Yongduan Song
Chongqing University, CHINA

Dongrui Wu
Huazhong University of Science and Technology, CHINA

Carlos A. Coello Coello
CINVESTAV-IPN, MEXICO

Georgios N. Yannakakis
University of Malta, MALTA

Huajin Tang
Zhejiang University, CHINA

Yiu-Ming Cheung
Hong Kong Baptist University, HONG KONG

Hussein Abbass
University of New South Wales, AUSTRALIA

CIS Publication Spotlight

IEEE Transactions on Neural Networks and Learning Systems

Endmember-Guided Unmixing Network (EGU-Net): A General Deep Learning Framework for Self-Supervised Hyperspectral Unmixing, by D. Hong, L. Gao, J. Yao, N. Yokoya, J. Chanussot, U. Heiden, and B. Zhang, *IEEE Transactions on Neural Networks and Learning Systems*, Vol. 33, No. 11, Nov. 2022, pp. 6518–6531.

Digital Object Identifier: 10.1109/TNNLS.2021.3082289

"Over the past decades, enormous efforts have been made to improve the performance of linear or nonlinear mixing models for hyperspectral unmixing (HU), yet their ability to simultaneously generalize various spectral variabilities (SVs) and extract physically meaningful endmembers still remains limited due to the poor ability in data fitting and reconstruction and the sensitivity to various SVs. Inspired by the powerful learning ability of deep learning (DL), we attempt to develop a general DL approach for HU, by fully considering the properties of endmembers extracted from the hyperspectral imagery, called endmember-guided unmixing network (EGU-Net). Beyond the alone autoencoder-like architecture, EGU-Net is a two-stream Siamese deep network, which learns an additional network from the pure or nearly pure endmembers to correct the weights of another unmixing network by sharing network parameters and adding spectrally meaningful constraints (e.g., nonnegativity and sum-to-one) toward a more accurate and interpretable unmixing solution. Furthermore, the resulting general framework is not only limited to pixelwise spectral unmixing but also applicable to spatial information modeling with convolutional operators for spatial–spectral unmixing. Experimental results conducted on three different datasets with the ground truth of abundance maps corresponding to each material demonstrate the effectiveness and superiority of the EGU-Net over state-of-the-art unmixing algorithms. The codes will be available from the website: https://github.com/danfenghong/IEEE_TNNLS_EGU-Net."

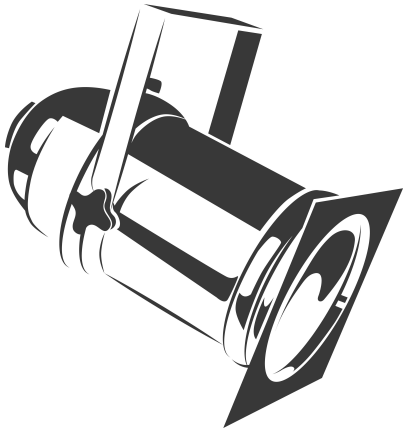

IMAGE LICENSED BY INGRAM PUBLISHING

Digital Object Identifier 10.1109/MCI.2023.3248759
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Corresponding author: Yongduan Song (e-mail: ydsong@cqu.edu.cn).

IEEE Transactions on Fuzzy Systems

Fuz-Spam: Label Smoothing-Based Fuzzy Detection of Spammers in Internet of Things, by Z. Guo, K. Yu, A. Jolfaei, F. Ding, N. Zhang, *IEEE Transactions on Fuzzy Systems*, Vol. 30, No. 11, Nov. 2022, pp. 4543–4554.

Digital Object Identifier: 10.1109/TFUZZ.2021.3130311

"Nowadays, online spamming has already been a remarkable threat to contents security of Internet of Things. Due to constant technical progress, online spamming activities have been more and more concealed. This brings much fuzziness to spammer detection scenarios, yielding the issue of fuzzy detection of spammers. Although existing detection techniques for spammers utilized idea of deep learning, they still ignore to release power of label spaces. As real nature about a user may be usually fuzzy, but the label annotated for a user is always certain. To remedy such gap, this article proposes a label smoothing-based fuzzy detection method for spammers (Fuz-Spam). First of all, deep representation is still utilized to deeply fuse features, which acts as the foundation of neural computing. On this basis, generative adversarial learning is introduced to transform previous label spaces into distributed forms. In addition, two groups of experiments are carried out on two real-world datasets for evaluation. The results demonstrate that the Fuz-Spam improves identification efficiency about 10% to 20% than previous ones, and that the Fuz-Spam is endowed with proper stability."

Fuzzy Deep Forest With Deep Contours Feature for Leaf Cultivar Classification, by W. Zheng, L. Yan, C. Gou, and F. Y. Wang, *IEEE Transactions on Fuzzy Systems*, Vol. 30, No. 12, Dec. 2022, pp. 5431–5444.

Digital Object Identifier: 10.1109/TFUZZ.2022.3177764

"Deep learning is a compelling technique for feature extraction due to its adaptive capacity of processing and providing deeper image information. However, for the task of leaf cultivar classification, the deep learning-based classifier model is unable to extract contour features of leaf images deeply due to the lack of large specialized datasets and expert knowledge annotations. Also, the scale/size of the current leaf cultivar dataset does not meet the needs of deep neural networks (DNNs). In particular, the high model complexity of DNNs implies that deep-learning-based neural networks seem to must require a large dataset to achieve good performance, but facing the fact that the leaf cultivar dataset often is small, even some classes in this kind of datasets contain less than ten images/examples. To overcome these problems and inspired by the resounding success of fuzzy logic, we propose a novel fuzzy ensemble model for leaf cultivar classification. To extract the contours of leaves, we first propose generative adversarial networks-based methods. Second, to improve the ability of feature representation, we present a data augmentation method to transform our contour features. Third, to get the essential features of leaves, we design a novel generation of the fuzzy random forest. Finally, to achieve accurate classification, we design a novel deep learning strategy, namely deep fuzzy representation learning, integrating and cascading a lot of our fuzzy random forests. Experimental results show that our model outperforms other existing state-of-the-art on three real-world datasets, and performs much better than the original deep forest and DNN-based algorithms particularly."

IEEE Transactions on Evolutionary Computation

Automated Configuration of Genetic Algorithms by Tuning for Anytime Performances, by F. Ye, C. Doerr, H. Wang, and T. Bäck, *IEEE Transactions on Evolutionary Computation*, Vol. 26, No. 6, Dec. 2022, pp. 1526–1538.

Digital Object Identifier: 10.1109/TEVC.2022.3159087

"Finding the best configuration of algorithms' hyperparameters for a given optimization problem is an important task in evolutionary computation. We compare in this work the results of four different hyperparameter optimization (HPO) approaches for a family of genetic algorithms (GAs) on 25 diverse pseudo-Boolean optimization (PBO) problems. More precisely, we compare previously obtained results from a grid search with those obtained from three automated configuration techniques: 1) iterated racing; 2) mixed-integer parallel-efficient global optimization (MIP-EGO); and 3) mixed-integer evolutionary strategies. Using two different cost metrics: 1) expected running time (ERT) and 2) the area under the empirical cumulative distribution function (ECDF) curve, we find that in several cases the best configurations with respect to ERT are obtained when using the area under the ECDF curve as the cost metric during the configuration process. Our results suggest that even when interested in ERT performance, it might be preferable to use anytime performance measures for the configuration task. We also observe that tuning for ERT is much more sensitive with respect to the budget that is allocated to the target algorithms."

IEEE Transactions on Games

Toward Designer Modeling Through Design Style Clustering, by A. Alvarez, J. Font, and J. Togelius, *IEEE Transactions on Games*, Vol. 14, No. 4, Dec. 2022, pp. 676–686.

Digital Object Identifier: 10.1109/TG.2022.3143800

"We propose modeling designer style in mixed-initiative game content creation tools as archetypical design traces. These design traces are formulated as transitions between design styles; these design styles are in turn found through clustering all intermediate designs along the way to making a complete design. This method is implemented in the Evolutionary Dungeon Designer, a research platform for mixed-initiative systems to create adventure and dungeon crawler games. We present results both in the form of design styles for rooms, which can be analyzed

to better understand the kind of rooms designed by users, and in the form of archetypical sequences between these rooms, i.e., designer personas."

IEEE Transactions on Cognitive and Developmental Systems

Conversational Affective Social Robots for Ageing and Dementia Support, by M. R. Lima, M. Wairagkar, M. Gupta, F. R. Baena, P. Barnaghi, D. J. Sharp, and R. Vaidyanathan, *IEEE Transactions on Cognitive and Developmental Systems*, Vol. 14, No. 4, Dec. 2022, pp. 1378–1397.

Digital Object Identifier: 10.1109/TCDS.2021.3115228

"Socially assistive robots (SAR) hold significant potential to assist older adults and people with dementia in human engagement and clinical contexts by supporting mental health and independence at home. While SAR research has recently experienced prolific growth, long-term trust, clinical translation, and patient benefit remain immature. Affective human–robot interactions are unresolved and the deployment of robots with conversational abilities is fundamental for robustness and human–robot engagement. In this article, we review the state of the art within the past two decades, design trends, and current applications of conversational affective SAR for ageing and dementia support. A horizon scanning of AI voice technology for healthcare, including ubiquitous smart speakers, is further introduced to address current gaps inhibiting home use. We discuss the role of user-centered approaches in the design of voice systems, including the capacity to handle communication breakdowns for effective use by target populations. We summarize the state of development in interactions using speech and natural language processing, which forms a baseline for longitudinal health monitoring and cognitive assessment. Drawing from this foundation, we identify open challenges and propose future directions to advance conversational affective social robots for: 1) user engagement; 2) deployment in real-world settings; and 3) clinical translation."

IEEE Transactions on Emerging Topics in Computational Intelligence

Monitoring Social Distancing With Single Image Depth Estimation, by A. Mingozzi, A. Conti, F. Aleotti, M. Poggi, and S. Mattoccia, *IEEE Transactions on Emerging Topics in Computational Intelligence*, Vol. 6, No. 6, Dec. 2022, pp. 1290–1301.

Digital Object Identifier: 10.1109/TETCI.2022.3171769

"The recent pandemic emergency raised many challenges regarding the countermeasures aimed at containing the virus spread, and constraining the minimum distance between people resulted in one of the most effective strategies. Thus, the implementation of autonomous systems capable of monitoring the so-called social distance gained much interest. In this paper, we aim to address this task leveraging a single RGB frame without additional depth sensors. In contrast to existing single-image alternatives failing when ground localization is not available, we rely on single image depth estimation to perceive the 3D structure of the observed scene and estimate the distance between people. During the setup phase, a straightforward calibration procedure, leveraging a scale-aware SLAM algorithm available even on consumer smartphones, allows us to address the scale ambiguity affecting single image depth estimation. We validate our approach through indoor and outdoor images employing a calibrated LiDAR + RGB camera asset. Experimental results highlight that our proposal enables sufficiently reliable estimation of the inter-personal distance to monitor social distancing effectively. This fact confirms that despite its intrinsic ambiguity, if appropriately driven single image depth estimation can be a viable alternative to other depth perception techniques, more expensive and not always feasible in practical applications. Our evaluation also highlights that our framework can run reasonably fast and comparably to competitors, even on pure CPU systems. Moreover, its practical deployment on low-power systems is around the corner."

IEEE Transactions on Artificial Intelligence

Graph Representation Learning Meets Computer Vision: A Survey, by L. Jiao, J. Chen, F. Liu, S. Yang, C. You, X. Liu, L. Li, and B. Hou, *IEEE Transactions on Artificial Intelligence*, Vol. 4, No. 1, Feb. 2023, pp. 2–22.

Digital Object Identifier: 10.1109/TAI.2022.3194869

"A graph structure is a powerful mathematical abstraction, which can not only represent information about individuals but also capture the interactions between individuals for reasoning. Geometric modeling and relational inference based on graph data is a long-standing topic of interest in the computer vision community. In this article, we provide a systematic review of graph representation learning and its applications in computer vision. First, we sort out the evolution of representation learning on graphs, categorizing them into the nonneural network and neural network methods based on the way the nodes are encoded. Specifically, nonneural network methods, such as graph embedding and probabilistic graphical models, are introduced, and neural network methods, such as graph recurrent neural networks, graph convolutional networks, and variants of graph neural networks, are also presented. Then, we organize the applications of graph representation algorithms in various vision tasks (such as image classification, semantic segmentation, object detection, and tracking) for review and reference, and the typical graph construction approaches in computer vision are also summarized. Finally, on the background of biology and brain inspiration, we discuss the existing challenges and future directions of graph representation learning and computer vision."