Lecture Notes in Computer Science 13019

Founding Editors

Gerhard Goos

Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis

Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino

Purdue University, West Lafayette, IN, USA

Wen Gao

Peking University, Beijing, China

Bernhard Steffen

TU Dortmund University, Dortmund, Germany

Gerhard Woeginger

RWTH Aachen, Aachen, Germany

Moti Yung

Columbia University, New York, NY, USA

More information about this subseries at http://www.springer.com/series/7412

Huimin Ma · Liang Wang · Changshui Zhang · Fei Wu · Tieniu Tan · Yaonan Wang · Jianhuang Lai · Yao Zhao (Eds.)

Pattern Recognition and Computer Vision

4th Chinese Conference, PRCV 2021 Beijing, China, October 29 – November 1, 2021 Proceedings, Part I



Editors Huimin Ma

University of Science and Technology Beijing

Beijing, China

Changshui Zhang Tsinghua University Beijing, China

Tieniu Tan Chinese Academy of Sciences Beijing, China

Jianhuang Lai Sun Yat-Sen University Guangzhou, Guangdong, China Liang Wang Chinese Academy of Sciences Beijing, China

Fei Wu D Zhejiang University Hangzhou, China

Yaonan Wang Hunan University Changsha, China

Yao Zhao D Beijing Jiaotong University Beijing, China

ISSN 0302-9743 ISSN 1611-3349 (electronic) Lecture Notes in Computer Science ISBN 978-3-030-88003-3 ISBN 978-3-030-88004-0 (eBook) https://doi.org/10.1007/978-3-030-88004-0

LNCS Sublibrary: SL6 - Image Processing, Computer Vision, Pattern Recognition, and Graphics

© Springer Nature Switzerland AG 2021

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

Welcome to the proceedings of the 4th Chinese Conference on Pattern Recognition and Computer Vision (PRCV 2021) held in Beijing, China!

PRCV was established to further boost the impact of the Chinese community in pattern recognition and computer vision, which are two core areas of artificial intelligence, and further improve the quality of academic communication. Accordingly, PRCV is co-sponsored by four major academic societies of China: the China Society of Image and Graphics (CSIG), the Chinese Association for Artificial Intelligence (CAAI), the China Computer Federation (CCF), and the Chinese Association of Automation (CAA).

PRCV aims at providing an interactive communication platform for researchers from academia and from industry. It promotes not only academic exchange but also communication between academia and industry. In order to keep track of the frontier of academic trends and share the latest research achievements, innovative ideas, and scientific methods, international and local leading experts and professors are invited to deliver keynote speeches, introducing the latest advances in theories and methods in the fields of pattern recognition and computer vision.

PRCV 2021 was hosted by University of Science and Technology Beijing, Beijing Jiaotong University, and the Beijing University of Posts and Telecommunications. We received 513 full submissions. Each submission was reviewed by at least three reviewers selected from the Program Committee and other qualified researchers. Based on the reviewers' reports, 201 papers were finally accepted for presentation at the conference, including 30 oral and 171 posters. The acceptance rate was 39.2%. PRCV took place during October 29 to November 1, 2021, and the proceedings are published in this volume in Springer's Lecture Notes in Computer Science (LNCS) series.

We are grateful to the keynote speakers, Larry Davis from the University of Maryland, USA, Yoichi Sato from the University of Tokyo, Japan, Michael Black from the Max Planck Institute for Intelligent Systems, Germany, Songchun Zhu from Peking University and Tsinghua University, China, and Bo Xu from the Institute of Automation, Chinese Academy of Sciences, China.

We give sincere thanks to the authors of all submitted papers, the Program Committee members and the reviewers, and the Organizing Committee. Without their contributions, this conference would not have been possible. Special thanks also go to all of the sponsors

vi Preface

and the organizers of the special forums; their support helped to make the conference a success. We are also grateful to Springer for publishing the proceedings.

October 2021

Tieniu Tan Yaonan Wang Jianhuang Lai Yao Zhao Huimin Ma Liang Wang Changshui Zhang Fei Wu

Organization

Steering Committee Chair

Tieniu Tan Institute of Automation, Chinese Academy of Sciences, China

Steering Committee

Xilin Chen Institute of Computing Technology, Chinese Academy of Sciences,

China

Chenglin Liu Institute of Automation, Chinese Academy of Sciences, China

Yong Rui Lenovo, China

Hongbing Zha Peking University, China

Nanning Zheng Xi'an Jiaotong University, China Jie Zhou Tsinghua University, China

Steering Committee Secretariat

Liang Wang Institute of Automation, Chinese Academy of Sciences, China

General Chairs

Tieniu Tan Institute of Automation, Chinese Academy of Sciences, China

Yaonan Wang
Jianhuang Lai
Yao Zhao

Hunan University, China
Sun Yat-sen University, China
Beijing Jiaotong University, China

Program Chairs

Huimin Ma
University of Science and Technology Beijing, China

Liang Wang Institute of Automation, Chinese Academy of Sciences, China

Changshui Zhang Tsinghua University, China Fei Wu Zhejiang University, China

Organizing Committee Chairs

Xucheng Yin

Zhanyu Ma

University of Science and Technology Beijing, China
Beijing University of Posts and Telecommunications, China

Zhenfeng Zhu Beijing Jiaotong University, China

Ruiping Wang Institute of Computing Technology, Chinese Academy of Sciences,

China

Sponsorship Chairs

Nenghai Yu University of Science and Technology of China, China Xiang Bai Huazhong University of Science and Technology, China

Yue Liu Beijing Institute of Technology, China

Jinfeng Yang Shenzhen Polytechnic, China

Publicity Chairs

Xiangwei Kong Zhejiang University, China

Tao Mei JD.com, China

Jiaying Liu Peking University, China Dan Zeng Shanghai University, China

International Liaison Chairs

Jingyi Yu ShanghaiTech University, China

Xuelong Li Northwestern Polytechnical University, China

Bangzhi Ruan Hong Kong Baptist University, China

Tutorial Chairs

Weishi Zheng Sun Yat-sen University, China Mingming Cheng Nankai University, China

Shikui Wei Beijing Jiaotong University, China

Symposium Chairs

Hua Huang Beijing Normal University, China

Yuxin Peng Peking University, China Nannan Wang Xidian University, China

Doctoral Forum Chairs

Xi Peng Sichuan University, China Hang Su Tsinghua University, China

Huihui Bai Beijing Jiaotong University, China

Competition Chairs

Nong Sang Huazhong University of Science and Technology, China

Wangmeng Zuo Harbin Institute of Technology, China

Xiaohua Xie Sun Yat-sen University, China

Special Issue Chairs

Jiwen Lu Tsinghua University, China

Shiming Xiang Institute of Automation, Chinese Academy of Sciences, China

Jianxin Wu Nanjing University, China

Publication Chairs

Zhouchen Lin Peking University, China

Chunyu Lin Beijing Jiaotong University, China

Huawei Tian People's Public Security University of China, China

Registration Chairs

Junjun Yin University of Science and Technology Beijing, China Yue Ming Beijing University of Posts and Telecommunications, China

Jimin Xiao Xi'an Jiaotong-Liverpool University, China

Demo Chairs

Xiaokang Yang Shanghai Jiaotong University, China

Xiaobin Zhu University of Science and Technology Beijing, China

Chunjie Zhang Beijing Jiaotong University, China

Website Chairs

Chao Zhu University of Science and Technology Beijing, China Zhaofeng He Beijing University of Posts and Telecommunications, China

Runmin Cong Beijing Jiaotong University, China

Finance Chairs

Weiping Wang University of Science and Technology Beijing, China

Lifang Wu Beijing University of Technology, China Meiqin Liu Beijing Jiaotong University, China

Program Committee

Jing Dong Chinese Academy of Sciences, China

Ran He Institute of Automation, Chinese Academy of Sciences, China

Xi Li Zhejiang University, China Si Liu Beihang University, China Xi Peng Sichuan University, China

Yu Qiao Chinese Academy of Sciences, China Jian Sun Xi'an Jiaotong University, China Rongrong Ji Xiamen University, China

Xiang Bai Huazhong University of Science and Technology, China Jian Cheng Institute of Automation, Chinese Academy of Sciences, China

Mingming Cheng Nankai University, China

Junyu Dong Ocean University of China, China

Weisheng Dong Xidian University, China

Yuming Fang Jiangxi University of Finance and Economics, China

Jianjiang Feng Tsinghua University, China
Shenghua Gao ShanghaiTech University, China
Maoguo Gong Xidian University, China
Yahong Han Tianjin University, China

Huiguang He Institute of Automation, Chinese Academy of Sciences, China Shuqiang Jiang Institute of Computing Technology, China Academy of Science,

China

Lianwen Jin South China University of Technology, China

Xiaoyuan Jing Wuhan University, China

Haojie Li Dalian University of Technology, China

Jianguo Li Ant Group, China

Peihua Li Dalian University of Technology, China

Liang Lin
Zhouchen Lin
Jiwen Lu
Siwei Ma
Deyu Meng
Sun Yat-sen University, China
Peking University, China
Tsinghua University, China
Peking University, China
Xi'an Jiaotong University, China

Qiguang Miao Xidian University, China
Liqiang Nie Shandong University, China

Wanli Ouyang The University of Sydney, Australia

Jinshan Pan Nanjing University of Science and Technology, China Nong Sang Huazhong University of Science and Technology, China

Shiguang Shan Institute of Computing Technology, Chinese Academy of Sciences,

China

Hongbin Shen Shanghai Jiao Tong University, China

Linlin Shen Shenzhen University, China Mingli Song Zhejiang University, China Hanli Wang Tongji University, China Xiamen University, China

Jingdong Wang Microsoft, China

Nannan Wang
Jianxin Wu
Jinjian Wu
Xidian University, China
Xidian University, China
Xidian University, China

Yihong Wu Institute of Automation, Chinese Academy of Sciences, China

Guisong Xia Wuhan University, China

Yong Xia Northwestern Polytechnical University, China

Shiming Xiang Chinese Academy of Sciences, China

Xiaohua Xie Sun Yat-sen University, China Jufeng Yang Nankai University, China Wankou Yang Southeast University, China

Yang Yang University of Electronic Science and Technology of China, China

Yilong Yin Shandong University, China

Xiaotong Yuan Nanjing University of Information Science and Technology, China

Zhengjun Zha
University of Science and Technology of China, China
Daoqiang Zhang
Zhaoxiang Zhang
University of Aeronautics and Astronautics, China
Institute of Automation, Chinese Academy of Sciences, China

Weishi Zheng Sun Yat-sen University, China

Wangmeng Zuo Harbin Institute of Technology, China

Reviewers

He Hongliang Bai Xiang Feng Jiachang Bai Xiao Feng Jiawei Hong Jincheng Fu Bin Hu Shishuai Cai Shen Cai Yinghao Fu Ying Hu Jie Chen Zailiang Gao Hongxia Hu Yang Gao Shang-Hua Hu Fuyuan Chen Weixiang Chen Jinyu Gao Changxin Hu Ruyun Chen Yifan Gao Guangwei Hu Yangwen Gao Yi Cheng Gong Huang Lei **Huang Sheng** Chu Jun Ge Shiming Cui Chaoran Ge Yongxin Huang Dong Cui Hengfei Geng Xin Huang Huaibo Cui Zhe Gong Chen Huang Jiangtao **Huang Xiaoming** Deng Hongxia Gong Xun Gu Guanghua Ji Fanfan Deng Cheng

Ding Zihan Gu Yu-Chao Ji Jiayi Dong Qiulei Guo Chunle Ji Zhong Dong Yu Guo Jianwei Jia Chuanmin Dong Xue Guo Zhenhua Jia Wei Duan Lijuan Han Oi Jia Xibin Fan Bin Han Linghao Jiang Bo Fan Yongxian He Hong Jiang Peng-Tao Fan Bohao He Mingjie Kan Meina Fang Yuchun He Zhaofeng Kang Wenxiong Lei Na Liu Zhou Tan Chaolei Lei Zhen Lu Shaoping Tan Xiaoyang Leng Lu Lu Haopeng Tang Jin Li Chenglong Luo Bin Tu Zhengzheng Li Chunlei Luo Gen Wang Fudong Li Hongjun Ma Chao Wang Hao Li Shuyan Ma Wenchao Wang Limin Li Xia Ma Cheng Wang Oinfen Li Zhiyong Ma Wei Wang Xingce Li Guanbin Wang Xinnian Mei Jie Wang Zitian Li Peng Miao Yongwei Li Ruirui Nie Ligiang Wang Hongxing Wang Jiapeng Li Zechao Nie Xiushan Wang Luting Li Zhen Niu Xuesong Li Ce Niu Yuzhen Wang Shanshan Wang Shengke Li Changzhou Ouyang Jianquan Pan Chunyan Wang Yude Li Jia Li Jian Pan Zhiyu Wang Zilei Li Shiying Pan Jinshan Wang Dong Wang Hanzi Li Wanhua Peng Yixing Wang Jinjia Li Yongjie Peng Jun Li Yunfan Oian Wenhua Wang Long Liang Jian Qin Binjie Wang Qiufeng Liang Yanjie Wang Shuqiang Qu Yanyun Liao Zehui Rao Yongming Wang Xingzheng Lin Zihang Ren Wengi Wei Xiu-Shen Lin Chunyu Rui Song Wei Wei Shen Chao Lin Guangfeng Wen Jie Liu Heng Shen Haifeng Wu Yadong Wu Hong Liu Li Shen Shuhan Liu Wu Shen Tiancheng Wu Shixiang Liu Yiguang Sheng Lijun Wu Xia Shi Caijuan Liu Zhiang Wu Yongxian Liu Chongyu Shi Wu Wu Yuwei Liu Li Shi Zhiping Wu Xinxiao Liu Qingshan Shi Hailin Wu Yihong Liu Yun Shi Lukui Xia Daoxun Liu Cheng-Lin Song Chunfeng Xiang Shiming Liu Min Su Hang Xiao Jinsheng Sun Xiaoshuai Xiao Liang Liu Risheng Xiao Jun Liu Tiange Sun Jinqiu Liu Weifeng Sun Zhanli Xie Xingyu Liu Xiaolong Sun Jun Xu Gang Liu Yang Sun Xian Xu Shugong Xu Xun Liu Zhi Sun Zhenan

Zuo Wangmeng

You Gexin Zhang Mingjin Xu Zhenghua Zhang Shanshan Xu Lixiang Yu Ye Zhang Xiao-Yu Xu Xin-Shun Yu Oian Xu Mingye Yu Zhe Zhang Yanming Xu Yong Zeng Lingan Zhang Yuefeng Xue Nan Zeng Hui Zhao Cairong Yan Bo Zhai Yongjie Zhao Yang Zhang Aiwu Zhao Yuqian Yan Dongming Zhen Peng Yan Junchi Zhang Chi **Zheng Wenming** Yang Dong Zhang Jie Yang Guan Zhang Shu Zheng Feng Yang Peipei Zhang Wenqiang Zhong Dexing Yang Wenming Zhang Yunfeng Zhong Guoqiang Yang Yibo Zhou Xiaolong Zhang Zhao Yang Lu Zhang Hui Zhou Xue Zhang Lei Yang Jinfu Zhou Quan Yang Wen Zhang Xuyao Zhou Xiaowei Yao Tao Zhang Yongfei Zhu Chaoyang Zhang Dingwen Zhu Xiangping Ye Mao Zhang Honggang Zou Yuexian Yin Ming

Zhang Lin

Yin Fei

Contents – Part I

Object Detection, Tracking and Recognition	
High-Performance Discriminative Tracking with Target-Aware Feature Embeddings	3
3D Multi-object Detection and Tracking with Sparse Stationary LiDAR Meng Zhang, Zhiyu Pan, Jianjiang Feng, and Jie Zhou	16
CRNet: Centroid Radiation Network for Temporal Action Localization	29
Weakly Supervised Temporal Action Localization with Segment-Level Labels Xinpeng Ding, Nannan Wang, Jie Li, and Xinbo Gao	42
Locality-Constrained Collaborative Representation with Multi-resolution Dictionary for Face Recognition Zhen Liu, Xiao-Jun Wu, Hefeng Yin, Tianyang Xu, and Zhenqiu Shu	55
Fast and Fusion: Real-Time Pedestrian Detector Boosted by Body-Head Fusion Jie Huang, Xiaoling Gu, Xun Liu, and Pai Peng	67
STA-GCN: Spatio-Temporal AU Graph Convolution Network for Facial Micro-expression Recognition	80
Attentive Contrast Learning Network for Fine-Grained Classification	92
Relation-Based Knowledge Distillation for Anomaly Detection	105
High Power-Efficient and Performance-Density FPGA Accelerator for CNN-Based Object Detection	117

Relation-Guided Actor Attention for Group Activity Recognition Lifang Wu, Qi Wang, Zeyu Li, Ye Xiang, and Xianglong Lang	129
MVAD-Net: Learning View-Aware and Domain-Invariant Representation for Baggage Re-identification	142
Joint Attention Mechanism for Unsupervised Video Object Segmentation Rui Yao, Xin Xu, Yong Zhou, Jiaqi Zhao, and Liang Fang	154
Foreground Feature Selection and Alignment for Adaptive Object Detection Zixuan Huang, Huicheng Zheng, and Manwei Chen	166
Exploring Category-Shared and Category-Specific Features for Fine-Grained Image Classification Haoyu Wang, DongLiang Chang, Weidong Liu, Bo Xiao, Zhanyu Ma, Jun Guo, and Yaning Chang	179
Deep Mixture of Adversarial Autoencoders Clustering Network	191
SA-InterNet: Scale-Aware Interaction Network for Joint Crowd Counting and Localization Xiuqi Chen, Xiao Yu, Huijun Di, and Shunzhou Wang	203
Conditioners for Adaptive Regression Tracking	216
Attention Template Update Model for Siamese Tracker Fengshou Jia, Zhao Tang, and Yun Gao	229
Insight on Attention Modules for Skeleton-Based Action Recognition	242
AO-AutoTrack: Anti-occlusion Real-Time UAV Tracking Based on Spatio-temporal Context Hongyu Chu, Kuisheng Liao, Yanhua Shao, Xiaoqiang Zhang, Yanying Mei, and Yadong Wu	256
Two-Stage Recognition Algorithm for Untrimmed Converter Steelmaking Flame Video	268
Scale-Aware Multi-branch Decoder for Salient Object Detection	280

ReFlowNet: Revisiting Coarse-to-fine Learning of Optical Flow	429
Local Mutual Metric Network for Few-Shot Image Classification	443
SimplePose V2: Greedy Offset-Guided Keypoint Grouping for Human Pose Estimation Jia Li, Linhua Xiang, Jiwei Chen, and Zengfu Wang	455
Control Variates for Similarity Search Jeremy Chew and Keegan Kang	468
Pyramid Self-attention for Semantic Segmentation	480
Re-Identify Deformable Targets for Visual Tracking	493
End-to-End Detection and Recognition of Arithmetic Expressions	505
FD-Net: A Fully Dilated Convolutional Network for Historical Document Image Binarization Wei Xiong, Ling Yue, Lei Zhou, Liying Wei, and Min Li	518
Appearance-Motion Fusion Network for Video Anomaly Detection	530
Can DNN Detectors Compete Against Human Vision in Object Detection Task? Qiaozhe Li, Jiahui Zhang, Xin Zhao, and Kaiqi Huang	542
Group Re-Identification Based on Single Feature Attention Learning Network (SFALN) Xuehai Liu, Lisha Yu, and Jianhuang Lai	554
Contrastive Cycle Consistency Learning for Unsupervised Visual Tracking Jiajun Zhu, Chao Ma, Shuai Jia, and Shugong Xu	564
Group-Aware Disentangle Learning for Head Pose Estimation	577

Facilitating 3D Object Tracking in Point Clouds with Image Semantics	
and Geometry	589
Multi-criteria Confidence Evaluation for Robust Visual Tracking	602
Author Index	615

Contents - Part I

xix