance of dilated convolution in handling high-frequency information. This is particularly important for semantic segmentation tasks requiring precise detail capture. Moreover, FADC's methodology can be seamlessly integrated into existing convolutional neural network architectures, offering new insights for improving computer vision models.*

4. **Linwei Chen**, Lin Gu, Liang Li, Chenggang Yan, Ying Fu*. Frequency Dynamic Convolution for Dense Image Prediction. IEEE Conference on Computer Vision and Pattern Recognition 2025 (**CVPR**, **CCF-A**)

   Research Content: *This research addresses the limitations of traditional dynamic convolution (DY-Conv) in frequency response by proposing Frequency Dynamic Convolution (FDConv). It learns weights in the Fourier domain, divides parameters into different frequency groups, and constructs diverse weights without increasing parameter costs. FDConv comprises three core modules: Fourier Disjoint Weights (FDW), Kernel Space Modulation (KSM), and Frequency Band Modulation (FBM). FDW learns spectral coefficients in the Fourier domain, groups them using disjoint Fourier indices, and then converts them to spatial weights via inverse Discrete Fourier Transform, ensuring different weights have distinct frequency responses. KSM generates a dense modulation value matrix from local and global channel information to precisely adjust each weight element. FBM decomposes weights into different frequency bands and dynamically modulates them based on local content, enabling the model to selectively emphasize or suppress frequency bands according to spatial location. Extensive experiments validate FDConv's effectiveness in tasks such as object detection, segmentation, and classification.*

   Research Contributions: *The primary contribution of the proposed FDConv lies in enhancing the model's adaptability to different frequency information while significantly reducing parameter costs. Compared to tra-*

ditional dynamic convolution methods, FDConv addresses the issue of similar frequency responses in weights by learning weights in the Fourier domain, enabling better capture of diverse image features. Furthermore, FDConv achieves excellent performance on multiple vision tasks, including object detection, instance segmentation, semantic segmentation, and image classification, demonstrating its broad applicability and effectiveness. More importantly, FDConv can be seamlessly integrated into various modern vision architectures, such as ConvNeXt and Swin-Transformer, providing a flexible and efficient solution for improving the performance of existing models.

5. **Linwei Chen**, Lin Gu, Ying Fu*. When Semantic Segmentation Meets Frequency Aliasing. The International Conference on Learning Representations 2024 (Semantic segmentation; **ICLR**, First author, **CAAI Class A** Top Conference)

   Research Content: *In the field of semantic segmentation, despite continuous improvements in model performance, understanding of hard-to-segment pixels (hard pixels) in images remains limited. These hard pixels are often associated with object boundaries, and in existing research, these pixel errors are typically treated uniformly, lacking in-depth classification and analysis. Furthermore, frequency aliasing, a common issue in the downsampling process, and its impact on semantic segmentation performance have not been thoroughly studied. Frequency aliasing occurs when high-frequency components of a signal exceed half the sampling rate during downsampling, leading to image distortion. This study aims to explore the relationship between hard pixel errors and frequency aliasing and propose solutions. The research categorizes hard pixels into three types: false responses, merging errors, and displacement errors. We then introduce the concept of equivalent sampling rate to calculate the Nyquist frequency, which serves as a threshold for aliasing occurrence, and propose an aliasing score to quantify the degree of aliasing. Based on this, we design two methods to mitigate the impact of aliasing on semantic segmentation performance: a De-Aliasing Filter (DAF) and a Frequency Mixing (FreqMix) module. DAF can accurately remove high-frequency components that cause aliasing before downsampling, while FreqMix dynamically selects and balances high-frequency components within encoder blocks. Through experiments in standard semantic segmentation tasks and low-light instance segmentation tasks, we demonstrate the effectiveness of the proposed methods, significantly improving segmentation accuracy and reducing hard pixel errors.*

   Research Contributions: *We are the first to classify hard pixel errors at boundaries and quantitatively analyze their relationship with aliasing phenomena, providing new perspectives for subsequent research. We propose an aliasing score, a new metric to quantify the degree of aliasing, which helps to more accurately understand and measure the impact of aliasing on semantic segmentation. This research not only theoretically offers new perspectives for understanding and solving the aliasing problem in semantic segmentation but also contributes to improving the accuracy and reliability of image segmentation tasks in these fields.*

6. Songlin Liu†, **Linwei Chen**†, Li Zhang, Jun Hu, Ying Fu*. A large-scale climate-aware satellite image dataset for domain adaptive land-cover semantic segmentation. ISPRS Journal of Photogrammetry and Remote Sensing, 2023. (Exploring the impact of climate differences on remote sensing segmentation; Co-first author, Impact Factor: 12.7, **CAS Q1 Top Journal**)

   Research Content: *Existing remote sensing datasets for semantic segmentation of land cover overlook the significant diversity across different climatic and geographical regions, which has a major impact on the characteristics of land cover. This leads to a domain gap in remote sensing imagery, severely affecting the performance of segmentation models. To enhance the generalization ability of land cover semantic segmentation, this study, for the first time, explores the impact of climate on land cover semantic segmentation tasks and proposes a unique, large-scale Climate-Aware Satellite Image Dataset (CASID) specifically for domain-adaptive land cover semantic segmentation. The CASID dataset comprises 980 satellite images of 5000×5000 pixels, covering over 24,500 square kilometers across 30 different Asian regions. These images originate from four distinct climate zones: temperate monsoon, subtropical monsoon, tropical monsoon, and tropical rainforest climates. CASID is the first climate-aware land cover semantic segmentation dataset to include multiple climate domains. Furthermore, this paper provides a comprehensive analysis of samples from the four climate regions, revealing differences in global image features, image texture, class distribution, spectral values, and landform shapes across climate zones. Additionally, extensive experimental evaluations of state-of-the-art semantic segmentation and unsupervised domain adaptation methods on the CASID dataset are presented, providing solid baseline results for future research.*

   Research Contributions: *This study is the first to investigate the impact of climate on land cover semantic segmentation and introduces CASID, a unique climate-aware satellite image dataset. It provides a statistical analysis of samples from four typical climate regions, demonstrating their differences in multiple aspects. It also evaluates state-of-the-art semantic segmentation and unsupervised domain adaptation methods on the*

CASID dataset, offering solid baseline results for future research.

7. **Linwei Chen**, Ying Fu*, Shaodi You, Hongzhe Liu. Hybrid supervised instance segmentation by learning label noise suppression. Neurocomputing, 2022. (Instance segmentation; First author, Impact Factor: 6, CCF-C)

   Research Content: *Current fully supervised instance segmentation methods rely on large-scale pixel-level annotated datasets to achieve high accuracy, but acquiring such data is costly and time-consuming. Weakly supervised or semi-supervised methods reduce annotation costs by using less expensive bounding box annotations, image-level annotations, or unlabeled samples, but at a significant performance loss. To save annotation costs without sacrificing too much performance, this study proposes a hybrid supervision framework capable of utilizing easily annotated bounding box labels and accurate pixel-level labels in a mixed manner. This research designs two auxiliary models to learn label noise suppression and obtain accurate pseudo pixel-level labels from bounding box labels for training. One model aims to suppress mislabeling between foreground and background, while the other aims to suppress noise from instance mislabeling. Additionally, the study utilizes a class-aware spatial attention module, a class constraint module, an instance constraint module, and a self-learning training method to improve the accuracy of pseudo-labels. Experimental results show that this method achieves performance comparable to fully supervised methods on the PASCAL VOC 2012 and Cityscapes datasets with lower annotation costs.*

   Research Contributions: *This research proposes a hybrid supervision paradigm that combines low-cost bounding box labels with high-accuracy pixel-level labels. By reducing label noise in weak supervision, the method significantly lowers annotation costs while maintaining performance, offering a new solution to the label noise problem in instance segmentation. In practical applications such as autonomous driving, robotics, and medical image diagnosis, this work helps improve the accuracy and reliability of instance segmentation tasks and reduce their application costs.*

8. **Linwei Chen**, Zheng Fang, and Ying Fu*. Consistency-Aware Map Generation at Multiple Zoom Levels Using Aerial Image. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (IEEE J-Stars), 2022. (Remote sensing image generation; First author, Impact Factor: 5.5, CAS Q2)

   Research Content: *Multi-Level Map (MLM) services, such as Google Maps, play a vital role in our daily lives, not only facilitating daily travel but also serving as crucial infrastructure for bike-sharing services, courier services, the logistics industry, and the transportation sector. These map tiles are typically rendered from vector data, and updating this data requires professionals to physically inspect each geographic point of interest, which is both costly and time-consuming. Compared to vector data, aerial images are easier and cheaper to acquire. Therefore, MLMs based on aerial imagery can be rapidly updated, providing crucial ground information for rescuers even in extreme conditions like earthquakes, floods, and mudslides, thereby saving lives in a timely manner. This paper proposes a novel Multi-Level Map (MLM) generation framework capable of automatically generating accurate and consistent maps at multiple zoom levels from aerial images. The framework consists of two main parts: a Level-Aware Map Generator (LAMG) and a Consistency-Aware Map Generator (CAMG). LAMG can generate accurate initial maps with realistic details for each zoom level. CAMG treats the initial maps of each zoom level as a sequence and establishes connections between them to ensure content consistency across different zoom levels. Furthermore, this study collected a large-scale, high-quality dataset, MLM, for multi-zoom level map generation tasks. Experiments on the MLM dataset show that this method outperforms previous state-of-the-art map generation methods in both comprehensive quantitative metrics and perceptual quality.*

   Research Contributions: *This research proposes a new method capable of generating accurate and consistent multi-level maps from aerial images. This study not only theoretically provides a new solution for generating multi-level maps from aerial images but also holds significant application value in practical fields such as disaster response and urban planning. By providing accurate and consistent maps, this work helps improve the accuracy and reliability of map services in these areas.*

9. **Linwei Chen**, Ying Fu*, Shaodi You, Hongzhe Liu. Efficient Hybrid Supervision for Instance Segmentation in Aerial Images. Remote Sensing, 2021. (Remote sensing image segmentation; First author, Impact Factor: 5.6, CAS Q2)

   Research Content: *In the field of remote sensing, instance segmentation of aerial images is crucial for various applications such as land change monitoring, urban management, and traffic surveillance. However, this task is inherently more challenging due to cluttered backgrounds, dense and small objects, and arbitrary object orientations. Moreover, current Convolutional Neural Network (CNN)-based methods face a trade-off between annotation cost and performance. To address these issues, this paper proposes a hybrid supervision frame-*

work aimed at reducing annotation costs while maintaining high performance. This study proposes a hybrid supervision method that designs an auxiliary segmentation model to generate accurate pseudo pixel-level labels from aerial images for training any instance segmentation model. Specifically, the auxiliary segmentation model includes a bounding box attention module and a bounding box filtering module, capable of generating accurate pseudo pixel-level labels from bounding box labels. This model can locate object pixel-level positions instead of relying on horizontal bounding box predictions, making it more adaptable to arbitrarily oriented objects. Additionally, the study utilizes oriented bounding box labels to handle arbitrarily oriented objects. In experiments, the method demonstrated performance comparable to fully supervised methods (32.1 AP) on the iSAID dataset, significantly higher than weakly supervised methods (26.5 AP), using only 10% of pixel-level labels.

Research Contributions: *This research proposes an instance segmentation method capable of achieving high performance while maintaining low annotation costs. It provides a new solution for instance segmentation in aerial images and holds significant application value in practical fields such as disaster response and urban planning. By reducing annotation costs, this work helps improve the efficiency and reliability of instance segmentation tasks in these areas.*

10. Ying Fu*, Zheng Fang, **Linwei Chen**, Tao Song and Defu Lin. Level-Aware Consistent Multi-level Map Translation From Satellite Imagery. IEEE Transactions on Geoscience and Remote Sensing (TGRS), 2022. (Remote sensing image generation; Third author, Impact Factor: 8.8, Top journal in remote sensing, CAS Q1)

    Research Content: *With the rapid development of remote sensing technology, the quality of satellite imagery (SI) is increasing, containing rich cartographic information that can be translated into maps. However, existing methods either focus only on generating single-level maps or do not fully consider the challenges of multi-level translation from SI, namely large domain gaps, level-dependent content differences, and main content consistency. To address these issues, this paper proposes a novel Level-Aware Fusion Network for the Multi-Level Map Generation (MLMG) task based on satellite imagery. This paper proposes a Level-Aware Fusion Network designed to address three challenges: large domain gaps, level-dependent content differences, and main content consistency. To tackle large domain gaps, a coarse-to-fine map generation approach is proposed. To handle level-dependent content differences, a level classifier is designed to explore map content at different levels. Furthermore, a map element extractor is used to extract main geographical element features from SI, helping to maintain main content consistency. A multi-level fusion generator is further designed to generate consistent multi-level maps from multi-level preliminary maps, further ensuring main content consistency. Additionally, the researchers collected a high-quality multi-level dataset for the SI-based MLMG task. Experimental results show that the proposed method outperforms existing state-of-the-art methods in both objective metrics and visual quality.*

    Research Contributions: *This research proposes a Level-Aware Fusion Network capable of generating high-quality multi-level maps solely from satellite imagery. This study not only theoretically provides a new solution for generating multi-level maps from satellite imagery, but this work also helps to improve the accuracy and reliability of map services in practical applications.*

11. Ying Fu*, Yang Hong, **Linwei Chen**, Shaodi You. LE-GAN: Unsupervised low-light image enhancement network using attention module and identity invariant loss. Knowledge-Based Systems, 2022. (Low-light enhancement; Third author, Impact Factor: 8.8, Top journal in artificial intelligence, CAS Q1)

    Research Content: *Low-light image enhancement aims to recover normally lit images from those captured in very dim environments. Existing methods perform poorly in handling noise, color deviation, and overexposure issues, and cannot guarantee visual quality in the absence of paired training data. To address these problems, this research proposes a novel unsupervised low-light image enhancement network, LE-GAN, based on Generative Adversarial Networks (GANs) and trained with unpaired low-light/normal-light images. The LE-GAN network specifically designs an illumination-aware attention module to enhance the network's feature extraction capabilities, address noise and color deviation problems, and improve visual quality. Furthermore, the study proposes a novel identity invariant loss function to tackle the overexposure issue, enabling the network to adaptively enhance low-light images. The researchers also collected a large-scale low-light dataset, named Paired Normal/Low-light Images (PNLI), containing 2000 pairs of low-light/normal-light images captured in various real-world scenarios, providing the research community with a high-quality dataset to advance the field.*

    Research Contributions: *This research proposes a novel unsupervised low-light enhancement method, LE-GAN, which outperforms existing state-of-the-art methods in performance. Furthermore, this paper constructs*

a new large-scale dataset, PNLI, containing high-quality low-light/normal-light image pairs, which is currently the largest real-world paired image dataset, providing a challenging new benchmark for low-light image enhancement.

12. Yang Hong, Kaixuan Wei, **Linwei Chen**, Ying Fu*. Crafting Object Detection in Very Low Light. British Machine Vision Conference, 2021. (Low-light object detection; Third author, Important computer vision conference, CCF-C)

    Research Content: *Over the past decade, object detection, as a major application in computer vision, has been extensively researched, engineered, and widely applied in daily life. However, existing object detection algorithms tend to fail in very dim environments due to a significant reduction in the signal-to-noise ratio (SNR). The common practice of performing low-light image enhancement before detection not only increases computational costs but also yields unsatisfactory results. This paper systematically investigates object detection under extremely low-light conditions and identifies several key design principles for building low-light detection systems. Based on these principles, the researchers designed a practical low-light detection system that utilizes a realistic low-light synthesis pipeline and an auxiliary low-light recovery module. The low-light synthesis pipeline can convert labeled images from existing object detection datasets into their low-light counterparts for end-to-end training, while the low-light recovery module can enhance low-light detection performance without adding extra computational cost during inference. Furthermore, the researchers captured a real-time low-light object detection dataset containing over 2000 pairs of low/normal light images to support this research area. Extensive experimental results demonstrate that the designed detection system performs excellently under extremely low-light conditions, paving the way for real-world object detection in the dark.*

    Research Contributions: *This research proposes a practical low-light object detection system that utilizes a low-light synthesis pipeline and an auxiliary low-light recovery module to enhance object detection performance under low-light conditions. Furthermore, this paper collected and annotated a dataset of over 2000 real-world low-light scenes, supporting the performance evaluation of low-light object detection systems.*