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Here is what was submitted on January 10, 2024.

Latency-aware Road Anomaly Segmentation in Videos: A Photorealistic Dataset and New Metrics

by Beiwen Tian, Huan-ang Gao, Leiyao Cui, Yupeng Zheng, Lan Luo, Baofeng Wang, Rong Zhi, Guyue Zhou, Hao Zhao

In the past several years, road anomaly segmentation is actively explored in the academia and drawing growing attention in the industry. The rationale behind is straightforward: if the autonomous car can brake before hitting an anomalous object, safety is promoted. However, this rationale naturally calls for a temporally informed setting while existing methods and benchmarks are designed in an unrealistic frame-wise manner. To bridge this gap, we contribute the first video anomaly segmentation dataset for autonomous driving. Since placing various anomalous objects on busy roads and annotating them in every frame are dangerous and expensive, we resort to synthetic data. To improve the relevance of this synthetic dataset to real-world applications, we train a generative adversarial network conditioned on rendering G-buffers for photorealism enhancement. Our dataset consists of 120,000 high-resolution frames at a 60 FPS framerate, as recorded in 7 different towns. As an initial benchmarking, we provide baselines using latest supervised and unsupervised road anomaly segmentation methods. Apart from conventional ones, we focus on two new metrics: temporal consistency and latencyaware streaming accuracy. We believe the latter is valuable as it measures whether an anomaly segmentation algorithm can truly prevent a car from crashing in a temporally informed setting.

EmMixformer: Mix transformer for eye movement recognition

by Huafeng Qin, Hongyu Zhu, Xin Jin, Qun Song, Mounim A. El-Yacoubi, Xinbo Gao

Eye movement (EM) is a new highly secure biometric behavioral modality that has received increasing attention in recent years. Although deep neural networks, such as convolutional neural network (CNN), have recently achieved promising performance, current solutions fail to capture local and global temporal dependencies within eye movement data. To overcome this problem, we propose in this paper a mixed transformer termed EmMixformer to extract time and frequency domain information for eye movement recognition. To this end, we propose a mixed block consisting of three modules, transformer, attention Long short-term memory (attention LSTM), and Fourier transformer. We are the first to attempt leveraging transformer to learn long temporal dependencies within eye movement. Second, we incorporate the attention mechanism into LSTM to propose attention LSTM with the aim to learn short temporal dependencies. Third, we perform self attention in the frequency domain to learn global features. As the three modules provide complementary feature representations in terms of local and global dependencies, the proposed EmMixformer is capable of improving recognition accuracy. The experimental results on our eye movement dataset and two public eye movement datasets show that the proposed EmMixformer outperforms the state of the art by achieving the lowest verification error.

ECC-PolypDet: Enhanced CenterNet with Contrastive Learning for Automatic Polyp Detection

by Yuncheng Jiang, Zixun Zhang, Yiwen Hu, Guanbin Li, Xiang Wan, Song Wu, Shuguang Cui, Silin Huang, Zhen Li

Accurate polyp detection is critical for early colorectal cancer diagnosis. Although remarkable progress has been achieved in recent years, the complex colon environment and concealed polyps with unclear boundaries still pose severe challenges in this area. Existing methods either involve computationally expensive context aggregation or lack prior modeling of polyps, resulting in poor performance in challenging cases. In this paper, we propose the Enhanced CenterNet with Contrastive Learning (ECC-PolypDet), a two-stage training \& end-to-end inference framework that leverages images and bounding box annotations to train a general model and fine-tune it based on the inference score to obtain a final robust model. Specifically, we conduct Box-assisted Contrastive Learning (BCL) during training to minimize the intra-class difference and maximize the inter-class difference between foreground polyps and backgrounds, enabling our model to capture concealed polyps. Moreover, to enhance the recognition of small polyps, we design the Semantic Flow-guided Feature Pyramid Network (SFFPN) to aggregate multi-scale features and the Heatmap Propagation (HP) module to boost the model's attention on polyp targets. In the fine-tuning stage, we introduce the IoU-guided Sample Re-weighting (ISR) mechanism to prioritize hard samples by adaptively adjusting the loss weight for each sample during fine-tuning. Extensive experiments on six large-scale colonoscopy datasets demonstrate the superiority of our model compared with previous state-of-the-art detectors.

Large Model based Sequential Keyframe Extraction for Video Summarization

by Kailong Tan, Yuxiang Zhou, Qianchen Xia, Rui Liu, Yong Chen

Keyframe extraction aims to sum up a video's semantics with the minimum number of its frames. This paper puts forward a Large Model based Sequential Keyframe Extraction for video summarization, dubbed LMSKE, which contains three stages as below. First, we use the large model "TransNetV21" to cut the video into consecutive shots, and employ the large model "CLIP2" to generate each frame's visual feature within each shot; Second, we develop an adaptive clustering algorithm to yield candidate keyframes for each shot, with each candidate keyframe locating nearest to a cluster center; Third, we further reduce the above candidate keyframes via redundancy elimination within each shot, and finally concatenate them in accordance with the sequence of shots as the final sequential keyframes. To evaluate LMSKE, we curate a benchmark dataset and conduct rich experiments, whose results exhibit that LMSKE performs much better than quite a few SOTA competitors with average F1 of 0.5311, average fidelity of 0.8141, and average compression ratio of 0.9922.

HaltingVT: Adaptive Token Halting Transformer for Efficient Video Recognition

by Qian Wu, Ruoxuan Cui, Yuke Li, Haoqi Zhu

Action recognition in videos poses a challenge due to its high computational cost, especially for Joint Space-Time video transformers (Joint VT). Despite their effectiveness, the excessive number of tokens in such architectures significantly limits their efficiency. In this paper, we propose HaltingVT, an efficient video transformer adaptively removing redundant video patch tokens, which is primarily composed of a Joint VT and a Glimpser module. Specifically, HaltingVT applies data-adaptive token reduction at each layer, resulting in a significant reduction in the overall computational cost. Besides, the Glimpser module quickly removes redundant tokens in shallow transformer layers, which may even be misleading for video recognition tasks based on our observations. To further encourage HaltingVT to focus on the key motion-related information in videos, we design an effective Motion Loss during training. HaltingVT acquires video analysis capabilities and token halting compression strategies simultaneously in a unified training process, without requiring additional training procedures or sub-networks. On the Mini-Kinetics dataset, we achieved 75.0% top-1 ACC with 24.2 GFLOPs, as well as 67.2% top-1 ACC with an extremely low 9.9 GFLOPs. The code is available at https://github.com/dun-research/HaltingVT.

MGNet: Learning Correspondences via Multiple Graphs

by Luanyuan Dai, Xiaoyu Du, Hanwang Zhang, Jinhui Tang

Learning correspondences aims to find correct correspondences (inliers) from the initial correspondence set with an uneven correspondence distribution and a low inlier rate, which can be regarded as graph data. Recent advances usually use graph neural networks (GNNs) to build a single type of graph or simply stack local graphs into the global one to complete the task. But they ignore the complementary relationship between different types of graphs, which can effectively capture potential relationships among sparse correspondences. To address this problem, we propose MGNet to effectively combine multiple complementary graphs. To obtain information integrating implicit and explicit local graphs, we construct local graphs from implicit and explicit aspects and combine them effectively, which is used to build a global graph. Moreover, we propose Graph~Soft~Degree~Attention (GSDA) to make full use of all sparse correspondence information at once in the global graph, which can capture and amplify discriminative features. Extensive experiments demonstrate that MGNet outperforms state-of-the-art methods in different visual tasks. The code is provided in https://github.com/DAILUANYUAN/MGNet-2024AAAI.

Optimising Graph Representation for Hardware Implementation of Graph Convolutional Networks for Event-based Vision

by Kamil Jeziorek, Piotr Wzorek, Krzysztof Blachut, Andrea Pinna, Tomasz Kryjak

Event-based vision is an emerging research field involving processing data generated by Dynamic Vision Sensors (neuromorphic cameras). One of the latest proposals in this area are Graph Convolutional Networks (GCNs), which allow to process events in its original sparse form while maintaining high detection and classification performance. In this paper, we present the hardware implementation of a~graph generation process from an event camera data stream, taking into account both the advantages and limitations of FPGAs. We propose various ways to simplify the graph representation and use scaling and quantisation of values. We consider both undirected and directed graphs that enable the use of PointNet convolution. The results obtained show that by appropriately modifying the graph representation, it is possible to create a~hardware module for graph generation. Moreover, the proposed modifications have no significant impact on object detection performance, only 0.08% mAP less for the base model and the N-Caltech data set.Finally, we describe the proposed hardware architecture of the graph generation module.

Less is More : A Closer Look at Multi-Modal Few-Shot Learning

by Chunpeng Zhou, Haishuai Wang, Xilu Yuan, Zhi Yu, Jiajun Bu

Few-shot Learning aims to learn and distinguish new categories with a very limited number of available images, presenting a significant challenge in the realm of deep learning. Recent researchers have sought to leverage the additional textual or linguistic information of these rare categories with a pre-trained language model to facilitate learning, thus partially alleviating the problem of insufficient supervision signals. However, the full potential of the textual information and pre-trained language model have been underestimated in the few-shot learning till now, resulting in limited performance enhancements. To address this, we propose a simple but effective framework for few-shot learning tasks, specifically designed to exploit the textual information and language model. In more detail, we explicitly exploit the zero-shot capability of the pre-trained language model with the learnable prompt. And we just add the visual feature with the textual feature for inference directly without the intricate designed fusion modules in previous works. Additionally, we apply the self-ensemble and distillation to further enhance these components. Our extensive experiments conducted across four widely used few-shot datasets demonstrate that our simple framework achieves impressive results. Particularly noteworthy is its outstanding performance in the 1-shot learning task, surpassing state-of-the-art methods by an average of 3.0\% in classification accuracy. We will make the source codes of the proposed framework publicly available upon acceptance. .

Dual-Perspective Knowledge Enrichment for Semi-Supervised 3D Object Detection

by Yucheng Han, Na Zhao, Weiling Chen, Keng Teck Ma, Hanwang Zhang

Semi-supervised 3D object detection is a promising yet under-explored direction to reduce data annotation costs, especially for cluttered indoor scenes. A few prior works, such as SESS and 3DIoUMatch, attempt to solve this task by utilizing a teacher model to generate pseudo-labels for unlabeled samples. However, the availability of unlabeled samples in the 3D domain is relatively limited compared to its 2D counterpart due to the greater effort required to collect 3D data. Moreover, the loose consistency regularization in SESS and restricted pseudo-label selection strategy in 3DIoUMatch lead to either low-quality supervision or a limited amount of pseudo labels. To address these issues, we present a novel Dual-Perspective Knowledge Enrichment approach named DPKE for semi-supervised 3D object detection. Our DPKE enriches the knowledge of limited training data, particularly unlabeled data, from two perspectives: data-perspective and feature-perspective. Specifically, from the data-perspective, we propose a class-probabilistic data augmentation method that augments the input data with additional instances based on the varying distribution of class probabilities. Our DPKE achieves feature-perspective knowledge enrichment by designing a geometry-aware feature matching method that regularizes feature-level similarity between object proposals from the student and teacher models. Extensive experiments on the two benchmark datasets demonstrate that our DPKE achieves superior performance over existing state-of-the-art approaches under various label ratio conditions. The source code will be made available to the public.

Source-Free Cross-Modal Knowledge Transfer by Unleashing the Potential of Task-Irrelevant Data

by Jinjing Zhu, Yucheng Chen, Lin Wang

Source-free cross-modal knowledge transfer is a crucial yet challenging task, which aims to transfer knowledge from one source modality (e.g., RGB) to the target modality (e.g., depth or infrared) with no access to the task-relevant (TR) source data due to memory and privacy concerns. A recent attempt leverages the paired task-irrelevant (TI) data and directly matches the features from them to eliminate the modality gap. However, it ignores a pivotal clue that the paired TI data could be utilized to effectively estimate the source data distribution and better facilitate knowledge transfer to the target modality. To this end, we propose a novel yet concise framework to unlock the potential of paired TI data for enhancing source-free cross-modal knowledge transfer. Our work is buttressed by two key technical components. Firstly, to better estimate the source data distribution, we introduce a Task-irrelevant data-Guided Modality Bridging (TGMB) module. It translates the target modality data (e.g., infrared) into the source-like RGB images based on paired TI data and the guidance of the available source model to alleviate two key gaps: 1) inter-modality gap between the paired TI data; 2) intra-modality gap between TI and TR target data. We then propose a Task-irrelevant data-Guided Knowledge Transfer (TGKT) module that transfers knowledge from the source model to the target model by leveraging the paired TI data. Notably, due to the unavailability of labels for the TR target data and its less reliable prediction from the source model, our TGKT model incorporates a self-supervised pseudo-labeling approach to enable the target model to learn from its predictions. Extensive experiments show that our method achieves state-of-the-art performance on three datasets (RGB-to-depth and RGB-to-infrared).

AdvMT: Adversarial Motion Transformer for Long-term Human Motion Prediction

by Sarmad Idrees, Jongeun Choi, Seokman Sohn

To achieve seamless collaboration between robots and humans in a shared environment, accurately predicting future human movements is essential. Human motion prediction has traditionally been approached as a sequence prediction problem, leveraging historical human motion data to estimate future poses. Beginning with vanilla recurrent networks, the research community has investigated a variety of methods for learning human motion dynamics, encompassing graph-based and generative approaches. Despite these efforts, achieving accurate long-term predictions continues to be a significant challenge. In this regard, we present the Adversarial Motion Transformer (AdvMT), a novel model that integrates a transformer-based motion encoder and a temporal continuity discriminator. This combination effectively captures spatial and temporal dependencies simultaneously within frames. With adversarial training, our method effectively reduces the unwanted artifacts in predictions, thereby ensuring the learning of more realistic and fluid human motions. The evaluation results indicate that AdvMT greatly enhances the accuracy of long-term predictions while also delivering robust short-term predictions

Content-Aware Depth-Adaptive Image Restoration

by Tom Richard Vargis, Siavash Ghiasvand

This work prioritizes building a modular pipeline that utilizes existing models to systematically restore images, rather than creating new restoration models from scratch. Restoration is carried out at an object-specific level, with each object regenerated using its corresponding class label information. The approach stands out by providing complete user control over the entire restoration process. Users can select models for specialized restoration steps, customize the sequence of steps to meet their needs, and refine the resulting regenerated image with depth awareness. The research provides two distinct pathways for implementing image regeneration, allowing for a comparison of their respective strengths and limitations. The most compelling aspect of this versatile system is its adaptability. This adaptability enables users to target particular object categories, including medical images, by providing models that are trained on those object classes.

Application of Deep Learning in Blind Motion Deblurring: Current Status and Future Prospects

by Yawen Xiang, Heng Zhou, Chengyang Li, Fangwei Sun, Zhongbo Li, Yongqiang Xie

Motion deblurring is one of the fundamental problems of computer vision and has received continuous attention. The variability in blur, both within and across images, imposes limitations on non-blind deblurring techniques that rely on estimating the blur kernel. As a response, blind motion deblurring has emerged, aiming to restore clear and detailed images without prior knowledge of the blur type, fueled by the advancements in deep learning methodologies. Despite strides in this field, a comprehensive synthesis of recent progress in deep learning-based blind motion deblurring is notably absent. This paper fills that gap by providing an exhaustive overview of the role of deep learning in blind motion deblurring, encompassing datasets, evaluation metrics, and methods developed over the last six years. Specifically, we first introduce the types of motion blur and the fundamental principles of deblurring. Next, we outline the shortcomings of traditional non-blind deblurring algorithms, emphasizing the advantages of employing deep learning techniques for deblurring tasks. Following this, we categorize and summarize existing blind motion deblurring methods based on different backbone networks, including convolutional neural networks, generative adversarial networks, recurrent neural networks, and Transformer networks. Subsequently, we elaborate not only on the fundamental principles of these different categories but also provide a comprehensive summary and comparison of their advantages and limitations. Qualitative and quantitative experimental results conducted on four widely used datasets further compare the performance of SOTA methods. Finally, an analysis of present challenges and future pathways. All collected models, benchmark datasets, source code links, and codes for evaluation have been made publicly available at https://github.com/VisionVerse/Blind-Motion-Deblurring-Survey

SwiMDiff: Scene-wide Matching Contrastive Learning with Diffusion Constraint for Remote Sensing Image

by Jiayuan Tian, Jie Lei, Jiaqing Zhang, Weiying Xie, Yunsong Li

With recent advancements in aerospace technology, the volume of unlabeled remote sensing image (RSI) data has increased dramatically. Effectively leveraging this data through self-supervised learning (SSL) is vital in the field of remote sensing. However, current methodologies, particularly contrastive learning (CL), a leading SSL method, encounter specific challenges in this domain. Firstly, CL often mistakenly identifies geographically adjacent samples with similar semantic content as negative pairs, leading to confusion during model training. Secondly, as an instance-level discriminative task, it tends to neglect the essential fine-grained features and complex details inherent in unstructured RSIs. To overcome these obstacles, we introduce SwiMDiff, a novel self-supervised pre-training framework designed for RSIs. SwiMDiff employs a scene-wide matching approach that effectively recalibrates labels to recognize data from the same scene as false negatives. This adjustment makes CL more applicable to the nuances of remote sensing. Additionally, SwiMDiff seamlessly integrates CL with a diffusion model. Through the implementation of pixel-level diffusion constraints, we enhance the encoder's ability to capture both the global semantic information and the fine-grained features of the images more comprehensively. Our proposed framework significantly enriches the information available for downstream tasks in remote sensing. Demonstrating exceptional performance in change detection and land-cover classification tasks, SwiMDiff proves its substantial utility and value in the field of remote sensing.

Efficient Fine-Tuning with Domain Adaptation for Privacy-Preserving Vision Transformer

by Teru Nagamori, Sayaka Shiota, Hitoshi Kiya

We propose a novel method for privacy-preserving deep neural networks (DNNs) with the Vision Transformer (ViT). The method allows us not only to train models and test with visually protected images but to also avoid the performance degradation caused from the use of encrypted images, whereas conventional methods cannot avoid the influence of image encryption. A domain adaptation method is used to efficiently fine-tune ViT with encrypted images. In experiments, the method is demonstrated to outperform conventional methods in an image classification task on the CIFAR-10 and ImageNet datasets in terms of classification accuracy.

CrossDiff: Exploring Self-Supervised Representation of Pansharpening via Cross-Predictive Diffusion Model

by Yinghui Xing, Litao Qu, ShiZhou Zhang, Xiuwei Zhang, Yanning Zhang

Fusion of a panchromatic (PAN) image and corresponding multispectral (MS) image is also known as pansharpening, which aims to combine abundant spatial details of PAN and spectral information of MS. Due to the absence of high-resolution MS images, available deep-learning-based methods usually follow the paradigm of training at reduced resolution and testing at both reduced and full resolution. When taking original MS and PAN images as inputs, they always obtain sub-optimal results due to the scale variation. In this paper, we propose to explore the self-supervised representation of pansharpening by designing a cross-predictive diffusion model, named CrossDiff. It has two-stage training. In the first stage, we introduce a cross-predictive pretext task to pre-train the UNet structure based on conditional DDPM, while in the second stage, the encoders of the UNets are frozen to directly extract spatial and spectral features from PAN and MS, and only the fusion head is trained to adapt for pansharpening task. Extensive experiments show the effectiveness and superiority of the proposed model compared with state-of-the-art supervised and unsupervised methods. Besides, the cross-sensor experiments also verify the generalization ability of proposed self-supervised representation learners for other satellite's datasets. We will release our code for reproducibility.

Toward distortion-aware change detection in realistic scenarios

by Yitao Zhao, Heng-Chao Li, Nanqing Liu, Rui Wang

In the conventional change detection (CD) pipeline, two manually registered and labeled remote sensing datasets serve as the input of the model for training and prediction. However, in realistic scenarios, data from different periods or sensors could fail to be aligned as a result of various coordinate systems. Geometric distortion caused by coordinate shifting remains a thorny issue for CD algorithms. In this paper, we propose a reusable self-supervised framework for bitemporal geometric distortion in CD tasks. The whole framework is composed of Pretext Representation Pre-training, Bitemporal Image Alignment, and Down-stream Decoder Fine-Tuning. With only single-stage pre-training, the key components of the framework can be reused for assistance in the bitemporal image alignment, while simultaneously enhancing the performance of the CD decoder. Experimental results in 2 large-scale realistic scenarios demonstrate that our proposed method can alleviate the bitemporal geometric distortion in CD tasks.

Derm-T2IM: Harnessing Synthetic Skin Lesion Data via Stable Diffusion Models for Enhanced Skin Disease Classification using ViT and CNN

by Muhammad Ali Farooq, Wang Yao, Michael Schukat, Mark A Little, Peter Corcoran

This study explores the utilization of Dermatoscopic synthetic data generated through stable diffusion models as a strategy for enhancing the robustness of machine learning model training. Synthetic data generation plays a pivotal role in mitigating challenges associated with limited labeled datasets, thereby facilitating more effective model training. In this context, we aim to incorporate enhanced data transformation techniques by extending the recent success of few-shot learning and a small amount of data representation in text-to-image latent diffusion models. The optimally tuned model is further used for rendering high-quality skin lesion synthetic data with diverse and realistic characteristics, providing a valuable supplement and diversity to the existing training data. We investigate the impact of incorporating newly generated synthetic data into the training pipeline of state-of-art machine learning models, assessing its effectiveness in enhancing model performance and generalization to unseen real-world data. Our experimental results demonstrate the efficacy of the synthetic data generated through stable diffusion models helps in improving the robustness and adaptability of end-to-end CNN and vision transformer models on two different real-world skin lesion datasets.

MISS: A Generative Pretraining and Finetuning Approach for Med-VQA

by Jiawei Chen, Dingkang Yang, Yue Jiang, Yuxuan Lei, Lihua Zhang

Medical visual question answering (VQA) is a challenging multimodal task, where Vision-Language Pre-training (VLP) models can effectively improve the generalization performance. However, most methods in the medical field treat VQA as an answer classification task which is difficult to transfer to practical application scenarios. Additionally, due to the privacy of medical images and the expensive annotation process, large-scale medical image-text pairs datasets for pretraining are severely lacking. In this paper, we propose a large-scale MultI-task Self-Supervised learning based framework (MISS) for medical VQA tasks. Unlike existing methods, we treat medical VQA as a generative task. We unify the text encoder and multimodal encoder and align image-text features through multi-task learning. Furthermore, we propose a Transfer-and-Caption method that extends the feature space of single-modal image datasets using large language models (LLMs), enabling those traditional medical vision field task data to be applied to VLP. Experiments show that our method achieves excellent results with fewer multimodal datasets and demonstrates the advantages of generative VQA models. The code and model weights will be released upon the paper's acceptance.

REACT 2024: the Second Multiple Appropriate Facial Reaction Generation Challenge

by Siyang Song, Micol Spitale, Cheng Luo, Cristina Palmero, German Barquero, Hengde Zhu, Sergio Escalera, Michel Valstar, Tobias Baur, Fabien Ringeval, Elisabeth Andre, Hatice Gunes

In dyadic interactions, humans communicate their intentions and state of mind using verbal and non-verbal cues, where multiple different facial reactions might be appropriate in response to a specific speaker behaviour. Then, how to develop a machine learning (ML) model that can automatically generate multiple appropriate, diverse, realistic and synchronised human facial reactions from an previously unseen speaker behaviour is a challenging task. Following the successful organisation of the first REACT challenge (REACT 2023), this edition of the challenge (REACT 2024) employs a subset used by the previous challenge, which contains segmented 30-secs dyadic interaction clips originally recorded as part of the NOXI and RECOLA datasets, encouraging participants to develop and benchmark Machine Learning (ML) models that can generate multiple appropriate facial reactions (including facial image sequences and their attributes) given an input conversational partner's stimulus under various dyadic video conference scenarios. This paper presents: (i) the guidelines of the REACT 2024 challenge; (ii) the dataset utilized in the challenge; and (iii) the performance of the baseline systems on the two proposed sub-challenges: Offline Multiple Appropriate Facial Reaction Generation and Online Multiple Appropriate Facial Reaction Generation, respectively. The challenge baseline code is publicly available at https://github.com/reactmultimodalchallenge/baseline\_react2024.

CLIP-guided Source-free Object Detection in Aerial Images

by Nanqing Liu, Xun Xu, Yongyi Su, Chengxin Liu, Peiliang Gong, Heng-Chao Li

Domain adaptation is crucial in aerial imagery, as the visual representation of these images can significantly vary based on factors such as geographic location, time, and weather conditions. Additionally, high-resolution aerial images often require substantial storage space and may not be readily accessible to the public. To address these challenges, we propose a novel Source-Free Object Detection (SFOD) method. Specifically, our approach is built upon a self-training framework; however, self-training can lead to inaccurate learning in the absence of labeled training data. To address this issue, we further integrate Contrastive Language-Image Pre-training (CLIP) to guide the generation of pseudo-labels, termed CLIP-guided Aggregation. By leveraging CLIP's zero-shot classification capability, we use it to aggregate scores with the original predicted bounding boxes, enabling us to obtain refined scores for the pseudo-labels. To validate the effectiveness of our method, we constructed two new datasets from different domains based on the DIOR dataset, named DIOR-C and DIOR-Cloudy. Experiments demonstrate that our method outperforms other comparative algorithms.

Video-based Automatic Lameness Detection of Dairy Cows using Pose Estimation and Multiple Locomotion Traits

by Helena Russello, Rik van der Tol, Menno Holzhauer, Eldert J. van Henten, Gert Kootstra

This study presents an automated lameness detection system that uses deep-learning image processing techniques to extract multiple locomotion traits associated with lameness. Using the T-LEAP pose estimation model, the motion of nine keypoints was extracted from videos of walking cows. The videos were recorded outdoors, with varying illumination conditions, and T-LEAP extracted 99.6% of correct keypoints. The trajectories of the keypoints were then used to compute six locomotion traits: back posture measurement, head bobbing, tracking distance, stride length, stance duration, and swing duration. The three most important traits were back posture measurement, head bobbing, and tracking distance. For the ground truth, we showed that a thoughtful merging of the scores of the observers could improve intra-observer reliability and agreement. We showed that including multiple locomotion traits improves the classification accuracy from 76.6% with only one trait to 79.9% with the three most important traits and to 80.1% with all six locomotion traits.

Exploring Vulnerabilities of No-Reference Image Quality Assessment Models: A Query-Based Black-Box Method

by Chenxi Yang, Yujia Liu, Dingquan Li, Tingting jiang

No-Reference Image Quality Assessment (NR-IQA) aims to predict image quality scores consistent with human perception without relying on pristine reference images, serving as a crucial component in various visual tasks. Ensuring the robustness of NR-IQA methods is vital for reliable comparisons of different image processing techniques and consistent user experiences in recommendations. The attack methods for NR-IQA provide a powerful instrument to test the robustness of NR-IQA. However, current attack methods of NR-IQA heavily rely on the gradient of the NR-IQA model, leading to limitations when the gradient information is unavailable. In this paper, we present a pioneering query-based black box attack against NR-IQA methods. We propose the concept of score boundary and leverage an adaptive iterative approach with multiple score boundaries. Meanwhile, the initial attack directions are also designed to leverage the characteristics of the Human Visual System (HVS). Experiments show our attack method outperforms all compared state-of-the-art methods and is far ahead of previous black-box methods. The effective DBCNN model suffers a Spearman rank-order correlation coefficient (SROCC) decline of 0.6972 attacked by our method, revealing the vulnerability of NR-IQA to black-box attacks. The proposed attack method also provides a potent tool for further exploration into NR-IQA robustness.

Do Vision and Language Encoders Represent the World Similarly?

by Mayug Maniparambil, Raiymbek Akshulakov, Yasser Abdelaziz Dahou Djilali, Sanath Narayan, Mohamed El Amine Seddik, Karttikeya Mangalam, Noel E. O'Connor

Aligned text-image encoders such as CLIP have become the de facto model for vision-language tasks. Furthermore, modality-specific encoders achieve impressive performances in their respective domains. This raises a central question: does an alignment exist between uni-modal vision and language encoders since they fundamentally represent the same physical world? Analyzing the latent spaces structure of vision and language models on image-caption benchmarks using the Centered Kernel Alignment (CKA), we find that the representation spaces of unaligned and aligned encoders are semantically similar. In the absence of statistical similarity in aligned encoders like CLIP, we show that a possible matching of unaligned encoders exists without any training. We frame this as a seeded graph-matching problem exploiting the semantic similarity between graphs and propose two methods - a Fast Quadratic Assignment Problem optimization, and a novel localized CKA metric-based matching/retrieval. We demonstrate the effectiveness of this on several downstream tasks including cross-lingual, cross-domain caption matching and image classification.

Measuring Natural Scenes SFR of Automotive Fisheye Cameras

by Daniel Jakab, Eoin Martino Grua, Brian Micheal Deegan, Anthony Scanlan, Pepijn Van De Ven, Ciarán Eising

The Modulation Transfer Function (MTF) is an important image quality metric typically used in the automotive domain. However, despite the fact that optical quality has an impact on the performance of computer vision in vehicle automation, for many public datasets, this metric is unknown. Additionally, wide field-of-view (FOV) cameras have become increasingly popular, particularly for low-speed vehicle automation applications. To investigate image quality in datasets, this paper proposes an adaptation of the Natural Scenes Spatial Frequency Response (NS-SFR) algorithm to suit cameras with a wide field-of-view.

Structure from Duplicates: Neural Inverse Graphics from a Pile of Objects

by Tianhang Cheng, Wei-Chiu Ma, Kaiyu Guan, Antonio Torralba, Shenlong Wang

Our world is full of identical objects (\emphe.g., cans of coke, cars of same model). These duplicates, when seen together, provide additional and strong cues for us to effectively reason about 3D. Inspired by this observation, we introduce Structure from Duplicates (SfD), a novel inverse graphics framework that reconstructs geometry, material, and illumination from a single image containing multiple identical objects. SfD begins by identifying multiple instances of an object within an image, and then jointly estimates the 6DoF pose for all instances.An inverse graphics pipeline is subsequently employed to jointly reason about the shape, material of the object, and the environment light, while adhering to the shared geometry and material constraint across instances. Our primary contributions involve utilizing object duplicates as a robust prior for single-image inverse graphics and proposing an in-plane rotation-robust Structure from Motion (SfM) formulation for joint 6-DoF object pose estimation. By leveraging multi-view cues from a single image, SfD generates more realistic and detailed 3D reconstructions, significantly outperforming existing single image reconstruction models and multi-view reconstruction approaches with a similar or greater number of observations.

PIXART-{\delta}: Fast and Controllable Image Generation with Latent Consistency Models

by Junsong Chen, Yue Wu, Simian Luo, Enze Xie, Sayak Paul, Ping Luo, Hang Zhao, Zhenguo Li

This technical report introduces PIXART-{\delta}, a text-to-image synthesis framework that integrates the Latent Consistency Model (LCM) and ControlNet into the advanced PIXART-{alpha} model. PIXART-{alpha} is recognized for its ability to generate high-quality images of 1024px resolution through a remarkably efficient training process. The integration of LCM in PIXART-{\delta} significantly accelerates the inference speed, enabling the production of high-quality images in just 2-4 steps. Notably, PIXART-{\delta} achieves a breakthrough 0.5 seconds for generating 1024x1024 pixel images, marking a 7x improvement over the PIXART-{alpha}. Additionally, PIXART-{\delta} is designed to be efficiently trainable on 32GB V100 GPUs within a single day. With its 8-bit inference capability (von Platen et al., 2023), PIXART-{\delta} can synthesize 1024px images within 8GB GPU memory constraints, greatly enhancing its usability and accessibility. Furthermore, incorporating a ControlNet-like module enables fine-grained control over text-to-image diffusion models. We introduce a novel ControlNet-Transformer architecture, specifically tailored for Transformers, achieving explicit controllability alongside high-quality image generation. As a state-of-the-art, open-source image generation model, PIXART-{\delta} offers a promising alternative to the Stable Diffusion family of models, contributing significantly to text-to-image synthesis.

Score Distillation Sampling with Learned Manifold Corrective

by Thiemo Alldieck, Nikos Kolotouros, Cristian Sminchisescu

Score Distillation Sampling (SDS) is a recent but already widely popular method that relies on an image diffusion model to control optimization problems using text prompts. In this paper, we conduct an in-depth analysis of the SDS loss function, identify an inherent problem with its formulation, and propose a surprisingly easy but effective fix. Specifically, we decompose the loss into different factors and isolate the component responsible for noisy gradients. In the original formulation, high text guidance is used to account for the noise, leading to unwanted side effects. Instead, we train a shallow network mimicking the timestep-dependent denoising deficiency of the image diffusion model in order to effectively factor it out. We demonstrate the versatility and the effectiveness of our novel loss formulation through several qualitative and quantitative experiments, including optimization-based image synthesis and editing, zero-shot image translation network training, and text-to-3D synthesis.

Enhanced Muscle and Fat Segmentation for CT-Based Body Composition Analysis: A Comparative Study

by Benjamin Hou, Tejas Sudharshan Mathai, Jianfei Liu, Christopher Parnell, Ronald M. Summers

Purpose: Body composition measurements from routine abdominal CT can yield personalized risk assessments for asymptomatic and diseased patients. In particular, attenuation and volume measures of muscle and fat are associated with important clinical outcomes, such as cardiovascular events, fractures, and death. This study evaluates the reliability of an Internal tool for the segmentation of muscle and fat (subcutaneous and visceral) as compared to the well-established public TotalSegmentator tool. Methods: We assessed the tools across 900 CT series from the publicly available SAROS dataset, focusing on muscle, subcutaneous fat, and visceral fat. The Dice score was employed to assess accuracy in subcutaneous fat and muscle segmentation. Due to the lack of ground truth segmentations for visceral fat, Cohen's Kappa was utilized to assess segmentation agreement between the tools. Results: Our Internal tool achieved a 3% higher Dice (83.8 vs. 80.8) for subcutaneous fat and a 5% improvement (87.6 vs. 83.2) for muscle segmentation respectively. A Wilcoxon signed-rank test revealed that our results were statistically different with p<0.01. For visceral fat, the Cohen's kappa score of 0.856 indicated near-perfect agreement between the two tools. Our internal tool also showed very strong correlations for muscle volume (R^2=0.99), muscle attenuation (R^2=0.93), and subcutaneous fat volume (R^2=0.99) with a moderate correlation for subcutaneous fat attenuation (R^2=0.45). Conclusion: Our findings indicated that our Internal tool outperformed TotalSegmentator in measuring subcutaneous fat and muscle. The high Cohen's Kappa score for visceral fat suggests a reliable level of agreement between the two tools. These results demonstrate the potential of our tool in advancing the accuracy of body composition analysis.

URHand: Universal Relightable Hands

by Zhaoxi Chen, Gyeongsik Moon, Kaiwen Guo, Chen Cao, Stanislav Pidhorskyi, Tomas Simon, Rohan Joshi, Yuan Dong, Yichen Xu, Bernardo Pires, He Wen, Lucas Evans, Bo Peng, Julia Buffalini, Autumn Trimble, Kevyn McPhail, Melissa Schoeller, Shoou-I Yu, Javier Romero, Michael Zollhöfer, Yaser Sheikh, Ziwei Liu, Shunsuke Saito

Existing photorealistic relightable hand models require extensive identity-specific observations in different views, poses, and illuminations, and face challenges in generalizing to natural illuminations and novel identities. To bridge this gap, we present URHand, the first universal relightable hand model that generalizes across viewpoints, poses, illuminations, and identities. Our model allows few-shot personalization using images captured with a mobile phone, and is ready to be photorealistically rendered under novel illuminations. To simplify the personalization process while retaining photorealism, we build a powerful universal relightable prior based on neural relighting from multi-view images of hands captured in a light stage with hundreds of identities. The key challenge is scaling the cross-identity training while maintaining personalized fidelity and sharp details without compromising generalization under natural illuminations. To this end, we propose a spatially varying linear lighting model as the neural renderer that takes physics-inspired shading as input feature. By removing non-linear activations and bias, our specifically designed lighting model explicitly keeps the linearity of light transport. This enables single-stage training from light-stage data while generalizing to real-time rendering under arbitrary continuous illuminations across diverse identities. In addition, we introduce the joint learning of a physically based model and our neural relighting model, which further improves fidelity and generalization. Extensive experiments show that our approach achieves superior performance over existing methods in terms of both quality and generalizability. We also demonstrate quick personalization of URHand from a short phone scan of an unseen identity.

InseRF: Text-Driven Generative Object Insertion in Neural 3D Scenes

by Mohamad Shahbazi, Liesbeth Claessens, Michael Niemeyer, Edo Collins, Alessio Tonioni, Luc Van Gool, Federico Tombari

We introduce InseRF, a novel method for generative object insertion in the NeRF reconstructions of 3D scenes. Based on a user-provided textual description and a 2D bounding box in a reference viewpoint, InseRF generates new objects in 3D scenes. Recently, methods for 3D scene editing have been profoundly transformed, owing to the use of strong priors of text-to-image diffusion models in 3D generative modeling. Existing methods are mostly effective in editing 3D scenes via style and appearance changes or removing existing objects. Generating new objects, however, remains a challenge for such methods, which we address in this study. Specifically, we propose grounding the 3D object insertion to a 2D object insertion in a reference view of the scene. The 2D edit is then lifted to 3D using a single-view object reconstruction method. The reconstructed object is then inserted into the scene, guided by the priors of monocular depth estimation methods. We evaluate our method on various 3D scenes and provide an in-depth analysis of the proposed components. Our experiments with generative insertion of objects in several 3D scenes indicate the effectiveness of our method compared to the existing methods. InseRF is capable of controllable and 3D-consistent object insertion without requiring explicit 3D information as input. Please visit our project page at https://mohamad-shahbazi.github.io/inserf.

Towards Online Sign Language Recognition and Translation

by Ronglai Zuo, Fangyun Wei, Brian Mak

The objective of sign language recognition is to bridge the communication gap between the deaf and the hearing. Numerous previous works train their models using the well-established connectionist temporal classification (CTC) loss. During the inference stage, the CTC-based models typically take the entire sign video as input to make predictions. This type of inference scheme is referred to as offline recognition. In contrast, while mature speech recognition systems can efficiently recognize spoken words on the fly, sign language recognition still falls short due to the lack of practical online solutions. In this work, we take the first step towards filling this gap. Our approach comprises three phases: 1) developing a sign language dictionary encompassing all glosses present in a target sign language dataset; 2) training an isolated sign language recognition model on augmented signs using both conventional classification loss and our novel saliency loss; 3) employing a sliding window approach on the input sign sequence and feeding each sign clip to the well-optimized model for online recognition. Furthermore, our online recognition model can be extended to boost the performance of any offline model, and to support online translation by appending a gloss-to-text network onto the recognition model. By integrating our online framework with the previously best-performing offline model, TwoStream-SLR, we achieve new state-of-the-art performance on three benchmarks: Phoenix-2014, Phoenix-2014T, and CSL-Daily. Code and models will be available at https://github.com/FangyunWei/SLRT

D3GU: Multi-Target Active Domain Adaptation via Enhancing Domain Alignment

by Lin Zhang, Linghan Xu, Saman Motamed, Shayok Chakraborty, Fernando De la Torre

Unsupervised domain adaptation (UDA) for image classification has made remarkable progress in transferring classification knowledge from a labeled source domain to an unlabeled target domain, thanks to effective domain alignment techniques. Recently, in order to further improve performance on a target domain, many Single-Target Active Domain Adaptation (ST-ADA) methods have been proposed to identify and annotate the salient and exemplar target samples. However, it requires one model to be trained and deployed for each target domain and the domain label associated with each test sample. This largely restricts its application in the ubiquitous scenarios with multiple target domains. Therefore, we propose a Multi-Target Active Domain Adaptation (MT-ADA) framework for image classification, named D3GU, to simultaneously align different domains and actively select samples from them for annotation. This is the first research effort in this field to our best knowledge. D3GU applies Decomposed Domain Discrimination (D3) during training to achieve both source-target and target-target domain alignments. Then during active sampling, a Gradient Utility (GU) score is designed to weight every unlabeled target image by its contribution towards classification and domain alignment tasks, and is further combined with KMeans clustering to form GU-KMeans for diverse image sampling. Extensive experiments on three benchmark datasets, Office31, OfficeHome, and DomainNet, have been conducted to validate consistently superior performance of D3GU for MT-ADA.

FPRF: Feed-Forward Photorealistic Style Transfer of Large-Scale 3D Neural Radiance Fields

by GeonU Kim, Kim Youwang, Tae-Hyun Oh

We present FPRF, a feed-forward photorealistic style transfer method for large-scale 3D neural radiance fields. FPRF stylizes large-scale 3D scenes with arbitrary, multiple style reference images without additional optimization while preserving multi-view appearance consistency. Prior arts required tedious per-style/-scene optimization and were limited to small-scale 3D scenes. FPRF efficiently stylizes large-scale 3D scenes by introducing a style-decomposed 3D neural radiance field, which inherits AdaIN's feed-forward stylization machinery, supporting arbitrary style reference images. Furthermore, FPRF supports multi-reference stylization with the semantic correspondence matching and local AdaIN, which adds diverse user control for 3D scene styles. FPRF also preserves multi-view consistency by applying semantic matching and style transfer processes directly onto queried features in 3D space. In experiments, we demonstrate that FPRF achieves favorable photorealistic quality 3D scene stylization for large-scale scenes with diverse reference images. Project page: https://kim-geonu.github.io/FPRF/

From Pampas to Pixels: Fine-Tuning Diffusion Models for Ga\'ucho Heritage

by Marcellus Amadeus, William Alberto Cruz Castañeda, André Felipe Zanella, Felipe Rodrigues Perche Mahlow

Generative AI has become pervasive in society, witnessing significant advancements in various domains. Particularly in the realm of Text-to-Image (TTI) models, Latent Diffusion Models (LDMs), showcase remarkable capabilities in generating visual content based on textual prompts. This paper addresses the potential of LDMs in representing local cultural concepts, historical figures, and endangered species. In this study, we use the cultural heritage of Rio Grande do Sul (RS), Brazil, as an illustrative case. Our objective is to contribute to the broader understanding of how generative models can help to capture and preserve the cultural and historical identity of regions. The paper outlines the methodology, including subject selection, dataset creation, and the fine-tuning process. The results showcase the images generated, alongside the challenges and feasibility of each concept. In conclusion, this work shows the power of these models to represent and preserve unique aspects of diverse regions and communities.

Consensus Focus for Object Detection and minority classes

by Erik Isai Valle Salgado, Chen Li, Yaqi Han, Linchao Shi, Xinghui Li

Ensemble methods exploit the availability of a given number of classifiers or detectors trained in single or multiple source domains and tasks to address machine learning problems such as domain adaptation or multi-source transfer learning. Existing research measures the domain distance between the sources and the target dataset, trains multiple networks on the same data with different samples per class, or combines predictions from models trained under varied hyperparameters and settings. Their solutions enhanced the performance on small or tail categories but hurt the rest. To this end, we propose a modified consensus focus for semi-supervised and long-tailed object detection. We introduce a voting system based on source confidence that spots the contribution of each model in a consensus, lets the user choose the relevance of each class in the target label space so that it relaxes minority bounding boxes suppression, and combines multiple models' results without discarding the poisonous networks. Our tests on synthetic driving datasets retrieved higher confidence and more accurate bounding boxes than the NMS, soft-NMS, and WBF.

Siamese Networks with Soft Labels for Unsupervised Lesion Detection and Patch Pretraining on Screening Mammograms

by Kevin Van Vorst, Li Shen

Self-supervised learning has become a popular way to pretrain a deep learning model and then transfer it to perform downstream tasks. However, most of these methods are developed on large-scale image datasets that contain natural objects with clear textures, outlines, and distinct color contrasts. It remains uncertain whether these methods are equally effective for medical imaging, where the regions of interest often blend subtly and indistinctly with the surrounding tissues. In this study, we propose an alternative method that uses contralateral mammograms to train a neural network to encode similar embeddings when a pair contains both normal images and different embeddings when a pair contains normal and abnormal images. Our approach leverages the natural symmetry of human body as weak labels to learn to distinguish abnormal lesions from background tissues in a fully unsupervised manner. Our findings suggest that it's feasible by incorporating soft labels derived from the Euclidean distances between the embeddings of the image pairs into the Siamese network loss. Our method demonstrates superior performance in mammogram patch classification compared to existing self-supervised learning methods. This approach not only leverages a vast amount of image data effectively but also minimizes reliance on costly labels, a significant advantage particularly in the field of medical imaging.

VLP: Vision Language Planning for Autonomous Driving

by Chenbin Pan, Burhaneddin Yaman, Tommaso Nesti, Abhirup Mallik, Alessandro G Allievi, Senem Velipasalar, Liu Ren

Autonomous driving is a complex and challenging task that aims at safe motion planning through scene understanding and reasoning. While vision-only autonomous driving methods have recently achieved notable performance, through enhanced scene understanding, several key issues, including lack of reasoning, low generalization performance and long-tail scenarios, still need to be addressed. In this paper, we present VLP, a novel Vision-Language-Planning framework that exploits language models to bridge the gap between linguistic understanding and autonomous driving. VLP enhances autonomous driving systems by strengthening both the source memory foundation and the self-driving car's contextual understanding. VLP achieves state-of-the-art end-to-end planning performance on the challenging NuScenes dataset by achieving 35.9\% and 60.5\% reduction in terms of average L2 error and collision rates, respectively, compared to the previous best method. Moreover, VLP shows improved performance in challenging long-tail scenarios and strong generalization capabilities when faced with new urban environments.

Diffusion Priors for Dynamic View Synthesis from Monocular Videos

by Chaoyang Wang, Peiye Zhuang, Aliaksandr Siarohin, Junli Cao, Guocheng Qian, Hsin-Ying Lee, Sergey Tulyakov

Dynamic novel view synthesis aims to capture the temporal evolution of visual content within videos. Existing methods struggle to distinguishing between motion and structure, particularly in scenarios where camera poses are either unknown or constrained compared to object motion. Furthermore, with information solely from reference images, it is extremely challenging to hallucinate unseen regions that are occluded or partially observed in the given videos. To address these issues, we first finetune a pretrained RGB-D diffusion model on the video frames using a customization technique. Subsequently, we distill the knowledge from the finetuned model to a 4D representations encompassing both dynamic and static Neural Radiance Fields (NeRF) components. The proposed pipeline achieves geometric consistency while preserving the scene identity. We perform thorough experiments to evaluate the efficacy of the proposed method qualitatively and quantitatively. Our results demonstrate the robustness and utility of our approach in challenging cases, further advancing dynamic novel view synthesis.

FourCastNeXt: Improving FourCastNet Training with Limited Compute

by Edison Guo, Maruf Ahmed, Yue Sun, Rahul Mahendru, Rui Yang, Harrison Cook, Tennessee Leeuwenburg, Ben Evans

Recently, the FourCastNet Neural Earth System Model (NESM) has shown impressive results on predicting various atmospheric variables, trained on the ERA5 reanalysis dataset. While FourCastNet enjoys quasi-linear time and memory complexity in sequence length compared to quadratic complexity in vanilla transformers, training FourCastNet on ERA5 from scratch still requires large amount of compute resources, which is expensive or even inaccessible to most researchers. In this work, we will show improved methods that can train FourCastNet using only 1% of the compute required by the baseline, while maintaining model performance or par or even better than the baseline.

Reverse Projection: Real-Time Local Space Texture Mapping

by Adrian Xuan Wei Lim, Lynnette Hui Xian Ng, Conor Griffin, Nicholas Kyger, Faraz Baghernezhad

We present Reverse Projection, a novel projective texture mapping technique for painting a decal directly to the texture of a 3D object. Designed to be used in games, this technique works in real-time. By using projection techniques that are computed in local space textures and outward-looking, users using low-end android devices to high-end gaming desktops are able to enjoy the personalization of their assets. We believe our proposed pipeline is a step in improving the speed and versatility of model painting.

Wasserstein Distance-based Expansion of Low-Density Latent Regions for Unknown Class Detection

by Prakash Mallick, Feras Dayoub, Jamie Sherrah

This paper addresses the significant challenge in open-set object detection (OSOD): the tendency of state-of-the-art detectors to erroneously classify unknown objects as known categories with high confidence. We present a novel approach that effectively identifies unknown objects by distinguishing between high and low-density regions in latent space. Our method builds upon the Open-Det (OD) framework, introducing two new elements to the loss function. These elements enhance the known embedding space's clustering and expand the unknown space's low-density regions. The first addition is the Class Wasserstein Anchor (CWA), a new function that refines the classification boundaries. The second is a spectral normalisation step, improving the robustness of the model. Together, these augmentations to the existing Contrastive Feature Learner (CFL) and Unknown Probability Learner (UPL) loss functions significantly improve OSOD performance. Our proposed OpenDet-CWA (OD-CWA) method demonstrates: a) a reduction in open-set errors by approximately 17%-22%, b) an enhancement in novelty detection capability by 1.5%-16%, and c) a decrease in the wilderness index by 2%-20% across various open-set scenarios. These results represent a substantial advancement in the field, showcasing the potential of our approach in managing the complexities of open-set object detection.

Nucleus subtype classification using inter-modality learning

by Lucas W. Remedios, Shunxing Bao, Samuel W. Remedios, Ho Hin Lee, Leon Y. Cai, Thomas Li, Ruining Deng, Can Cui, Jia Li, Qi Liu, Ken S. Lau, Joseph T. Roland, Mary K. Washington, Lori A. Coburn, Keith T. Wilson, Yuankai Huo, Bennett A. Landman

Understanding the way cells communicate, co-locate, and interrelate is essential to understanding human physiology. Hematoxylin and eosin (H&E) staining is ubiquitously available both for clinical studies and research. The Colon Nucleus Identification and Classification (CoNIC) Challenge has recently innovated on robust artificial intelligence labeling of six cell types on H&E stains of the colon. However, this is a very small fraction of the number of potential cell classification types. Specifically, the CoNIC Challenge is unable to classify epithelial subtypes (progenitor, endocrine, goblet), lymphocyte subtypes (B, helper T, cytotoxic T), or connective subtypes (fibroblasts, stromal). In this paper, we propose to use inter-modality learning to label previously un-labelable cell types on virtual H&E. We leveraged multiplexed immunofluorescence (MxIF) histology imaging to identify 14 subclasses of cell types. We performed style transfer to synthesize virtual H&E from MxIF and transferred the higher density labels from MxIF to these virtual H&E images. We then evaluated the efficacy of learning in this approach. We identified helper T and progenitor nuclei with positive predictive values of 0.34 ± 0.15 (prevalence 0.03 ± 0.01) and 0.47 ± 0.1 (prevalence 0.07 ± 0.02) respectively on virtual H&E. This approach represents a promising step towards automating annotation in digital pathology.

Face-GPS: A Comprehensive Technique for Quantifying Facial Muscle Dynamics in Videos

by Juni Kim, Zhikang Dong, Pawel Polak

We introduce a novel method that combines differential geometry, kernels smoothing, and spectral analysis to quantify facial muscle activity from widely accessible video recordings, such as those captured on personal smartphones. Our approach emphasizes practicality and accessibility. It has significant potential for applications in national security and plastic surgery. Additionally, it offers remote diagnosis and monitoring for medical conditions such as stroke, Bell's palsy, and acoustic neuroma. Moreover, it is adept at detecting and classifying emotions, from the overt to the subtle. The proposed face muscle analysis technique is an explainable alternative to deep learning methods and a non-invasive substitute to facial electromyography (fEMG).

Transforming Image Super-Resolution: A ConvFormer-based Efficient Approach

by Gang Wu, Junjun Jiang, Junpeng Jiang, Xianming Liu

Recent progress in single-image super-resolution (SISR) has achieved remarkable performance, yet the computational costs of these methods remain a challenge for deployment on resource-constrained devices. Especially for transformer-based methods, the self-attention mechanism in such models brings great breakthroughs while incurring substantial computational costs. To tackle this issue, we introduce the Convolutional Transformer layer (ConvFormer) and the ConvFormer-based Super-Resolution network (CFSR), which offer an effective and efficient solution for lightweight image super-resolution tasks. In detail, CFSR leverages the large kernel convolution as the feature mixer to replace the self-attention module, efficiently modeling long-range dependencies and extensive receptive fields with a slight computational cost. Furthermore, we propose an edge-preserving feed-forward network, simplified as EFN, to obtain local feature aggregation and simultaneously preserve more high-frequency information. Extensive experiments demonstrate that CFSR can achieve an advanced trade-off between computational cost and performance when compared to existing lightweight SR methods. Compared to state-of-the-art methods, e.g. ShuffleMixer, the proposed CFSR achieves 0.39 dB gains on Urban100 dataset for x2 SR task while containing 26% and 31% fewer parameters and FLOPs, respectively. Code and pre-trained models are available at https://github.com/Aitical/CFSR.

MatSAM: Efficient Materials Microstructure Extraction via Visual Large Model

by Changtai Li, Xu Han, Chao Yao, Xiaojuan Ban

Accurate and efficient extraction of microstructures in microscopic images of materials plays a critical role in the exploration of structure-property relationships and the optimization of process parameters. Deep learning-based image segmentation techniques that rely on manual annotation are time-consuming and labor-intensive and hardly meet the demand for model transferability and generalization. Segment Anything Model (SAM), a large visual model with powerful deep feature representation and zero-shot generalization capabilities, has provided new solutions for image segmentation. However, directly applying SAM to segmenting microstructures in microscopic images of materials without human annotation cannot achieve the expected results, as the difficulty of adapting its native prompt engineering to the dense and dispersed characteristics of key microstructures in materials microscopy images. In this paper, we propose MatSAM, a general and efficient microstructure extraction solution based on SAM. A new point-based prompts generation strategy is designed, grounded on the distribution and shape of materials microstructures. It generates prompts for different microscopic images, fuses the prompts of the region of interest (ROI) key points and grid key points, and integrates post-processing methods for quantitative characterization of materials microstructures. For common microstructures including grain boundary and phase, MatSAM achieves superior segmentation performance to conventional methods and is even preferable to supervised learning methods evaluated on 18 materials microstructures imaged by the optical microscope (OM) and scanning electron microscope (SEM). We believe that MatSAM can significantly reduce the cost of quantitative characterization of materials microstructures and accelerate the design of new materials.

Masked Attribute Description Embedding for Cloth-Changing Person Re-identification

by Chunlei Peng, Boyu Wang, Decheng Liu, Nannan Wang, Ruimin Hu, Xinbo Gao

Cloth-changing person re-identification (CC-ReID) aims to match persons who change clothes over long periods. The key challenge in CC-ReID is to extract clothing-independent features, such as face, hairstyle, body shape, and gait. Current research mainly focuses on modeling body shape using multi-modal biological features (such as silhouettes and sketches). However, it does not fully leverage the personal description information hidden in the original RGB image. Considering that there are certain attribute descriptions which remain unchanged after the changing of cloth, we propose a Masked Attribute Description Embedding (MADE) method that unifies personal visual appearance and attribute description for CC-ReID. Specifically, handling variable clothing-sensitive information, such as color and type, is challenging for effective modeling. To address this, we mask the clothing and color information in the personal attribute description extracted through an attribute detection model. The masked attribute description is then connected and embedded into Transformer blocks at various levels, fusing it with the low-level to high-level features of the image. This approach compels the model to discard clothing information. Experiments are conducted on several CC-ReID benchmarks, including PRCC, LTCC, Celeb-reID-light, and LaST. Results demonstrate that MADE effectively utilizes attribute description, enhancing cloth-changing person re-identification performance, and compares favorably with state-of-the-art methods. The code is available at https://github.com/moon-wh/MADE.

That's all for today, thank you for listening. If you found the podcast helpful, please leave a comment, like, or share it with a friend. See you tomorrow!