2020 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW 2020)

Seattle, Washington, USA 14-19 June 2020

Pages 1-746



IEEE Catalog Number: ISBN: CFP2088A-POD 978-1-7281-9361-8

Copyright © 2020 by the Institute of Electrical and Electronics Engineers, Inc. All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

*** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

IEEE Catalog Number:	
ISBN (Print-On-Demand):	
ISBN (Online):	
ISSN:	

CFP2088A-POD 978-1-7281-9361-8 978-1-7281-9360-1 2160-7508

Additional Copies of This Publication Are Available From:

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA Phone: (845) 758-0400 Fax: (845) 758-2633 E-mail: curran@proceedings.com Web: www.proceedings.com



2020 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW) CVPRW 2020

Table of Contents

Organizers Ixxiii	 	
Area Chairs Ixxv	 	
Reviewers lxxx	 	

TCV: Fair, Data-Efficient and Trusted Computer Vision

Explaining Failure: Investigation of Surprise and Expectation in CNNs .56 Thomas Hartley (Cardiff University), Kirill Sidorov (Cardiff University), Christopher Willis (BAE Systems Applied Intelligence), and David Marshall (Cardiff University)
Enhancing Facial Data Diversity with Style-Based Face Aging .66 Markos Georgopoulos (Imperial College London, United Kingdom), James Oldfield (Computation-based Science and Technology Research Center, The Cyprus Institute), Mihalis A. Nicolaou (Computation-based Science and Technology Research Center, The Cyprus Institute), Yannis Panagakis (Imperial College London, United Kingdom; University of Athens, Greece), and Maja Pantic (Imperial College London, United Kingdom; Samsung Al Research Center, Cambridge, United Kingdom)
Imparting Fairness to Pre-Trained Biased Representations .7.5 Bashir Sadeghi (Michigan State University) and Vishnu Naresh Boddeti (Michigan State University)
 Exploring Racial Bias Within Face Recognition via Per-Subject Adversarially-Enabled Data Augmentation .8.3. Seyma Yucer (Durham University, Durham, UK), Samet Akçay (Durham University, Durham, UK; COSMONiO, Durham, UK), Noura Al-Moubayed (Durham University, Durham, UK), and Toby P. Breckon (Durham University, Durham, UK)
Minimizing Supervision in Multi-label Categorization <u>.93</u> Rajat K. (IIT Kanpur, India), Munender Varshney (IIT Kanpur, India), Pravendra Singh (IIT Kanpur, India), and Vinay P. Namboodiri (IIT Kanpur, India)
DNDNet: Reconfiguring CNN for Adversarial Robustness .1.03 Akhil Goel (IIIT-Delhi, India), Akshay Agarwal (IIIT-Delhi, India), Mayank Vatsa (IIT Jodhpur, India), Richa Singh (IIT Jodhpur, India), and Nalini K. Ratha (IBM TJ Watson Research Center, USA)
Score-CAM: Score-Weighted Visual Explanations for Convolutional Neural Networks .1.1 Haofan Wang (Carnegie Mellon University), Zifan Wang (Carnegie Mellon University), Mengnan Du (Texas A&M University), Fan Yang (Texas A&M University), Zijian Zhang (Wuhan University), Sirui Ding (Wuhan University), Piotr Mardziel (Carnegie Mellon University), and Xia Hu (Texas A&M University)
On Privacy Preserving Anonymization of Finger-Selfies .1.20 Aakarsh Malhotra (IIIT-Delhi, India), Saheb Chhabra (IIIT-Delhi, India), Mayank Vatsa (IIT Jodhpur, India), and Richa Singh (IIT Jodhpur, India)
Bias in Multimodal AI: Testbed for Fair Automatic Recruitment .1.29. Alejandro Peña (Universidad Autonoma de Madrid, Spain), Ignacio Serna (Universidad Autonoma de Madrid, Spain), Aythami Morales (Universidad Autonoma de Madrid, Spain), and Julian Fierrez (Universidad Autonoma de Madrid, Spain)

- Plug-and-Pipeline: Efficient Regularization for Single-Step Adversarial Training .1.38..... Vivek B.S. (Indian Institute of Science, Bangalore, India), Ambareesh Revanur (Indian Institute of Science, Bangalore, India), Naveen Venkat (Indian Institute of Science, Bangalore, India), and R. Venkatesh Babu (Indian Institute of Science, Bangalore, India)
- Attribute Aware Filter-Drop for Bias Invariant Classification .1.47..... Shruti Nagpal (IIIT-Delhi, India), Maneet Singh (IIIT-Delhi, India), Richa Singh (IIT Jodhpur, India), and Mayank Vatsa (IIT Jodhpur, India)

Privacy Enhanced Decision Tree Inference .1.5.4. Kanthi Sarpatwar (IBM Research, Yorktown Heights, NY), Nalini K. Ratha (IBM Research, Yorktown Heights, NY), Karthik Nandakumar (IBM Singapore Lab, Singapore), Karthikeyan Shanmugam (IBM Research, Yorktown Heights, NY), James T. Rayfield (IBM Research, Yorktown Heights, NY), Sharath Pankanti (IBM Research, Yorktown Heights, NY), and Roman Vaculin (IBM Research, Yorktown Heights, NY)

VisualSLAM: Long Term Visual Localization, Visual Odometry and Geometric and Learning-Based SLAM

Dynamic Attention-Based Visual Odometry .1.6.0 Xin-Yu Kuo (National Tsing Hua University, Hsinchu, Taiwan), Chien Liu (National Tsing Hua University, Hsinchu, Taiwan), Kai-Chen Lin (National Tsing Hua University, Hsinchu, Taiwan), and Chun-Yi Lee (National Tsing Hua University, Hsinchu, Taiwan)
Extending Absolute Pose Regression to Multiple Scenes .1.70 Hunter Blanton (University of Kentucky), Connor Greenwell (University of Kentucky), Scott Workman (DZYNE Technologies), and Nathan Jacobs (University of Kentucky)
Reconstruct, Rasterize and Backprop: Dense Shape and Pose Estimation from a Single Image 179 Aniket Pokale (Robotics Research Center, KCIS, IIIT Hyderabad, India), Aditya Aggarwal (Robotics Research Center, KCIS, IIIT Hyderabad, India), Krishna Murthy Jatavallabhula (Mila, Universite de Montreal, Canada), and Madhava Krishna (Robotics Research Center, KCIS, IIIT Hyderabad, India)
 ViPR: Visual-Odometry-Aided Pose Regression for 6DoF Camera Localization .1.8.7 Felix Ott (Fraunhofer Institute for Integrated Circuits IIS, Nuremberg, Germany), Tobias Feigl (Fraunhofer Institute for Integrated Circuits IIS, Nuremberg, Germany; FAU Erlangen-Nuremberg, Germany), Christoffer Löffler (Fraunhofer Institute for Integrated Circuits IIS, Nuremberg, Germany; FAU Erlangen-Nuremberg, Germany), and Christopher Mutschler (Fraunhofer Institute for Integrated Circuits IIS, Nuremberg, Germany; Ludwig-Maximilians-University (LMU), Munich, Germany)

AgriVision: Agriculture-Vision: Challenges & Opportunities for Computer Vision in Agriculture

Multi-view Self-Constructing Graph Convolutional Networks with Adaptive Class Weighting Loss for Semantic Segmentation 199 Qinghui Liu (Norwegian Computing Center, Oslo, Norway; UiT Machine Learning Group, UiT the Arctic University of Norway, Tromsø, Norway), Michael C. Kampffmeyer (UiT Machine Learning Group, UiT the Arctic University of Norway, Tromsø, Norway), Robert Jenssen (Norwegian Computing Center, Oslo, Norway; UiT Machine Learning Group, UiT the Arctic University of Norway, Tromsø, Norway), and Arnt-Børre Salberg (Norwegian Computing Center, Oslo, Norway)
Reducing the Feature Divergence of RGB and Near-Infrared Images Using Switchable Normalization .206. Siwei Yang (Tongji University, Shanghai, China), Shaozuo Yu (Tongji University, Shanghai, China), Bingchen Zhao (Tongji University, Shanghai, China), and Yin Wang (Tongji University, Shanghai, China)
 The 1st Agriculture-Vision Challenge: Methods and Results .212
Finding Berries: Segmentation and Counting of Cranberries Using Point Supervision and Shape Priors .21.9 Peri Akiva (Rutgers University), Kristin Dana (Rutgers University),
Peter Oudemans (Rutgers University), and Michael Mars (Rutgers University)
Leaf Spot Attention Network for Apple Leaf Disease Identification .229 Hee-Jin Yu (Kunsan National University, Republic of Korea) and Chang-Hwan Son (Kunsan National University, Republic of Korea)

Visual 3D Reconstruction and Dynamic Simulation of Fruit Trees for Robotic Manipulation .238 Francisco Yandun (Carnegie Mellon University), Abhisesh Silwal (Carnegie Mellon University), and George Kantor (Carnegie Mellon University)	3
Cross-Regional Oil Palm Tree Detection .248. Wenzhao Wu (Tsinghua University, Beijing, China), Juepeng Zheng (Tsinghua University, Beijing, China), Haohuan Fu (Tsinghua University, Beijing, China), Weijia Li (CUHK-SenseTime Joint Lab, The Chinese University of Hong Kong, China), and Le Yu (Tsinghua University, Beijing, China)	
Multi-stream CNN for Spatial Resource Allocation: A Crop Management Application .258 Alexandre Barbosa (University of Illinois at Urbana-Champaign, Urbana, IL, USA), Thiago Marinho (University of Illinois at Urbana-Champaign, Urbana, IL, USA), Nicolas Martin (University of Illinois at Urbana-Champaign, Urbana, IL, USA), and Naira Hovakimyan (University of Illinois at Urbana-Champaign, Urbana, IL, USA)	
Effective Data Fusion with Generalized Vegetation Index: Evidence from Land Cover Segmentation in Agriculture .267 Hao Sheng (Stanford University), Xiao Chen (Stanford University), Jingyi Su (Chegg, Inc), Ram Rajagopal (Stanford University), and Andrew Ng (Stanford University)	
Deep Transfer Learning for Plant Center Localization .27.7 Enyu Cai (Purdue University, West Lafayette, Indiana, USA), Sriram Baireddy (Purdue University, West Lafayette, Indiana, USA), Changye Yang (Purdue University, West Lafayette, Indiana, USA), Melba Crawford (Purdue University, West Lafayette, Indiana, USA), and Edward J. Delp (Purdue University, West Lafayette, Indiana, USA)	
Segmentation and Detection From Organised 3D Point Clouds: A Case Study in Broccoli Head Detection .285 Justin Le Louëdec (University of Lincoln), Hector A. Montes (University of Lincoln), Tom Duckett (University of Lincoln), and Grzegorz Cielniak (University of Lincoln)	
Deep Learning Based Corn Kernel Classification .294. Henry O. Velesaca (Escuela Superior Politécnica del Litoral, ESPOL, CIDIS, Guayaquil, Ecuador), Raúl Mira (Escuela Superior Politécnica del Litoral, ESPOL, CIDIS, Guayaquil, Ecuador), Patricia L. Suárez (Escuela Superior Politécnica del Litoral, ESPOL, CIDIS, Guayaquil, Ecuador), Christian X. Larrea (Escuela Superior Politécnica del Litoral, ESPOL, CIDIS, Guayaquil, Ecuador), and Angel D. Sappa (Escuela Superior Politécnica del Litoral, ESPOL, CIDIS, Guayaquil, Ecuador)	

Improving In-Field Cassava Whitefly Pest Surveillance With Machine Learning .3.0.3 Jeremy Francis Tusubira (Artificial Intelligence Lab, Makerere University), Solomon Nsumba (Artificial Intelligence Lab, Makerere University), Flavia Ninsiima (Artificial Intelligence Lab, Makerere University), Benjamin Akera (Artificial Intelligence Lab, Makerere University), Guy Acellam (Artificial Intelligence Lab, Makerere University), Joyce Nakatumba (Artificial Intelligence Lab, Makerere University), Joyce Nakatumba (Artificial Intelligence Lab, Makerere University), Ernest Mwebaze (Google Research), John Quinn (Google Research), and Tonny Oyana (Geospatial Data and Computational Intelligence Lab, Makerere University)
Weakly Supervised Learning Guided by Activation Mapping Applied to a Novel Citrus Pest
Edson Bollis (University of Campinas (UNICAMP), Campinas, SP, Brazil), Helio Pedrini (University of Campinas (UNICAMP), Campinas, SP, Brazil), and Sandra Avila (University of Campinas (UNICAMP), Campinas, SP, Brazil)
Fine-Grained Recognition in High-Throughput Phenotyping .320 Beichen Lyu (Purdue University, West Lafayette, IN), Stuart D. Smith (Purdue University, West Lafayette, IN), and Keith A. Cherkauer (Purdue University, West Lafayette, IN)
A Novel Technique Combining Image Processing, Plant Development Properties, and the Hungarian Algorithm, to Improve Leaf Detection in Maize .330 Nazifa Azam Khan (University of Saskatchewan, Saskatoon, SK, Canada), Oliver A.S. Lyon (Queen's University, Kingston, ON, Canada), Mark Eramian (University of Saskatchewan, Saskatoon, SK, Canada), and Ian McQuillan (University of Saskatchewan, Saskatoon, SK, Canada)
Farm Parcel Delineation Using Spatio-Temporal Convolutional Networks .340 Han Lin Aung (Stanford University), Burak Uzkent (Stanford University), Marshall Burke (Science Stanford University), David Lobell (Science Stanford University), and Stefano Ermon (Stanford University)
Climate Adaptation: Reliably Predicting From Imbalanced Satellite Data .350 Ruchit Rawal (Netaji Subhas University of Technology, New Delhi, India) and Prabhu Pradhan (Max Planck Institute for Intelligent Systems, Tübingen, Germany)

PBVS: Perception Beyond the Visible Spectrum

C-SURE: Shrinkage Estimator and Prototype Classifier for Complex-Valued Deep Learning .36.0 Rudrasis Chakraborty (UC Berkeley / ICSI), Yifei Xing (UC Berkeley / ICSI), Minxuan Duan (Peking University), and Stella X. Yu (UC Berkeley / ICSI)

SOFEA: A Non-Iterative and Robust Optical Flow Estimation Algorithm for Dynamic Vision Sensors .368.

Weng Fei Low (The N.1 Institute for Health, National University of Singapore), Zhi Gao (The N.1 Institute for Health, National University of Singapore), Cheng Xiang (The N.1 Institute for Health, National University of Singapore), and Bharath Ramesh (The N.1 Institute for Health, National University of Singapore) Mosaic Super-Resolution via Sequential Feature Pyramid Networks .378..... Mehrdad Shoeiby (CSIRO-Data61), Ali Armin (CSIRO-Data61), Sadegh Aliakbarian (CSIRO-Data61; Australian National University), Saeed Anwar (CSIRO-Data61), and Lars Petersson (CSIRO-Data61)

TherISuRNet – A Computationally Efficient Thermal Image Super-Resolution Network .388...... Vishal Chudasama (Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India), Heena Patel (Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India), Kalpesh Prajapati (Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India), Kishor P. Upla (Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India; Norwegian University of Science and Technology (NTNU), Gjøvik, Norway), Raghavendra Ramachandra (Norwegian University of Science and Technology (NTNU), Gjøvik, Norway), Kiran Raja (Norwegian University of Science and Technology (NTNU), Gjøvik, Norway), and Christoph Busch (Norwegian University of Science and Technology (NTNU), Gjøvik, Norway)

Low-Resolution Overhead Thermal Tripwire for Occupancy Estimation .398..... Mertcan Cokbas (Boston University, Boston, MA), Prakash Ishwar (Boston University, Boston, MA), and Janusz Konrad (Boston University, Boston, MA)

Unsupervised Object Detection via LWIR/RGB Translation .407..... Rachael Abbott (ECIT, Queen's University Belfast), Neil M. Robertson (ECIT, Queen's University Belfast), Jesus Martinez del Rincon (ECIT, Queen's University Belfast), and Barry Connor (Thales UK, Linthouse road, Glasgow)

FusAtNet: Dual Attention Based SpectroSpatial Multimodal Fusion Network for Hyperspectral and LiDAR Classification .416.

Satyam Mohla (IIT Bombay, Mumbai, India), Shivam Pande (IIT Bombay, Mumbai, India), Biplab Banerjee (IIT Bombay, Mumbai, India), and Subhasis Chaudhuri (IIT Bombay, Mumbai, India)

A Multi-level Supervision Model: A Novel Approach for Thermal Image Super Resolution .426.. Priya Kansal (Couger Inc, Shibuya, Tokyo, Japan) and Sabari Nathan (Couger Inc, Shibuya, Tokyo, Japan)

Thermal Image Super-Resolution Challenge – PBVS 2020 .432 Rafael E. Rivadeneira (Escuela Superior Politécnica del Litoral, ESPOL, Guayaquil, Ecuador), Angel D. Sappa (Escuela Superior Politécnica del Litoral, ESPOL, Guayaquil, Ecuador; Computer Vision Center, Campus UAB, Bellaterra, Barcelona, Spain), Boris X. Vintimilla (Escuela Superior Politécnica del Litoral, ESPOL, Guayaquil, Ecuador), Lin Guo (Oklahoma State University, Stillwater, OK, USA), Jiankun Hou (Oklahoma State University, Stillwater, OK, USA), Jiankun Hou (Oklahoma State University, Stillwater, OK, USA), Armin Mehri (Computer Vision Center, Campus UAB, Bellaterra, Barcelona, Spain), Parichehr Behjati Ardakani (Computer Vision Center, Campus UAB, Bellaterra, Barcelona, Spain), Heena Patel (SVNIT, Surat, India), Vishal Chudasama (SVNIT, Surat, India), Kalpesh Prajapati (SVNIT, Surat, India), Kishor P. Upla (SVNIT, Surat, India; NTNU, Gjøvik, Norway), Raghavendra Ramachandra (NTNU, Gjøvik, Norway), Kiran Raja (NTNU, Gjøvik, Norway), Christoph Busch (NTNU, Gjøvik, Norway), Feras Almasri (Universite Libre de Bruxelles, Belgium), Olivier Debeir (Universite Libre de Bruxelles, Belgium), Sabari Nathan (Couger Inc, Japan), Priya Kansal (Couger Inc, Japan), Nolan Gutierrez (University of Texas at Arlington, Arlington, TX, USA), and William J. Beksi (University of Texas at Arlington, Arlington, TX, USA)
Low-Latency Hand Gesture Recognition with a Low-Resolution Thermal Imager .440 Maarten Vandersteegen (EAVISE, KU Leuven - Campus De Nayer - Belgium), Wouter Reusen (Melexis Technologies nv - Belgium), Kristof Van Beeck (EAVISE, KU Leuven - Campus De Nayer - Belgium), and Toon Goedemé (EAVISE, KU Leuven - Campus De Nayer - Belgium)
High-Resolution Radar Dataset for Semi-Supervised Learning of Dynamic Objects .450 Mohammadreza Mostajabi (Zendar Inc), Ching Ming Wang (Zendar Inc), Darsh Ranjan (Zendar Inc), and Gilbert Hsyu (Zendar Inc)
Probabilistic Oriented Object Detection in Automotive Radar .458 Xu Dong (XSense.ai), Pengluo Wang (XSense.ai), Pengyue Zhang (XSense.ai), and Langechuan Liu (XSense.ai)
VIFB: A Visible and Infrared Image Fusion Benchmark <u>.468</u> Xingchen Zhang (Shanghai Jiao Tong University; Imperial College London), Ping Ye (Shanghai Jiao Tong University), and Gang Xiao (Shanghai Jiao Tong University)
Fast Human Head and Shoulder Detection Using Convolutional Networks and RGBD Data .479 Wassim A. El Ahmar (University of Ottawa, Ottawa, Ontario, Canada), Farzan Erlik Nowruzi (University of Ottawa, Ottawa, Ontario, Canada), and Robert Laganiere (University of Ottawa, Ottawa, Ottawa, Ontario, Canada)
An Evaluation of Objective Image Quality Assessment for Thermal Infrared Video Tone Mapping .488. Michael Teutsch (Hensoldt Optronics GmbH, Oberkochen, Germany), Simone Sedelmaier (Hensoldt Optronics GmbH, Oberkochen, Germany; Ulm University of Applied Sciences, Germany), Sebastian Moosbauer (Hensoldt Optronics GmbH, Oberkochen, Germany), Gabriel Eilertsen (Linköping University, Sweden), and Thomas Walter (Ulm University of Applied Sciences, Germany)

Calibrated Vehicle Paint Signatures for Simulating Hyperspectral Imagery .498..... Zachary Mulhollan (Rochester Institute of Technology), Aneesh Rangnekar (n/a), Timothy Bauch (n/a), Matthew J. Hoffman (n/a), and Anthony Vodacek (n/a)

Unsupervised Ensemble-Kernel Principal Component Analysis for Hyperspectral Anomaly Detection .507.....

Nicholas Merrill (U.S. Naval Research Laboratory, Naval Research Enterprise Internship Program) and Colin C. Olson (U.S. Naval Research Laboratory)

CLIC: Learned Image Compression

Improve Image Codec's Performance by Variating Post Enhancing Neural Network: Submission of zxw for CLIC2020 .516. *Ming Li (VimicroAl, Guangdong Provice, P.R.C), Yundong Zhang (VimicroAl, Zhuhai city, Guangdong Provice, P.R.C), Changsheng Xia (VimicroAl, Zhuhai city, Guangdong Provice, P.R.C), Jinwen Zan (VimicroAl, Zhuhai city, Guangdong Provice, P.R.C), Zhangming Huang (VimicroAl, Zhuhai city, Guangdong Provice, P.R.C), Dekai Chen (VimicroAl, Zhuhai city, Guangdong Provice, P.R.C), Guoxin Li (VimicroAl, Zhuhai city, Guangdong Provice, P.R.C), and Jing Nie (VimicroAl, Zhuhai city, Guangdong Provice, P.R.C)* (VimicroAl, Zhuhai city, Guangdong Provice, P.R.C) 3-D Context Entropy Model for Improved Practical Image Compression .520..... Zongyu Guo (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), Yaojun Wu (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), Runsen Feng (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), Zhizheng Zhang (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), and Zhibo Chen (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China) Ultra Low Bitrate Learned Image Compression by Selective Detail Decoding .524.....

Hiroaki Akutsu (Hitachi, Ltd., Japan), Akifumi Suzuki (Hitachi, Ltd., Japan), Zhisheng Zhong (The University of Tokyo, Japan), and Kiyoharu Aizawa (The University of Tokyo, Japan)

Learned Video Compression with Feature-Level Residuals .529 Runsen Feng (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), Yaojun Wu (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), Zongyu Guo (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), Zhizheng Zhang (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), and Zhibo Chen (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China)
 Variable Rate Image Compression with Content Adaptive Optimization .5.33. Tiansheng Guo (Huawei Technologies, Beijing, China), Jing Wang (Huawei Technologies, Beijing, China), Ze Cui (Huawei Technologies, Beijing, China), Yihui Feng (Huawei Technologies, Beijing, China), Yunying Ge (Huawei Technologies, Beijing, China), and Bo Bai (Huawei Technologies, Beijing, China)
 SR-CL-DMC: P-Frame Coding with Super-Resolution, Color Learning, and Deep Motion Compensation .538. Man M. Ho (Hosei University Tokyo, Japan), Jinjia Zhou (Hosei University and JST, PRESTO, Tokyo, Japan), Gang He (Xi'dian University Xi'an, China), Muchen Li (Hosei University Tokyo, Japan), and Lei Li (Xi'dian University Xi'an, China)
Low Bitrate Image Compression with Discretized Gaussian Mixture Likelihoods .5.4.3 Zhengxue Cheng (Waseda University, Tokyo, Japan), Heming Sun (Waseda Research Institute for Science and Engineering, Tokyo, Japan; JST, PRESTO, Kawaguchi, Saitama, Japan), and Jiro Katto (Waseda University, Tokyo, Japan)
Post-Processing Network Based on Dense Inception Attention for Video Compression .5.4.7 Hao Tao (Huazhong Univ. of Sci. & Tech.), Jian Qian (Huazhong Univ. of Sci. & Tech.), Li Yu (Huazhong Univ. of Sci. & Tech.), Hongkui Wang (Huazhong Univ. of Sci. & Tech.), Wenhao Zhang (ZTE Corporation), Zhengang Li (ZTE Corporation), Ning Wang (ZTE Corporation), and Xing Zeng (ZTE Corporation)
Efficient Context-Aware Lossy Image Compression .552 Jan Xu (Deep Render Ltd), Alexander Lytchiér (Deep Render Ltd), Ciro Cursio (Deep Render Ltd), Dimitrios Kollias (Deep Render Ltd), Christian Besenbruch (Deep Render Ltd), and Arsalan Zafar (Deep Render Ltd)
Compression Artifact Removal With Ensemble Learning of Neural Networks .555 Yueyu Hu (Peking University, Beijing, China), Haichuan Ma (University of Science and Technology of China, Hefei, China), Dong Liu (University of Science and Technology of China, Hefei, China), and Jiaying Liu (Peking University, Beijing, China)

Joint Learned and Traditional Video Compression for P Frame .560 Zhao Wang (XG Lab of Damo Academy, Alibaba Group), Ru-Ling Liao (XG Lab of Damo Academy, Alibaba Group), and Yan Ye (XG Lab of Damo Academy, Alibaba Group)
Towards the Perceptual Quality Enhancement of Low Bit-Rate Compressed Images .565 Younhee Kim (Electronics and Telecommunications Research Institute, Korea), Seunghyun Cho (7 Kyungnamdaehak-ro, Masanhappo-gu, Changwon-si, Gyeongsangnam-do, Republic of Korea), Jooyoung Lee (Electronics and Telecommunications Research Institute, Daejeon, Korea), Se-Yoon Jeong (Electronics and Telecommunications Research Institute, Korea), Jin Soo Choi (Electronics and Telecommunications Research Institute, Korea), and Jihoon Do (Electronics and Telecommunications Research Institute, Korea)
A Hybrid Image Codec with Learned Residual Coding .570 Wei-Cheng Lee (National Chiao Tung University, Taiwan) and Hsueh-Ming Hang (National Chiao Tung University, Taiwan)
Learned Low Bit-Rate Image Compression with Adversarial Mechanism .575 Jiayu Yang (Peking University, China), Chunhui Yang (Peking University, China), Yi Ma (Peking University, China), Shiyi Liu (Peking University, China), and Ronggang Wang (Peking University, China)
End-to-End Learning for Video Frame Compression With Self-Attention .5.80 Nannan Zou (Tampere University, Tampere, Finland), Honglei Zhang (Nokia Technologies), Francesco Cricri (Nokia Technologies), Hamed R. Tavakoli (Nokia Technologies), Jani Lainema, Emre Aksu, Miska Hannuksela, and Esa Rahtu
A Training Method for Image Compression Networks to Improve Perceptual Quality of Reconstructions .585
Jooyoung Lee (Broadcasting and Media Research Laboratory, Electronics and Telecommunications Research Institute, Daejeon, Korea), Donghyun Kim (Broadcasting and Media Research Laboratory, Electronics and Telecommunications Research Institute, Daejeon, Korea), Younhee Kim (Broadcasting and Media Research Laboratory, Electronics and Telecommunications Research Institute, Daejeon, Korea), Hyoungjin Kwon (Broadcasting and Media Research Laboratory, Electronics and Telecommunications Research Institute, Daejeon, Korea), Jongho Kim (Broadcasting and Media Research Laboratory, Electronics and Telecommunications Research Institute, Daejeon, Korea), Jongho Kim (Broadcasting and Media Research Laboratory, Electronics and Telecommunications Research Institute, Daejeon, Korea), and Taejin Lee (Broadcasting and Media Research Laboratory, Electronics and Telecommunications Research Institute, Daejeon, Korea), and Taejin Lee
Joint Motion and Residual Information Latent Representation for P-Frame Coding .590 Renam Castro da Silva (Samsung R&D Institute Brazil), Nilson Donizete Guerin (Universidade de Brasília), Pedro Sanches (Universidade de Brasília), Henrique Costa Jung (Universidade de Brasília), Eduardo Peixoto (Universidade de Brasília), Bruno Macchiavello (Universidade de Brasília), Edson M. Hung (Universidade de Brasília), Vanessa Testoni (Samsung R&D Institute Brazil), and Pedro Garcia Freitas (Samsung R&D Institute Brazil)

A Video Compression Framework Using an Overfitted Restoration Neural Network .593 Gang He (Xi'dian University, Xi'an, China; Beijing Kuaishou Technology), Chang Wu (Xi'dian University, Xi'an, China), Lei Li (Xi'dian University, Xi'an, China), Jinjia Zhou (Graduate School of Science and Engineering, Hosei Univeristy, Tokyo, Japan), Xianglin Wang (Beijing Kuaishou Technology), Yunfei Zheng (Beijing Kuaishou Technology), Bing Yu (Beijing Kuaishou Technology), and Weiying Xie (Xi'dian University, Xi'an, China)
P-Frame Coding Proposal by NCTU: Parametric Video Prediction Through Backprop-Based Motion Estimation .598 Yung-Han Ho (, National Chiao Tung University, Taiwan), Chih-Chun Chan (, National Chiao Tung University, Taiwan), David Alexandre (, National Chiao Tung University, Taiwan), Wen-Hsiao Peng (National Chiao Tung University, Taiwan), and Chih-Peng Chang (National Chiao Tung University, Taiwan)
An Image Compression Framework with Learning-Based Filter .602 Heming Sun (Waseda University, Tokyo, Japan; JST, PRESTO, Kawaguchi, Saitama, Japan), Chao Liu (Fudan University, Shanghai, P.R. China), Jiro Katto (Waseda University, Tokyo, Japan), and Yibo Fan (Fudan University, Shanghai, P.R. China)
Low-Rate Image Compression with Super-Resolution Learning .60.7 Wei Gao (Peking University, Shenzhen, China; Peng Cheng Laboratory, Shenzhen, China), Lvfang Tao (Peking University, Shenzhen, China; Peng Cheng Laboratory, Shenzhen, China), Linjie Zhou (Peking University, Shenzhen, China; Peng Cheng Laboratory, Shenzhen, China), Dinghao Yang (Peng Cheng Laboratory, Shenzhen, China), Xiaoyu Zhang (Peking University, Shenzhen, China; Peng Cheng Laboratory, Shenzhen, China), and Zixuan Guo (Peking University, Shenzhen, China; Peng Cheng Laboratory, Shenzhen, China)
End-to-End Optimized Video Compression with MV-Residual Prediction <u>.6.1.1</u> Xiangji Wu (Tucodec Inc), Ziwen Zhang (Tucodec Inc), Jie Feng (Tucodec Inc), Lei Zhou (Tucodec Inc), and Junmin Wu (Tucodec Inc)
Multi-scale Grouped Dense Network for VVC Intra Coding .6.15 Xin Li (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), Simeng Sun (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), Zhizheng Zhang (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China), and Zhibo Chen (CAS Key Laboratory of Technology in Geo-spatial Information Processing and Application System, University of Science and Technology of China)
Image Compression with Encoder-Decoder Matched Semantic Segmentation .61.9 Trinh Man Hoang (Hosei University, Tokyo, Japan), Jinjia Zhou (Hosei University, Tokyo, Japan; JST, PRESTO, Tokyo, Japan), and Yibo Fan (Fudan University, Shanghai, China)

Variable Rate Image Compression Method with Dead-Zone Quantizer .624 Jing Zhou (Fujitsu R&D Center Co. Ltd.), Akira Nakagawa (Fujitsu Laboratories Ltd.), Keizo Kato (Fujitsu Laboratories Ltd.), Sihan Wen (Fujitsu R&D Center Co. Ltd.), Kimihiko Kazui (Fujitsu Laboratories Ltd.), and Zhiming Tan (Fujitsu R&D Center Co. Ltd.)
Adapting JPEG XS Gains and Priorities to Tasks and Contents .629 Benoit Brummer (intoPIX, Mont-Saint-Guibert, Belgium) and Christophe de Vleeschouwer (Université catholique de Louvain Louvain-la-Neuve, Belgium)
Lossy Compression with Distortion Constrained Optimization .634 Ties van Rozendaal (Qualcomm Al Research, Qualcomm Technologies Netherlands B.V.), Guillaume Sautière (Qualcomm Al Research, Qualcomm Technologies Netherlands B.V.), and Taco S. Cohen (Qualcomm Al Research, Qualcomm Technologies Netherlands B.V.)
Adversarial Distortion for Learned Video Compression .640 Vijay Veerabadran (University of California San Diego), Reza Pourreza (Qualcomm AI Research, Qualcomm Technologies, Inc.), Amirhossein Habibian (Qualcomm AI Research, Qualcomm Technologies Netherlands B.V.), and Taco S. Cohen (Qualcomm AI Research, Qualcomm Technologies Netherlands B.V.)

DIRA: Diagram Image Retrieval and Analysis: Representation, Learning, and Similarity Metrics

Syntharch: Interactive Image Search with Attribute-Conditioned Synthesis .645..... Zac Yu (University of Pittsburgh) and Adriana Kovashka (University of Pittsburgh)

Learning Spatial Relationships Between Samples of Patent Image Shapes <u>.655</u>..... Juan Castorena (Los Alamos National Laboratory, Los Alamos, NM, USA), Manish Bhattarai (Los Alamos National Laboratory, Los Alamos, NM, USA), and Diane Oyen (Los Alamos National Laboratory, Los Alamos, NM, USA)

Diagram Image Retrieval Using Sketch-Based Deep Learning and Transfer Learning .663...... Manish Bhattarai (University of New Mexico, Albuquerque, NM, USA; Los Alamos National Laboratory, Los Alamos, NM, USA), Diane Oyen (Los Alamos National Laboratory, Los Alamos, NM, USA), Juan Castorena (Los Alamos National Laboratory, Los Alamos, NM, USA), Liping Yang (University of New Mexico, Albuquerque, NM, USA), and Brendt Wohlberg (Los Alamos National Laboratory, Los Alamos, NM, USA)

Automatic Digitization of Engineering Diagrams Using Deep Learning and Graph Search .673.. Shouvik Mani (C3.ai), Michael A. Haddad (C3.ai), Dan Constantini (C3.ai), Willy Douhard (C3.ai), Qiwei Li (C3.ai), and Louis Poirier (C3.ai)

Structured Query-Based Image Retrieval Using Scene Graphs .680..... Brigit Schroeder (University of California, Santa Cruz) and Subarna Tripathi (Intel Labs) Diagram Image Retrieval and Analysis: Challenges and Opportunities .685..... Liping Yang (University of New Mexico, Albuquerque, NM, USA), Ming Gong (University of Dayton, Dayton, OH, USA), and Vijayan K. Asari (University of Dayton, Dayton, OH, USA)

A Simplified Framework for Zero-Shot Cross-Modal Sketch Data Retrieval .699..... Ushasi Chaudhuri (Indian Institute of Technology, Bombay, India), Biplab Banerjee (Indian Institute of Technology, Bombay, India), Avik Bhattacharya (Indian Institute of Technology, Bombay, India), and Mihai Datcu (German Aerospace Center (DLR), Germany)

EarthVision: EarthVision: Large Scale Computer Vision for Remote Sensing Imagery

ResDepth: Learned Residual Stereo Reconstruction .7.07. Corinne Stucker (Photogrammetry and Remote Sensing, ETH Zurich, Switzerland) and Konrad Schindler (Photogrammetry and Remote Sensing, ETH Zurich, Switzerland)
DALES: A Large-Scale Aerial LiDAR Data Set for Semantic Segmentation .7.1.7 Nina Varney (University of Dayton), Vijayan K. Asari (University of Dayton), and Quinn Graehling (University of Dayton)
S2A: Wasserstein GAN with Spatio-Spectral Laplacian Attention for Multi-spectral Band Synthesis .727
Litu Rout (Signal and Image Processing Group, Space Applications Centre, Indian Space Research Organisation), Indranil Misra (Signal and Image Processing Group, Space Applications Centre, Indian Space Research Organisation), S Manthira Moorthi (Signal and Image Processing Group, Space Applications Centre, Indian Space Research Organisation), and Debajyoti Dhar (Signal and Image Processing Group, Space Applications Centre, Indian Space Research
Density Map Guided Object Detection in Aerial Images .7.3.7 Changlin Li (University of North Carolina at Charlotte), Taojiannan Yang (University of North Carolina at Charlotte), Sijie Zhu (University of North Carolina at Charlotte), Chen Chen (University of North Carolina at Charlotte), and Shanyue Guan (East Carolina University)
StandardGAN: Multi-source Domain Adaptation for Semantic Segmentation of Very High Resolution Satellite Images by Data Standardization .7.4.7 Onur Tasar (Université Côte d'Azur, Inria), Yuliya Tarabalka (LuxCarta), Alain Giros (Centre National d'Études Spatiales), Pierre Alliez (Université Côte d'Azur, Inria), and Sébastien Clerc (ACRI-ST)
Monte-Carlo Siamese Policy on Actor for Satellite Image Super Resolution .7.5.7 Litu Rout (Signal and Image Processing Group, Space Applications Centre, Indian Space Research Organisation), Saumyaa Shah (Work done at Space Applications Centre), S Manthira Moorthi (Signal and Image Processing Group, Space Applications Centre, Indian Space Research Organisation), and Debajyoti Dhar (Signal and Image Processing Group, Space Applications Centre, Indian Space Research Organisation)

SpaceNet 6: Multi-sensor All Weather Mapping Dataset .768..... Jacob Shermeyer (In-Q-Tel - CosmiQ Works), Daniel Hogan (In-Q-Tel -CosmiQ Works), Jason Brown (Capella Space), Adam Van Etten (In-Q-Tel -CosmiQ Works), Nicholas Weir (In-Q-Tel - CosmiQ Works), Fabio Pacifici (Maxar Technologies), Ronny Hänsch (German Aerospace Center), Alexei Bastidas (Intel AI Lab), Scott Soenen (Capella Space), Todd Bacastow (Maxar Technologies), and Ryan Lewis (In-Q-Tel - CosmiQ Works) FGCN: Deep Feature-Based Graph Convolutional Network for Semantic Segmentation of Urban 3D Point Clouds .778..... Sagib Ali Khan (National University of Sciences and Technology (NUST), Islamabad, Pakistan), Yilei Shi (Technical University of Munich (TUM), Munich, Germany), Muhammad Shehzad (National University of Sciences and Technology (NUST), Islamabad, Pakistan), and Xiao Xiang Zhu (Signal Processing in Earth Observation (SiPEO), Technical University of Munich (TUM), Munich, Germany; Remote Sensing Technology Institute (IMF), German Aerospace Center (DLR), Wessling, Germany) Meta-Learning for Few-Shot Land Cover Classification .788..... Marc Rußwurm (Technical University of Munich), Sherrie Wang (Stanford University), Marco Körner (Technical University of Munich), and David Lobell (Stanford University) Toronto-3D: A Large-Scale Mobile LiDAR Dataset for Semantic Segmentation of Urban Roadways... 797 Weikai Tan (University of Waterloo, Waterloo, ON, Canada), Nannan Qin (University of Waterloo, Waterloo, ON, Canada), Lingfei Ma (University of Waterloo, Waterloo, ON, Canada), Ying Li (University of Waterloo, Waterloo, ON, Canada), Jing Du (Jimei University, Xiamen, China), Guorong Cai (limei University, Xiamen, China), Ke Yang (University of Waterloo, Waterloo, ON, Canada), and Jonathan Li (University of Waterloo, Waterloo, ON, Canada) Deep Regression for Imaging Solar Magnetograms Using Pyramid Generative Adversarial Networks .807..... Rasha Alshehhi (New York University, Abu Dhabi, Abu Dhabi, United Arab Emirates) Multi-image Super-Resolution for Remote Sensing Using Deep Recurrent Networks .816...... Md Rifat Arefin (Mila - Quebec Al Institute; Université de Montréal), Vincent Michalski (Mila - Quebec Al Institute; Université de Montréal), Pierre-Luc St-Charles (Mila - Quebec Al Institute), Alfredo Kalaitzis (Element AI), Sookyung Kim (Lawrence Livermore National Laboratory), Samira E. Kahou (Mila - Quebec Al Institute; McGill University), and Yoshua Bengio (Mila - Quebec Al Institute; Université de Montréal) RasterNet: Modeling Free-Flow Speed Using LiDAR and Overhead Imagery .826..... Armin Hadzic (University of Kentucky), Hunter Blanton (University of Kentucky), Weilian Song (Simon Fraser University), Mei Chen (University of Kentucky), Scott Workman (DZYNE Technologies), and Nathan Jacobs (University of Kentucky)

Sen1Floods11: A Georeferenced Dataset to Train and Test Deep Learning Flood Algorithms for

Sentinel-1 .83.5. Derrick Bonafilia (Cloud to Street), Beth Tellman (Cloud to Street;

Earth Institute, Columbia University), Tyler Anderson (Cloud to Street), and Erica Issenberg (Cloud to Street)

VAS: Vision for All Seasons: Adverse Weather and Lighting Conditions

HIDeGan: A Hyperspectral-Guided Image Dehazing GAN .846 Aditya Mehta (BITS, Pilani, India), Harsh Sinha (BITS, Pilani, India), Pratik Narang (BITS, Pilani, India), and Murari Mandal (MNIT, Jaipur, India)
Removal of Image Obstacles for Vehicle-Mounted Surrounding Monitoring Cameras by Real-Time Video Inpainting .85.7 Yoshihiro Hirohashi (DENSO CORPORATION, Japan), Kenichi Narioka (DENSO CORPORATION, Japan), Masanori Suganuma (Tohoku University, Japan; Center for Advanced Intelligence Project, RIKEN, Japan), Xing Liu (Tohoku University, Japan), Yukimasa Tamatsu (DENSO CORPORATION, Japan), and Takayuki Okatani (Tohoku University, Japan; Center for Advanced Intelligence Project, RIKEN, Japan)
A New Multimodal RGB and Polarimetric Image Dataset for Road Scenes Analysis .86.7 Rachel Blin (Normandie Univ, INSA Rouen, Rouen, France), Samia Ainouz (Normandie Univ, INSA Rouen, Rouen, France), Stéphane Canu (Normandie Univ, INSA Rouen, Rouen, France), and Fabrice Meriaudeau (University of Burgundy, Le Creusot, France)
Implicit Euler ODE Networks for Single-Image Dehazing .87.7 Jiawei Shen (Wuhan University), Zhuoyan Li (Wuhan University), Lei Yu (Wuhan University), Gui-Song Xia (Wuhan University), and Wen Yang (Wuhan University)
CLVISION: Continual Learning in Computer Vision

Lifelong Machine Learning with Deep Streaming Linear Discriminant Analysis .887...... Tyler L. Hayes (Rochester Institute of Technology) and Christopher Kanan (Rochester Institute of Technology; Paige; Cornell Tech)

Cognitively-Inspired Model for Incremental Learning Using a Few Examples .89.7..... Ali Ayub (The Pennsylvania State University) and Alan R. Wagner (The Pennsylvania State University)

Continual Learning of Object Instances .90.7.... Kishan Parshotam (University of Amsterdam, The Netherlands; Prosus, The Netherlands) and Mert Kilickaya (University of Amsterdam, The Netherlands)

Generative Feature Replay for Class-Incremental Learning .9.15 Xialei Liu (Universitat Autonoma de Barcelona, Barcelona, Spain), Chenshen Wu (Universitat Autonoma de Barcelona, Barcelona, Spain), Mikel Menta (Universitat Autonoma de Barcelona, Barcelona, Spain), Luis Herranz (Universitat Autonoma de Barcelona, Barcelona, Spain), Bogdan Raducanu (Universitat Autonoma de Barcelona, Barcelona, Spain), Andrew D. Bagdanov (University of Florence, Florence, Italy), Shangling Jui (Huawei Kirin Solution, Shanghai, China), and Joost van de Weijer (Universitat Autonoma de Barcelona, Barcelona, Spain)
Stream-51: Streaming Classification and Novelty Detection from Videos .925 Ryne Roady (Rochester Institute of Technology), Tyler L. Hayes (Rochester Institute of Technology), Hitesh Vaidya (Rochester Institute of Technology), and Christopher Kanan (Rochester Institute of Technology; Paige; Cornell Tech)
CatNet: Class Incremental 3D ConvNets for Lifelong Egocentric Gesture Recognition <u>.9.35</u> Zhengwei Wang (V-SENSE, Trinity College Dublin), Qi She (Intel Labs China), Tejo Chalasani (V-SENSE, Trinity College Dublin), and Aljosa Smolic (V-SENSE, Trinity College Dublin)
Dropout as an Implicit Gating Mechanism for Continual Learning .945 Seyed Iman Mirzadeh (Washington State University), Mehrdad Farajtabar (DeepMind), and Hassan Ghasemzadeh (Washington State University)
What Is Happening Inside a Continual Learning Model? A Representation-Based Evaluation of Representational Forgetting .952 Kengo Murata (Aoyama Gakuin University), Tetsuya Toyota (Toho University), and Kouzou Ohara (Aoyama Gakuin University)
M2SGD: Learning to Learn Important Weights .957 Nicholas I-Hsien Kuo (RSCS, The Australian National University), Mehrtash Harandi (Monash University, Australia), Nicolas Fourrier (Pôle Universitaire Léonard de Vinci, Paris La Défense, France), Christian Walder (RSCS, The Australian National University; Data61, CSIRO, Australia), Gabriela Ferraro (RSCS, The Australian National University; Data61, CSIRO, Australia), and Hanna Suominen (RSCS, The Australian National University; Data61, CSIRO, Australia; University of Turku, Turku, Finland)
Few-Shot Image Recognition for UAV Sports Cinematography .9.65 Emmanouil Patsiouras (Aristotle University of Thessaloniki), Anastasios Tefas (Aristotle University of Thessaloniki), and Ioannis Pitas (Aristotle University of Thessaloniki)
Generalized Class Incremental Learning .9.70. <i>Fei Mi (Ecole Polytechnique Fédérale de Lausanne (EPFL)), Lingjing</i> <i>Kong (Ecole Polytechnique Fédérale de Lausanne (EPFL)), Tao Lin (Ecole</i> <i>Polytechnique Fédérale de Lausanne (EPFL)), Kaicheng Yu (Ecole</i> <i>Polytechnique Fédérale de Lausanne (EPFL)), and Boi Faltings (Ecole</i> <i>Polytechnique Fédérale de Lausanne (EPFL))</i>
StackNet: Stacking Feature Maps for Continual Learning .975. Jangho Kim (Seoul National University, Seoul, Korea), Jeesoo Kim (Seoul National University, Seoul, Korea), and Nojun Kwak (Seoul National University, Seoul, Korea)

Noise-Based Selection of Robust Inherited Model for Accurate Continual Learning .9.8.3 Xiaocong Du (Arizona State University), Zheng Li (Arizona State University), Jae-sun Seo (Arizona State University), Frank Liu (Oak Ridge National Lab), and Yu Cao (Arizona State University)
Rehearsal-Free Continual Learning Over Small Non-I.I.D. Batches .989 Vincenzo Lomonaco (University of Bologna, Italy), Davide Maltoni (University of Bologna, Italy), and Lorenzo Pellegrini (University of Bologna, Italy)
Continual Reinforcement Learning in 3D Non-Stationary Environments <u>.999</u> Vincenzo Lomonaco (University of Bologna, Italy), Karan Desai (University of Michigan, United States), Eugenio Culurciello (Purdue University, United States), and Davide Maltoni (University of Bologna, Italy)
Relationship Matters: Relation Guided Knowledge Transfer for Incremental Learning of Object Detectors .1.009 Kandan Ramakrishnan (IBM Research; MIT-IBM Watson AI Lab), Rameswar Panda (IBM Research; MIT-IBM Watson AI Lab), Quanfu Fan (IBM Research; MIT-IBM Watson AI Lab), John Henning (IBM Research; MIT-IBM Watson AI Lab), Aude Oliva (MIT-IBM Watson AI Lab; MIT CSAIL), and Rogerio Feris (IBM Research; MIT-IBM Watson AI Lab)
Reducing Catastrophic Forgetting with Learning on Synthetic Data .1.0.19 Wojciech Masarczyk (Institute of Theoretical and Applied Informatics, Polish Academy of Sciences, Tooploox) and Ivona Tautkute (Polish-Japanese Academy of Information Technology, Tooploox)
Continual Learning for Anomaly Detection in Surveillance Videos .1.025 Keval Doshi (University of South Florida) and Yasin Yilmaz (University of South Florida)
Generating Accurate Pseudo Examples for Continual Learning .1.035 Daniel L. Silver (Acadia University) and Sazia Mahfuz (Queens Uninversity)

DLGC: Deep Learning for Geometric Computing

Subpixel Dense Refinement Network for Skeletonization <u>1043</u> Sohom Dey (Kalinga Institute of Industrial Technology, Bhubaneshwar, India)
Capturing Cellular Topology in Multi-Gigapixel Pathology Images .1.0.49. Wenqi Lu (University of Warwick, UK), Simon Graham (University of Warwick, UK), Mohsin Bilal (University of Warwick, UK), Nasir Rajpoot (University of Warwick, UK), and Fayyaz Minhas (University of Warwick, UK)
A Novel Local Geometry Capture in PointNet++ for 3D Classification <u>.1.0.59</u> Shivanand Venkanna Sheshappanavar (University of Delaware, Newark, DE, USA) and Chandra Kambhamettu (University of Delaware, Newark, DE, USA)

L3DGM: Learning 3D Generative Models

VoronoiNet: General Functional Approximators with Local Support <u>1069</u> Francis Williams (New York University), Jérôme Parent-Lévesque (McGill University), Derek Nowrouzezahrai (McGill University), Daniele Panozzo (New York University), Kwang Moo Yi (University of Victoria), and Andrea Tagliasacchi (Google Brain)
Deep Octree-Based CNNs with Output-Guided Skip Connections for 3D Shape and Scene Completion .1.0.7.4 Peng-Shuai Wang (Microsoft Research Asia), Yang Liu (Microsoft Research Asia), and Xin Tong (Microsoft Research Asia)
Generalized Autoencoder for Volumetric Shape Generation .1.082 Yanran Guan (Carleton University, Canada), Tansin Jahan (Carleton University, Canada), and Oliver van Kaick (Carleton University, Canada)
Topology-Aware Single-Image 3D Shape Reconstruction .1.089 Qimin Chen (UC San Diego.), Vincent Nguyen (UC San Diego.), Feng Han (Google Inc.), Raimondas Kiveris (Google Inc.), and Zhuowen Tu (UC San Diego.)
Geometry to the Rescue: 3D Instance Reconstruction from a Cluttered Scene .1.0.98 Lin Li (Data61-CSIRO, ANU), Salman Khan (IIAI, ANU), and Nick Barnes (ANU)
Mesh Variational Autoencoders with Edge Contraction Pooling .1.105 Yu-Jie Yuan (Beijing Key Laboratory of Mobile Computing and Pervasive Device, Institute of Computing Technology, CAS; University of Chinese Academy of Sciences), Yu-Kun Lai (Cardiff University, UK), Jie Yang (Beijing Key Laboratory of Mobile Computing and Pervasive Device, Institute of Computing Technology, CAS; University of Chinese Academy of Sciences), Qi Duan (SenseTime Research), Hongbo Fu (City University of Hong Kong), and Lin Gao (Beijing Key Laboratory of Mobile Computing and Pervasive Device, Institute of Computing Technology, CAS; University of Chinese Academy of Sciences; Shenzhen Research Institute of Big Data)

CVPM: Computer Vision for Physiological Measurement

Photoplethysmography Based Stratification of Blood Pressure Using Multi-information Fusion

Photoplethysmography Based Stratification of Blood Pressure Using Artificial Neural Network .1.1.13... Dingliang Wang (Hefei University of Technology, Hefei, China), Xuezhi Yang (Hefei University of Technology, Hefei, China), Xuenan Liu (Hefei University of Technology, Hefei, China), Shuai Fang (Hefei University of Technology, Hefei, China), Likun Ma (The First Affiliated Hospital of University of Science and Technology of China, Hefei, China), and Longwei Li (The First Affiliated Hospital of University of Science and Technology of China, Hefei, China)

Remote Photoplethysmography: Rarely Considered Factors .1.197 Yuriy Mironenko (Southern Federal University, Center of Neurotechnologies, Rostov-on-Don, Russian Federation), Konstantin Kalinin (Southern Federal University, Center of Neurotechnologies, Rostov-on-Don, Russian Federation), Mikhail Kopeliovich (Southern Federal University, Center of Neurotechnologies, Rostov-on-Don, Russian Federation), and Mikhail Petrushan (Southern Federal University, Center of Neurotechnologies, Rostov-on-Don, Russian Federation)
In Search of Life: Learning from Synthetic Data to Detect Vital Signs in Videos .1.207 Florin Condrea (Arnia Software, Romania), Victor-Andrei Ivan (Arnia Software, Romania), and Marius Leordeanu (Arnia Software, Romania, University "Politehnica" of Bucharest)
Convulsive Movement Detection Using Low-Resolution Thermopile Sensor Array .1.217 Ouday Hanosh (University of Illinois at Chicago (UIC)), Rashid Ansari (University of Illinois at Chicago (UIC)), Naoum P. Issa, and A. Enis Cetin (University of Illinois at Chicago (UIC))
Predicting Fall Probability Based on a Validated Balance Scale .1.224 Alaa Masalha (University of Haifa), Nadav Eichler (University of Haifa), Shmuel Raz (University of Haifa), Adi Toledano-Shubi (Physiotherapy Institute Galilee Medical Center), Daphna Niv (Physiotherapy Institute Galilee Medical Center), Ilan Shimshoni (University of Haifa), and Hagit Hel-Or (University of Haifa)
An Assessment of Algorithms to Estimate Respiratory Rate from the Remote Photoplethysmogram .1.2.32 Duncan Luguern (Univ. Bourgogne Franche-Comté, Dijon, France), Simon Perche (Univ. Bourgogne Franche-Comté, Dijon, France), Yannick Benezeth (Univ. Bourgogne Franche-Comté, Dijon, France), Virginie Moser (CSEM, Neuchâtel, Switzerland), L. Andrea Dunbar (CSEM, Neuchâtel, Switzerland), Fabian Braun (CSEM, Neuchâtel, Switzerland), Alia Lemkaddem (CSEM, Neuchâtel, Switzerland), Keisuke Nakamura (Honda Research Institute Japan Co., Honcho, Wako-shi, Saitama, Japan), Randy Gomez (Honda Research Institute Japan Co., Honcho, Wako-shi, Saitama, Japan), and Julien Dubois (Univ. Bourgogne Franche-Comté, Dijon, France)
Long Short-Term Memory Deep-Filter in Remote Photoplethysmography .1.2.42 Deivid Botina-Monsalve (Univ. Bourgogne Franche-Comté, France), Yannick Benezeth (Univ. Bourgogne Franche-Comté, France), Richard Macwan (Univ. Paris 13, France), Paul Pierrart (Univ. Bourgogne Franche-Comté, France), Federico Parra (Univ. Bourgogne Franche-Comté, France), Keisuke Nakamura (Honda Research Institute Japan Co., Honcho, Wako-shi, Saitama, Japan), Randy Gomez (Honda Research Institute Japan Co., Honcho, Wako-shi, Saitama, Japan), and Johel Miteran (Univ.

Bourgogne Franche-Comté, France)

Detecting Deepfake Videos Using Attribution-Based Confidence Metric .1.250 Steven Fernandes (University of Central Florida, Orlando, FL), Sunny Raj (University of Central Florida, Orlando, FL), Rickard Ewetz (University of Central Florida, Orlando, FL), Jodh Singh Pannu (University of Central Florida, Orlando, FL), Sumit Kumar Jha (University of Central Florida, Orlando, FL), Eddy Ortiz (Solution Acceleration and Innovation Department, Royal Bank of Canada), Iustina Vintila (Solution Acceleration and Innovation Department, Royal Bank of Canada), and Margaret Salter (Solution Acceleration and Innovation Department, Royal Bank of Canada)
On Indirect Assessment of Heart Rate in Video .1.260 Mikhail Kopeliovich (Southern Federal University, Center of Neurotechnologies, Rostov-on-Don, Russian Federation), Konstantin Kalinin (Southern Federal University, Center of Neurotechnologies, Rostov-on-Don, Russian Federation), Yuriy Mironenko (Southern Federal University, Center of Neurotechnologies, Rostov-on-Don, Russian Federation), and Mikhail Petrushan (Southern Federal University, Center of Neurotechnologies, Rostov-on-Don, Russian Federation)
Skin Segmentation Using Active Contours and Gaussian Mixture Models for Heart Rate Detection in Videos .1.265 Alexander Woyczyk (University of Applied Sciences and Arts Dortmund, Dortmund, Germany), Vincent Fleischhauer (University of Applied Sciences and Arts Dortmund, Dortmund, Germany), and Sebastian Zaunseder (University of Applied Sciences and Arts Dortmund, Dortmund, Germany)
The 1st Challenge on Remote Physiological Signal Sensing (RePSS) .1.274 Xiaobai Li (Center for Machine Vision and Signal Analysis, University of Oulu, Finland), Hu Han (Key Laboratory of Intelligient Information Processing of Chinese Academy of Sciences (CAS), Institute of Computing Technology, CAS, China; Peng Cheng Laboratory, Shenzhen, China), Hao Lu (Key Laboratory of Intelligient Information Processing of Chinese Academy of Sciences (CAS), Institute of Computing Technology, CAS, China), Xuesong Niu (Key Laboratory of Intelligient Information Processing of Chinese Academy of Sciences (CAS), Institute of Computing Technology, CAS, China), Zitong Yu (Center for Machine Vision and Signal Analysis, University of Oulu, Finland), Antitza Dantcheva (STARS team, INRIA, France), Guoying Zhao (Center for Machine Vision and Signal Analysis, University of Oulu, Finland), and Shiguang Shan (Key Laboratory of Intelligient Information Processing of Chinese Academy of Sciences (CAS), Institute of Computing Technology, CAS, China), Xuesong Niu (Key Laboratory of Oulu, Finland), and Shiguang Shan (Key Laboratory of Intelligient Information Processing of Chinese Academy of Sciences (CAS), Institute of Computing Technology, CAS, China)

Neurodata Lab's Approach to the Challenge on Computer Vision for Physiological Measurement... 1282

Mikhail Artemyev (Neurodata Lab LLC, Miami, USA), Marina Churikova (Neurodata Lab LLC, Miami, USA; Lomonosov Moscow State University, Faculty of Biology, Department of Higher Nervous Activity, Moscow, Russia), Mikhail Grinenko (Neurodata Lab LLC, Miami, USA), and Olga Perepelkina (Neurodata Lab LLC, Miami, USA)

SAIAD: Safe Artificial Intelligence for Automated Driving

Evaluating Scalable Bayesian Deep Learning Methods for Robust Computer Vision .1.2.89 Fredrik K. Gustafsson (Uppsala University, Sweden), Martin Danelljan (Computer Vision Lab, ETH Zurich, Switzerland), and Thomas B. Schön (Uppsala University, Sweden)
Improved Noise and Attack Robustness for Semantic Segmentation by Using Multi-task Training with Self-Supervised Depth Estimation .1.299 Marvin Klingner (Technische Universität Braunschweig), Andreas Bär (Technische Universität Braunschweig), and Tim Fingscheidt (Technische Universität Braunschweig)
Attentional Bottleneck: Towards an Interpretable Deep Driving Network .1.3.10 Jinkyu Kim (Waymo Research) and Mayank Bansal (Waymo Research)
Leveraging Combinatorial Testing for Safety-Critical Computer Vision Datasets .1.3.14 Christoph Gladisch (Robert Bosch GmbH, Corporate Research), Christian Heinzemann (Robert Bosch GmbH, Corporate Research), Martin Herrmann (Robert Bosch GmbH, Corporate Research), and Matthias Woehrle (Robert Bosch GmbH, Corporate Research)
Multivariate Confidence Calibration for Object Detection .1.322 Fabian Küppers (Ruhr West University of Applied Sciences, Bottrop, Germany), Jan Kronenberger (Ruhr West University of Applied Sciences, Bottrop, Germany), Amirhossein Shantia (Visteon Electronics GmbH, Kerpen, Germany), and Anselm Haselhoff (Ruhr West University of Applied Sciences, Bottrop, Germany)
Detection and Retrieval of Out-of-Distribution Objects in Semantic Segmentation .1.33.1 Philipp Oberdiek (TU Dortmund University), Matthias Rottmann (University of Wuppertal), and Gernot A. Fink (TU Dortmund University)
Generating Socially Acceptable Perturbations for Efficient Evaluation of Autonomous Vehicles .1.34.1 Songan Zhang (University of Michigan), Huei Peng (University of Michigan), Subramanya Nageshrao (Ford Motor Company), and H. Eric Tseng (Ford Motor Company)
Robust Semantic Segmentation by Redundant Networks with a Layer-Specific Loss Contribution and Majority Vote .1.3.48 Andreas Bär (Technische Universität Braunschweig), Marvin Klingner (Technische Universität Braunschweig), Serin Varghese (Technische Universität Braunschweig; Volkswagen Group Automation), Fabian Hüger (Volkswagen Group Automation), Peter Schlicht (Volkswagen Group Automation), and Tim Fingscheidt (Technische Universität Braunschweig)
Self-Supervised Domain Mismatch Estimation for Autonomous Perception <u>1359</u> Jonas Löhdefink (Technische Universität Braunschweig), Justin Fehrling (Technische Universität Braunschweig), Marvin Klingner (Technische Universität Braunschweig), Fabian Hüger (Volkswagen Group Automation), Peter Schlicht (Volkswagen Group Automation), Nico M. Schmidt (Volkswagen Group Automation), and Tim Fingscheidt (Technische Universität Braunschweig)

Unsupervised Temporal Consistency Metric for Video Segmentation in Highly-Automated Driving .1.369..... Serin Varghese (Volkswagen AG; Technische Universität Braunschweig), Yasin Bayzidi (Volkswagen AG), Andreas Bär (Technische Universität Braunschweig), Nikhil Kapoor (Volkswagen AG), Sounak Lahiri (Volkswagen AG), Jan David Schneider (Volkswagen AG), Nico M. Schmidt (Volkswagen AG), Peter Schlicht (Volkswagen AG), Fabian Hüger (Volkswagen AG), and Tim Fingscheidt (Technische Universität Braunschweig) Mind the Gap – A Benchmark for Dense Depth Prediction Beyond Lidar <u>1379</u>..... Hendrik Schilling (rabbitAl, Heidelberg), Marcel Gutsche (rabbitAl, Heidelberg), Alexander Brock (Visual Learning Lab, Heidelberg University), Dane Späth (Visual Learning Lab, Heidelberg University), Carsten Rother (Visual Learning Lab, Heidelberg University), and Karsten Krispin (rabbitAl, Heidelberg) Explaining Autonomous Driving by Learning End-to-End Visual Attention .1.389..... Luca Cultrera (MICC, University of Florence), Lorenzo Seidenari (MICC, University of Florence), Federico Becattini (MICC, University of Florence), Pietro Pala (MICC, University of Florence), and Alberto Del Bimbo (MICC, University of Florence) Using Mixture of Expert Models to Gain Insights Into Semantic Segmentation .1.399..... Svetlana Pavlitskaya (FZI Research Center for Information Technology), Christian Hubschneider (FZI Research Center for Information Technology), Michael Weber (FZI Research Center for Information Technology), Ruby Moritz (Volkswagen Group Automation), Fabian Hüger (Volkswagen Group Automation), Peter Schlicht (Volkswagen Group Automation), and Marius Zöllner (FZI Research Center for Information Technology)

DynaVis: Dynamic Scene Reconstruction

The "Vertigo Effect" on Your Smartphone: Dolly Zoom via Single Shot View Synthesis .1.407.... Yangwen Liang (Samsung Semiconductor Inc), Rohit Ranade (Samsung Semiconductor Inc), Shuangquan Wang (Samsung Semiconductor Inc), Dongwoon Bai (Samsung Semiconductor Inc), and Jungwon Lee (Samsung Semiconductor Inc)

Bilinear Parameterization for Differentiable Rank-Regularization <u>1416</u>..... Marcus Valtonen Örnhag (Centre for Mathematical Sciences, Lund University), Carl Olsson (Centre for Mathematical Sciences, Lund University; Department of Electrical Engineering, Chalmers University of Technology), and Anders Heyden (Centre for Mathematical Sciences, Lund University) Semi-Supervised 3D Face Representation Learning from Unconstrained Photo Collections .1.426 Zhongpai Gao (Artificial Intelligence Institute, Shanghai Jiao Tong University), Juyong Zhang (University of Science and Technology of China), Yudong Guo (University of Science and Technology of China), Chao Ma (Artificial Intelligence Institute, Shanghai Jiao Tong University), Guangtao Zhai (Artificial Intelligence Institute, Shanghai Jiao Tong University), and Xiaokang Yang (Artificial Intelligence Institute, Shanghai Jiao Tong University)

WiCV: Women in Computer Vision

Deep Learning for Automatic Pneumonia Detection <u>1.436</u> Tatiana Gabruseva (Independent Researcher), Dmytro Poplavskiy (Topcon Positioning Systems, Brisbane, Queensland, Australia), and Alexandr Kalinin (University of Michigan, USA; Shenzhen Research Institute of Big Data, Shenzhen, China)
REIN: Flexible Mesh Generation from Point Clouds <u>1444</u> Rangel Daroya (University of the Philippines Diliman, Electrical and Electronics Engineering Institute), Rowel Atienza (University of the Philippines Diliman, Electrical and Electronics Engineering Institute), and Rhandley Cajote (University of the Philippines Diliman, Electrical and Electronics Engineering Institute)
In Defense of the Triplet Loss Again: Learning Robust Person Re-Identification with Fast Approximated Triplet Loss and Label Distillation .1.454 Ye Yuan (Texas A&M University), Wuyang Chen (Texas A&M University), Yang Yang (Walmart Technology), and Zhangyang Wang (Texas A&M University)
Salient Object Detection by Contextual Refinement .1.464 Sayanti Bardhan (Indian Institute of Technology Madras, India; National Institute of Ocean Technology, India)
Eff-UNet: A Novel Architecture for Semantic Segmentation in Unstructured Environment .1.4.73 Bhakti Baheti (Center of Excellence in Signal and Image Processing, SGGSIET, Nanded, India), Shubham Innani (Center of Excellence in Signal and Image Processing, SGGSIET, Nanded, India), Suhas Gajre (Center of Excellence in Signal and Image Processing, SGGSIET, Nanded, India), and Sanjay Talbar (Center of Excellence in Signal and Image Processing, SGGSIET, Nanded, India)
Using Sinusoidally-Modulated Noise as a Surrogate for Slow-Wave Sleep to Accomplish Stable Unsupervised Dictionary Learning in a Spike-Based Sparse Coding Model <u>1482</u> <i>Yijing Watkins (Los Alamos National Laboratory), Edward Kim (Drexel</i> <i>University), Andrew Sornborger (Los Alamos National Laboratory), and</i> <i>Garrett T. Kenyon (Los Alamos National Laboratory; New Mexico</i> <i>Consortium)</i>
RIT-18: A Novel Dataset for Compositional Group Activity Understanding .1.488 Junwen Chen (Rochester Institute of Technology, Rochester, NY, USA), Haiting Hao (Rochester Institute of Technology, Rochester, NY, USA), Hanbin Hong (Rochester Institute of Technology, Rochester, NY, USA), and Yu Kong (Rochester Institute of Technology, Rochester, NY, USA)

Squeeze U-Net: A Memory and Energy Efficient Image Segmentation Network <u>1.495</u>..... Nazanin Beheshti (University of Houston) and Lennart Johnsson (University of Houston)

Learning Furniture Compatibility with Graph Neural Networks .1.505..... Luisa F. Polanía (Target Corporation, Sunnyvale, California, USA), Mauricio Flores (Target Corporation, Sunnyvale, California, USA), Matthew Nokleby (Target Corporation, Sunnyvale, California, USA), and Yiran Li (Target Corporation, Sunnyvale, California, USA)

CICV: Compositionality in Computer Vision

Inferring Temporal Compositions of Actions Using Probabilistic Automata .1.5.14...... Rodrigo Santa Cruz (The Australian e-Health Research Centre, CSIRO, Brisbane, Australia; Australian Centre for Robotic Vision (ACRV), Australian National University, Canberra, Australia), Anoop Cherian (Mitsubishi Electric Research Labs (MERL), Cambridge, MA), Basura Fernando (A*AI, A*STAR, Singapore), Dylan Campbell (Australian Centre for Robotic Vision (ACRV), Australian National University, Canberra, Australia), and Stephen Gould (Australian Centre for Robotic Vision (ACRV), Australian National University, Canberra, Australia)

Understanding Action Recognition in Still Images .1.523.... Deeptha Girish (University of Cincinnati, USA), Vineeta Singh (University of Cincinnati, USA), and Anca Ralescu (University of Cincinnati, USA)

Decomposing Image Generation Into Layout Prediction and Conditional Synthesis .1.5.30...... Anna Volokitin (Computer Vision Laboratory, ETH Zürich), Ender Konukoglu (Computer Vision Laboratory, ETH Zürich), and Luc Van Gool (Computer Vision Laboratory, ETH Zürich)

MVM: Minds vs. Machines: How Far Are We From the Common Sense of a Toddler?

SomethingFinder: Localizing Undefined Regions Using Referring Expressions .1.55.1..... Sungmin Eum (US Army Research Lab; Booz Allen Hamilton), David Han (US Army Research Lab), and Gordon Briggs (US Naval Research Lab)

Eric Taylor (Vector Institute, University of Guelph), Shashank Shekhar (University of Guelph, Vector Institute), and Graham W. Taylor (University of Guelph, Vector Institute, CIFAR Canada AI Chair)	
Hierarchical Color Learning in Convolutional Neural Networks .1.559 Chris Hickey (Seoul National University) and Byoung-Tak Zhang (Seoul National University)	
Understanding Knowledge Gaps in Visual Question Answering: Implications for Gap Identification and Testing .1.563 Goonmeet Bajaj (The Ohio State University (OSU)), Bortik Bandyopadhyay (The Ohio State University (OSU)), Daniel Schmidt (Wright State University), Pranav Maneriker (The Ohio State University (OSU)), Christopher Myers (Air Force Research Laboratory (AFRL)), and Srinivasan Parthasarathy (The Ohio State University (OSU))	
 3DQ-Nets: Visual Concepts Emerge in Pose Equivariant 3D Quantized Neural Scene Representations .1.567	
LPCV: Low-Power Computer Vision Challenge	
LPCV: Low-Power Computer vision Challenge	
CSPNet: A New Backbone that Can Enhance Learning Capability of CNN <u>1571</u> Chien-Yao Wang (Institute of Information Science, Academia Sinica, Taiwan), Hong-Yuan Mark Liao (Institute of Information Science, Academia Sinica, Taiwan; Providence University, Taiwan), Yueh-Hua Wu (Institute of Information Science, Academia Sinica, Taiwan; National Taiwan University, Taiwan), Ping-Yang Chen (National Chiao Tung University, Taiwan), Jun-Wei Hsieh (National Chiao Tung University, Taiwan), and I-Hau Yeh (Elan Microelectronics Corporation, Taiwan)	
 CSPNet: A New Backbone that Can Enhance Learning Capability of CNN .1571	
 CSPNet: A New Backbone that Can Enhance Learning Capability of CNN .1.571	

A Hardware Prototype Targeting Distributed Deep Learning for On-Device Inference .1.6.0.... Allen-Jasmin Farcas (The University of Texas at Austin), Guihong Li (The University of Texas at Austin), Kartikeya Bhardwaj (Arm Inc, San Jose, CA), and Radu Marculescu (The University of Texas at Austin)

Challenges in Energy-Efficient Deep Neural Network Training with FPGA .1.6.02..... Yudong Tao (University of Miami, USA), Rui Ma (University of Miami, USA), Mei-Ling Shyu (University of Miami, USA), and Shu-Ching Chen (Florida International University, USA)

Recursive Hybrid Fusion Pyramid Network for Real-Time Small Object Detection on Embedded Devices .1.612....

Ping-Yang Chen (National Chiao Tung University, Taiwan), Jun-Wei Hsieh (National Chiao Tung University, Taiwan), Chien-Yao Wang (Academia Sinica, Taiwan), and Hong-Yuan Mark Liao (Academia Sinica, Taiwan)

EmotioNet: Challenges and Promises to Inferring Emotion From Images and Video

Predicting Sentiments in Image Advertisements Using Semantic Relations Among Sentiment Labels .1640.

Stephen Pilli (TCS Research, India), Manasi Patwardhan (TCS Research, India), Niranjan Pedanekar (TCS Research, India), and Shirish Karande (TCS Research, India)

Facial Action Unit Recognition in the Wild with Multi-task CNN Self-Training for the EmotioNet Challenge .1.649.....

Philipp Werner (Otto von Guericke University Magdeburg, Germany), Frerk Saxen (Otto von Guericke University Magdeburg, Germany), and Ayoub Al-Hamadi (Otto von Guericke University Magdeburg, Germany)

TAL EmotioNet Challenge 2020 Rethinking the Model Chosen Problem in Multi-task Learning 1653

Pengcheng Wang (TAL Education Group), Zihao Wang (TAL Education Group), Zhilong Ji (TAL Education Group), Xiao Liu (TAL Education Group), Songfan Yang (TAL Education Group), and Zhongqin Wu (TAL Education Group) Multiple Transfer Learning and Multi-label Balanced Training Strategies for Facial AU Detection in the Wild <u>1657</u>.

Sijie Ji (Nanyang Technological University Singapore), Kai Wang (ShenZhen Key Lab of Computer Vision and Pattern Recognition, SIAT-SenseTime Joint Lab, Shenzhen Institutes of Advanced Technology, Chinese Academy of Science), Xiaojiang Peng (ShenZhen Key Lab of Computer Vision and Pattern Recognition, SIAT-SenseTime Joint Lab, Shenzhen Institutes of Advanced Technology, Chinese Academy of Science), Jianfei Yang (Nanyang Technological University Singapore), Zhaoyang Zeng (Sun Yat-Sen University, China), and Yu Qiao (ShenZhen Key Lab of Computer Vision and Pattern Recognition, SIAT-SenseTime Joint Lab, Shenzhen Institutes of Advanced Technology, Chinese Academy of Science)

NTIRE: New Trends in Image Restoration and Enhancement

NTIRE 2020 Challenge on Image and Video Deblurring .1.662 Seungjun Nah (ASRI, SNU, Korea), Sanghyun Son (ASRI, SNU, Korea), Radu Timofte (ETH Zurich, Switzerland), and Kyoung Mu Lee (ASRI, SNU, Korea)
Rendering Natural Camera Bokeh Effect with Deep Learning .1.6.76 Andrey Ignatov (ETH Zurich, Switzerland), Jagruti Patel (ETH Zurich, Switzerland), and Radu Timofte (ETH Zurich, Switzerland)
Deep Wavelet Network with Domain Adaptation for Single Image Demoireing .1.687 Xiaotong Luo (Xiamen University, Xiamen, China), Jiangtao Zhang (Xiamen University, Xiamen, China), Ming Hong (Xiamen University, Xiamen, China), Yanyun Qu (Xiamen University, Xiamen, China), Yuan Xie (East China Normal University, Shanghai, China), and Cuihua Li (Xiamen University, Xiamen, China)
 Hierarchical Regression Network for Spectral Reconstruction from RGB Images .1.6.95
Investigating Loss Functions for Extreme Super-Resolution .1.7.05 Younghyun Jo (Yonsei University), Sejong Yang (Yonsei University), and Seon Joo Kim (Yonsei University; Facebook)
C3Net: Demoiréing Network Attentive in Channel, Color and Concatenation .1.7.13 Sangmin Kim (Hanyang University, Seoul, Korea), Hyungjoon Nam (Hanyang University, Seoul, Korea), Jisu Kim (Hanyang University, Seoul, Korea), and Jechang Jeong (Hanyang University, Seoul, Korea)
Guided Frequency Separation Network for Real-World Super-Resolution .1.722 Yuanbo Zhou (College of Physics and Information Engineering, Fuzhou University), Wei Deng (College of Physics and Information Engineering, Fuzhou University), Tong Tong (College of Physics and Information Engineering, Fuzhou University), and Qinquan Gao (College of Physics and Information Engineering, Fuzhou University)

Trident Dehazing Network .1.732 Jing Liu (East China Normal University, Shanghai, China), Haiyan Wu (East China Normal University, Shanghai, China), Yuan Xie (East China Normal University, Shanghai, China), Yanyun Qu (Xiamen University, Fujian, China), and Lizhuang Ma (East China Normal University, Shanghai, China)
Densely Self-Guided Wavelet Network for Image Denoising .1.7.42 Wei Liu (SenseTime Research; Harbin Institute of Technology), Qiong Yan (SenseTime Research), and Yuzhi Zhao (City University of Hong Kong)
MMDM: Multi-frame and Multi-scale for Image Demoiréing .1.75.1 Shuai Liu (North China University of Technology), Chenghua Li (Institute of Automation, Chinese Academy of Sciences), Nan Nan (North China University of Technology), Ziyao Zong (North China University of Technology), and Ruixia Song (North China University of Technology)
Real-World Super-Resolution Using Generative Adversarial Networks .1.760 Haoyu Ren (Samsung Semiconductor, Inc. San Diego, CA, USA), Amin Kheradmand (Samsung Semiconductor, Inc. San Diego, CA, USA), Mostafa El-Khamy (Samsung Semiconductor, Inc. San Diego, CA, USA), Shuangquan Wang (Samsung Semiconductor, Inc. San Diego, CA, USA), Dongwoon Bai (Samsung Semiconductor, Inc. San Diego, CA, USA), and Jungwon Lee (Samsung Semiconductor, Inc. San Diego, CA, USA)
Deep Generative Adversarial Residual Convolutional Networks for Real-World Super-Resolution .1.769 Rao Muhammad Umer (University of Udine, Italy), Gian Luca Foresti (University of Udine, Italy), and Christian Micheloni (University of Udine, Italy)
Perceptual Extreme Super-Resolution Network with Receptive Field Block .1.7.78 Taizhang Shang (OPPO Research, China), Qiuju Dai (OPPO Research, China), Shengchen Zhu (OPPO Research, China), Tong Yang (OPPO Research, China), and Yandong Guo (OPPO Research, China)
Unsupervised Real Image Super-Resolution via Generative Variational AutoEncoder .1.788 Zhi-Song Liu (The Hong Kong Polytechnic University; LIX, École polytechnique), Wan-Chi Siu (The Hong Kong Polytechnic University), Li-Wen Wang (The Hong Kong Polytechnic University), Chu-Tak Li (The Hong Kong Polytechnic University), Marie-Paule Cani (LIX, École polytechnique), and Yui-Lam Chan (The Hong Kong Polytechnic University)
NH-HAZE: An Image Dehazing Benchmark with Non-homogeneous Hazy and Haze-Free Images 1798

Codruta O. Ancuti (Universitatea Politehnica Timisoara, Romania), Cosmin Ancuti (Universitatea Politehnica Timisoara, Romania; Institute of Informatics and Applications, University of Girona, Spain), and Radu Timofte (ETH Zurich, Switzerland)

NTIRE 2020 Challenge on Spectral Reconstruction from an RGB Image .1.806 Boaz Arad (Ben-Gurion University of the Negev, Israel; Voyage81), Radu Timofte (Computer Vision Lab, ETH Zurich, Switzerland), Ohad Ben-Shahar (Ben-Gurion University of the Negev, Israel), Yi-Tun Lin (University of East Anglia, UK), Graham D. Finlayson (University of East Anglia, UK), and Shai Givati (Ben-Gurion University of the Negev, Israel)
Real Image Denoising Based on Multi-scale Residual Dense Block and Cascaded U-Net With Block-Connection .1.823 Long Bao (SOC R&D, Samsung Semiconductor, Inc.), Zengli Yang (SOC R&D, Samsung Semiconductor, Inc.), Shuangquan Wang (SOC R&D, Samsung Semiconductor, Inc.), Dongwoon Bai (SOC R&D, Samsung Semiconductor, Inc.), and Jungwon Lee (SOC R&D, Samsung Semiconductor, Inc.)
Ensemble Dehazing Networks for Non-homogeneous Haze <u>1.8.32</u> Mingzhao Yu (The Pennsylvania State University, USA), Venkateswararao Cherukuri (The Pennsylvania State University, USA), Tiantong Guo (The Pennsylvania State University, USA), and Vishal Monga (The Pennsylvania State University, USA)
NonLocal Channel Attention for NonHomogeneous Image Dehazing .1.842 Kareem Metwaly (Pennsylvania State University, USA), Xuelu Li (Pennsylvania State University, USA), Tiantong Guo (Pennsylvania State University, USA), and Vishal Monga (Pennsylvania State University, USA)
Residual Channel Attention Generative Adversarial Network for Image Super-Resolution and Noise Reduction <u>1852</u> <i>Jie Cai (InnoPeak Technology, Palo Alto, CA, USA), Zibo Meng (InnoPeak Technology, Palo Alto, CA, USA), and Chiu Man Ho (InnoPeak Technology, Palo Alto, CA, USA)</i>
Unsupervised Real-World Super Resolution with Cycle Generative Adversarial Network and Domain Discriminator .1.862 <i>Gwantae Kim (Korea University, Seoul, Korea), Jaihyun Park (Korea University, Seoul, Korea), Kanghyu Lee (Korea University, Seoul, Korea), Junyeop Lee (Korea University, Seoul, Korea), Jeongki Min (Korea University, Seoul, Korea), Bokyeung Lee (Korea University, Seoul, Korea), David K. Han (Army Research Laboratory, Adelphi, MD, USA), and Hanseok Ko (Korea University, Seoul, Korea)</i>
High-Resolution Dual-Stage Multi-level Feature Aggregation for Single Image and Video Deblurring .1872 Stephan Brehm (University of Augsburg, Germany), Sebastian Scherer (University of Augsburg, Germany), and Rainer Lienhart (University of Augsburg, Germany)
NTIRE 2020 Challenge on Image Demoireing: Methods and Results .1.882 Shanxin Yuan (Huawei Noah's Ark Lab), Radu Timofte (ETH Zürich, Switzerland), Aleš Leonardis (Huawei Noah's Ark Lab), and Gregory Slabaugh (Huawei Noah's Ark Lab)

Adaptive Weighted Attention Network with Camera Spectral Sensitivity Prior for Spectral Reconstruction from RGB Images .1.8.9.4 Jiaojiao Li (Xidian University, China), Chaoxiong Wu (Xidian University, China), Rui Song (Xidian University, China), Yunsong Li (Xidian University, China), and Fei Liu (Xidian University, China)
Unsupervised Single Image Super-Resolution Network (USISResNet) for Real-World Data Using Generative Adversarial Network .1.904 Kalpesh Prajapati (Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India), Vishal Chudasama (Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India), Heena Patel (Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India), Kishor Upla (Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India; Norwegian University of Science and Technology (NTNU), Gjøvik, Norway), Raghavendra Ramachandra (Norwegian University of Science and Technology (NTNU), Gjøvik, Norway), Kiran Raja (Norwegian University of Science and Technology (NTNU), Gjøvik, Norway), and Christoph Busch (Norwegian University of Science and Technology (NTNU), Gjøvik, Norway)
Real-World Super-Resolution via Kernel Estimation and Noise Injection .1.9.1.4 Xiaozhong Ji (Nanjing University; Tencent Youtu Lab), Yun Cao (Tencent Youtu Lab), Ying Tai (Tencent Youtu Lab), Chengjie Wang (Tencent Youtu Lab), Jilin Li (Tencent Youtu Lab), and Feiyue Huang (Tencent Youtu Lab)
Unsupervised Image Super-Resolution with an Indirect Supervised Path .1.924 Shuaijun Chen (Huawei Noah's Ark Lab), Zhen Han (Huawei Noah's Ark Lab; Renmin University of China), Enyan Dai (Huawei Noah's Ark Lab), Xu Jia (Huawei Noah's Ark Lab), Ziluan Liu (Huawei Consumer Business Group), Liu Xing (Huawei Consumer Business Group), Xueyi Zou (Huawei Noah's Ark Lab), Chunjing Xu (Huawei Noah's Ark Lab), Jianzhuang Liu (Huawei Noah's Ark Lab), and Qi Tian (Huawei Noah's Ark Lab)
Dual-Domain Deep Convolutional Neural Networks for Image Demoireing .1.934 An Gia Vien (Dongguk University, Seoul, Korea), Hyunkook Park (Dongguk University, Seoul, Korea), and Chul Lee (Dongguk University, Seoul, Korea)
Moiré Pattern Removal via Attentive Fractal Network <u>.1.943</u> Dejia Xu (Peking University), Yihao Chu (Beijing University of Posts and Telecommunications), and Qingyan Sun (Beijing Jiaotong University)
SimUSR: A Simple but Strong Baseline for Unsupervised Image Super-Resolution <u>.1.953</u> Namhyuk Ahn (Ajou University), Jaejun Yoo (EPFL), and Kyung-Ah Sohn (Ajou University)
NTIRE 2020 Challenge on Video Quality Mapping: Methods and Results .1.962 Dario Fuoli (ETH Zurich, Switzerland), Zhiwu Huang (ETH Zurich, Switzerland), Martin Danelljan (ETH Zurich, Switzerland), and Radu Timofte (ETH Zurich, Switzerland)

- Knowledge Transfer Dehazing Network for NonHomogeneous Dehazing .1975..... Haiyan Wu (East China Normal University, Shanghai, China), Jing Liu (East China Normal University, Shanghai, China), Yuan Xie (East China Normal University, Shanghai, China), Yanyun Qu (Xiamen University, Fujian, China), and Lizhuang Ma (East China Normal University, Shanghai, China) RGB to Spectral Reconstruction via Learned Basis Functions and Weights .1.984..... Biebele Joslyn Fubara (Staffordshire University, Stoke-on-Trent, UK), Mohamed Sedky (Staffordshire University, Stoke-on-Trent, UK), and David Dyke (Staffordshire University, Stoke-on-Trent, UK) Fast Deep Multi-patch Hierarchical Network for Nonhomogeneous Image Dehazing .1.994.... Sourya Dipta Das (Jadavpur University, Kolkata, India) and Saikat Dutta (IIT Madras, Chennai, India) Superkernel Neural Architecture Search for Image Denoising .2002..... Marcin Mozejko (TCL Research Europe), Tomasz Latkowski (TCL Research Europe), Lukasz Treszczotko (TCL Research Europe), Michal Szafraniuk (TCL Research Europe), and Krzysztof Trojanowski (TCL Research Europe) Residual Pixel Attention Network for Spectral Reconstruction from RGB Images .2012..... Hao Peng (Beijing Institute of Technology, China), Xiaomei Chen (Beijing Institute of Technology, China), and Jie Zhao (Beijing Institute of Technology, China) FBRNN: Feedback Recurrent Neural Network for Extreme Image Super-Resolution .2021..... Junyeop Lee (Korea University, Seoul, Korea), Jaihyun Park (Korea University, Seoul, Korea), Kanghyu Lee (Korea University, Seoul, Korea), Jeongki Min (Korea University, Seoul, Korea), Gwantae Kim (Korea University, Seoul, Korea), Bokyeung Lee (Korea University, Seoul, Korea), Bonhwa Ku (Korea University, Seoul, Korea), David K. Han (Army Research Laboratory, Adelphi, MD, USA), and Hanseok Ko (Korea University, Seoul, Korea) NTIRE 2020 Challenge on NonHomogeneous Dehazing .2029..... Codruta O. Ancuti (University Politehnica of Timisoara, Romania), Cosmin Ancuti (University Politehnica of Timisoara, Romania; University of Girona, Spain), Florin-Alexandru Vasluianu (Computer Vision Lab, ETH Zurich, Switzerland), and Radu Timofte (Computer Vision Lab, ETH Zurich, Switzerland) NTIRE 2020 Challenge on Perceptual Extreme Super-Resolution: Methods and Results .2045. Kai Zhang (Computer Vision Lab, ETH Zurich, Switzerland), Shuhang Gu (Computer Vision Lab, ETH Zurich, Switzerland), and Radu Timofte (Computer Vision Lab, ETH Zurich, Switzerland) NTIRE 2020 Challenge on Real-World Image Super-Resolution: Methods and Results .2058.... Andreas Lugmayr (Computer Vision Lab, ETH Zurich), Martin Danelljan (Computer Vision Lab, ETH Zurich), and Radu Timofte (Computer Vision Lab, ETH Zurich) NTIRE 2020 Challenge on Real Image Denoising: Dataset, Methods and Results .2077..... Abdelrahman Abdelhamed (York University, Canada), Mahmoud Afifi (York
 - University, Canada), Radu Timofte (ETH Zurich, Switzerland), and Michael S. Brown (York University, Canada)

DA-cGAN: A Framework for Indoor Radio Design Using a Dimension-Aware Conditional Generative Adversarial Network .2089 Chun-Hao Liu (Global Al Accelerator (GAIA), Ericsson Inc.), Hun Chang (Global Al Accelerator (GAIA), Ericsson Inc.), and Taesuh Park (Global Al Accelerator (GAIA), Ericsson Inc.)
Joint Learning of Blind Video Denoising and Optical Flow Estimation .2099 Songhyun Yu (Hanyang University), Bumjun Park (Hanyang University), Junwoo Park (Korea Advanced Institute of Science and Technology), and Jechang Jeong (Hanyang University)
Deploying Image Deblurring Across Mobile Devices: A Perspective of Quality and Latency .2109 <i>Cheng-Ming Chiang (MediaTek Inc., Hsinchu, Taiwan), Yu Tseng (MediaTek</i> <i>Inc., Hsinchu, Taiwan), Yu-Syuan Xu (MediaTek Inc., Hsinchu, Taiwan),</i> <i>Hsien-Kai Kuo (MediaTek Inc., Hsinchu, Taiwan), Yi-Min Tsai (MediaTek</i> <i>Inc., Hsinchu, Taiwan), Guan-Yu Chen (MediaTek Inc., Hsinchu, Taiwan),</i> <i>Koan-Sin Tan (MediaTek Inc., Hsinchu, Taiwan), Wei-Ting Wang (MediaTek</i> <i>Inc., Hsinchu, Taiwan), Yu-Chieh Lin (MediaTek Inc., Hsinchu, Taiwan),</i> <i>Shou-Yao Roy Tseng (MediaTek Inc., Hsinchu, Taiwan), Wei-Shiang Lin</i> <i>(MediaTek Inc., Hsinchu, Taiwan), Chia-Lin Yu (MediaTek Inc., Hsinchu, Taiwan), BY Shen, Kloze Kao (MediaTek Inc., Hsinchu, Taiwan),</i> <i>Chia-Ming Cheng (MediaTek Inc., Hsinchu, Taiwan), and Hung-Jen Chen</i> <i>(MediaTek Inc., Hsinchu, Taiwan)</i>
MSFSR: A Multi-stage Face Super-Resolution with Accurate Facial Representation via Enhanced Facial Boundaries .2120 Yunchen Zhang (Fujian Normal University), Yi Wu (Fujian Normal University), and Liang Chen (Fujian Normal University)
Color-Wise Attention Network for Low-Light Image Enhancement .2130 Yousef Atoum (Yarmouk University), Mao Ye (BOSCH Research North America), Liu Ren (BOSCH Research North America), Ying Tai (Tencent YouTu), and Xiaoming Liu (Michigan State University)
GradNet Image Denoising .2140 Yang Liu (Australian National University; Data61-CSIRO), Saeed Anwar (Australian National University; Data61-CSIRO), Liang Zheng (Australian National University), and Qi Tian (Huawei Noah's Ark Lab)
Photosequencing of Motion Blur Using Short and Long Exposures .2150 Vijay Rengarajan (Carnegie Mellon University), Shuo Zhao (Carnegie Mellon University), Ruiwen Zhen (Samsung Research America), John Glotzbach (Samsung Research America), Hamid Sheikh (Samsung Research America), and Aswin C. Sankaranarayanan (Carnegie Mellon University)
Multi-step Reinforcement Learning for Single Image Super-Resolution .2160 Kyle Vassilo (University of Dayton, Dayton, OH), Cory Heatwole (University of Dayton, Dayton, OH), Tarek Taha (University of Dayton, Dayton, OH), and Asif Mehmood (Air Force Research Laboratory, Wright-Patterson AFB, OH)
A Review of an Old Dilemma: Demosaicking First, or Denoising First? .2169 Qiyu Jin (School of mathematical science, Inner Mongolia University), Gabriele Facciolo (Centre Borelli, ENS Paris-Saclay, CNRS), and Jean-Michel Morel (Centre Borelli, ENS Paris-Saclay, CNRS)

Sensor-Realistic Synthetic Data Engine for Multi-frame High Dynamic Range Photography .2180 Jinhan Hu (Arizona State University), Gyeongmin Choe (Samsung Research America), Zeeshan Nadir (Samsung Research America), Osama Nabil (UCLA), Seok-Jun Lee (Samsung Research America), Hamid Sheikh (Samsung Research America), Youngjun Yoo (Samsung Research America), and Michael Polley (Samsung Research America)
ImagePairs: Realistic Super Resolution Dataset via Beam Splitter Camera Rig .21.90 Hamid Reza Vaezi Joze (Microsoft), Ilya Zharkov (Microsoft), Karlton Powell (Microsoft), Carl Ringler (Microsoft), Luming Liang (Microsoft), Andy Roulston (Microsoft), Moshe Lutz (Microsoft), and Vivek Pradeep (Microsoft)
Identity Enhanced Residual Image Denoising .2201 Saeed Anwar (Data61-CSIRO; The Australian Natinal University), Cong Phuoc Huynh (The Australian Natinal University), and Fatih Porikli (The Australian Natinal University)
Structure Preserving Compressive Sensing MRI Reconstruction Using Generative Adversarial Networks .2211 Puneesh Deora (IIT Roorkee, Uttarakhand, India), Bhavya Vasudeva (IIT Roorkee, Uttarakhand, India), Saumik Bhattacharya (IIT Kharagpur, West Bengal, India), and Pyari Mohan Pradhan (IIT Roorkee, Uttarakhand, India)
LIDIA: Lightweight Learned Image Denoising with Instance Adaptation .2220 Gregory Vaksman (The Technion), Michael Elad (Google Research), and Peyman Milanfar (Google Research)
Sky Optimization: Semantically Aware Image Processing of Skies in Low-Light Photography .2230 Orly Liba (Google Research), Longqi Cai (Google Research), Yun-Ta Tsai (Google Research), Elad Eban (Google Research), Yair Movshovitz-Attias (Google Research), Yael Pritch (Google Research), Huizhong Chen (Google Research), and Jonathan T. Barron (Google Research)
Fast and Flexible Image Blind Denoising via Competition of Experts .2239 Shunta Maeda (Navier Inc.)
 FabSoften: Face Beautification via Dynamic Skin Smoothing, Guided Feathering, and Texture Restoration .2248 Sudha Velusamy (Samsung R&D Institute, Bangalore, India), Rishubh Parihar (Samsung R&D Institute, Bangalore, India), Raviprasad Kini (Samsung R&D Institute, Bangalore, India), and Aniket Rege (Samsung R&D Institute, Bangalore, India)
Physically Plausible Spectral Reconstruction from RGB Images .2257 Yi-Tun Lin (University of East Anglia, UK) and Graham D. Finlayson (University of East Anglia, UK)
Semantic Pixel Distances for Image Editing .2267. Josh Myers-Dean (Western Washington University, Bellingham, WA) and Scott Wehrwein (Western Washington University, Bellingham, WA)
Replacing Mobile Camera ISP with a Single Deep Learning Model .2275 Andrey Ignatov (ETH Zurich, Switzerland), Luc Van Gool (ETH Zurich, Switzerland), and Radu Timofte (ETH Zurich, Switzerland)

L2UWE: A Framework for the Efficient Enhancement of Low-Light Underwater Images Using Local Contrast and Multi-scale Fusion .2286..... *Tunai Porto Marques (University of Victoria, British Columbia, Canada) and Alexandra Branzan Albu (University of Victoria, British Columbia, Canada) Canada)*

WTDDLE: Text and Documents in the Deep Learning Era

A Method for Detecting Text of Arbitrary Shapes in Natural Scenes that Improves Text Spotting .2296. Qitong Wang (Boston University), Yi Zheng (Boston University), and Margrit Betke (Boston University) Textual Visual Semantic Dataset for Text Spotting .2306..... Ahmed Sabir (Universitat Politècnica de Catalunya, TALP Research Center, Barcelona, Spain), Francesc Moreno-Noguer (Institut de Robòtica i Informàtica Industrial, CSIC-UPC, Barcelona, Spain), and Lluís Padró (Universitat Politècnica de Catalunya, TALP Research Center, Barcelona, Spain) READ: Recursive Autoencoders for Document Layout Generation .23.16..... Akshay Gadi Patil (Simon Fraser University), Omri Ben-Eliezer (Tel-Aviv University), Or Perel (Amazon), and Hadar Averbuch-Elor (Cornell Tech, Cornell University) On Recognizing Texts of Arbitrary Shapes with 2D Self-Attention .2326..... Junyeop Lee (Clova Al Research, NAVER/LINE Corp), Sungrae Park (Clova AI Research, NAVER/LINE Corp), Jeonghun Baek (Clova AI Research, NAVER/LINE Corp), Seong Joon Oh (Clova AI Research, NAVER/LINE Corp), Seonghyeon Kim (Clova AI Research, NAVER/LINE Corp), and Hwalsuk Lee (Clova AI Research, NAVER/LINE Corp) A Large Dataset of Historical Japanese Documents with Complex Layouts .2336..... Zejiang Shen (Harvard University), Kaixuan Zhang (Harvard University), and Melissa Dell (Harvard University) An Accurate Segmentation-Based Scene Text Detector with Context Attention and Repulsive Text Border .2344..... Xi Liu (Meituan-Dianping Group, Beijing, China), Gaojing Zhou (Meituan-Dianping Group, Beijing, China), Rui Zhang (Meituan-Dianping Group, Beijing, China), and Xiaolin Wei (Meituan-Dianping Group, Beijing, China) Illegible Text to Readable Text: An Image-to-Image Transformation Using Conditional Sliced Wasserstein Adversarial Networks .2353..... Mostafa Karimi (Texas A&M University), Gopalkrishna Veni (Ancestry.com), and Yen-Yun Yu (Ancestry.com)

Optical Braille Recognition Based on Semantic Segmentation Network with Auxiliary Learning

Strategy .2362 Renqiang Li (Beijing Key Laboratory of Mobile Computing and Pervasive Device, Institute of Computing Technology, Chinese Academy of Sciences), Hong Liu (Beijing Key Laboratory of Mobile Computing and Pervasive Device, Institute of Computing Technology, Chinese Academy of Sciences), Xiangdong Wang (Beijing Key Laboratory of Mobile Computing and Pervasive Device, Institute of Computing Technology, Chinese Academy of Sciences), Jianxing Xu (Northwestern Polytechnical University), and Yueliang Qian (Beijing Key Laboratory of Mobile Computing and Pervasive Device, Institute of Computing Technology, Chinese Academy of Sciences), Jianxing Key Laboratory of Mobile
Font-ProtoNet: Prototypical Network-Based Font Identification of Document Images in Low Data Regime .2369 Nikita Goel (TCS Research, New Delhi, India), Monika Sharma (TCS Research, New Delhi, India), and Lovekesh Vig (TCS Research, New Delhi, India)
Information Extraction from Document Images via FCA-Based Template Detection and Knowledge Graph Rule Induction .2.3.7 <i>Mouli Rastogi (TCS Research, New Delhi), Syed Afshan Ali (TCS Research, New Delhi), Mrinal Rawat (TCS Research, New Delhi), Lovekesh Vig (TCS Research, New Delhi), Puneet Agarwal (TCS Research, New Delhi), Gautam Shroff (TCS Research, New Delhi), and Ashwin Srinivasan (BITS Pilani, Goa Campus)</i>
An OCR for Classical Indic Documents Containing Arbitrarily Long Words .2386 Agam Dwivedi (International Institute of Information Technology, Hyderabad (IIIT-H), India), Rohit Saluja (International Institute of Information Technology, Hyderabad (IIIT-H), India), and Ravi Kiran Sarvadevabhatla (International Institute of Information Technology, Hyderabad (IIIT-H), India)
Visual and Textual Deep Feature Fusion for Document Image Classification .2394 Souhail Bakkali (L3i, University of La Rochelle, France), Zuheng Ming (L3i, University of La Rochelle, France), Mickaël Coustaty (L3i, University of La Rochelle, France), and Marçal Rusiñol (CVC, Universitat Autònoma de Barcelona, Spain)
CLEval: Character-Level Evaluation for Text Detection and Recognition Tasks .2404 Youngmin Baek (Clova AI Research, NAVER Corp.), Daehyun Nam (Clova AI Research, NAVER Corp.), Sungrae Park (Clova AI Research, NAVER Corp.), Junyeop Lee (Clova AI Research, NAVER Corp.), Seung Shin (Clova AI Research, NAVER Corp.), Jeonghun Baek (Clova AI Research, NAVER Corp.), Chae Young Lee (Yale University), and Hwalsuk Lee (Clova AI Research, NAVER Corp.)
Recognizing Handwritten Mathematical Expressions via Paired Dual Loss Attention Network and Printed Mathematical Expressions .2413

Anh Duc Le (The center for Open Data in Humanities, Tokyo, Japan)

Symbol Spotting on Digital Architectural Floor Plans Using a Deep Learning-Based Framework...... 2419

Alireza Rezvanifar (University of Victoria, British Columbia, Canada), Melissa Cote (University of Victoria, British Columbia, Canada), and Alexandra Branzan Albu (University of Victoria, British Columbia, Canada)

Visual Parsing with Query-Driven Global Graph Attention (QD-GGA): Preliminary Results for Handwritten Math Formula Recognition .2429.

Mahshad Mahdavi (Rochester Institute of Technology, NY) and Richard Zanibbi (Rochester Institute of Technology, NY)

CascadeTabNet: An Approach for End to End Table Detection and Structure Recognition From

Image-Based Documents 2439

Devashish Prasad (Pune Institute of Computer Technology, India), Ayan Gadpal (Pune Institute of Computer Technology, India), Kshitij Kapadni (Pune Institute of Computer Technology, India), Manish Visave (Pune Institute of Computer Technology, India), and Kavita Sultanpure (Pune Institute of Computer Technology, India)

AI-City: AI City Challenge

Viewpoint-Aware Channel-Wise Attentive Network for Vehicle Re-Identification .2448..... Tsai-Shien Chen (NTU IoX Center, National Taiwan University; Graduate Institute of Electronic Engineering, National Taiwan University), Man-Yu Lee (NTU IoX Center, National Taiwan University; Graduate Institute of Electronic Engineering, National Taiwan University), Chih-Ting Liu (NTU IoX Center, National Taiwan University; Graduate Institute of Electronic Engineering, National Taiwan University), and Shao-Yi Chien (NTU IoX Center, National Taiwan University; Graduate Institute of Electronic Engineering, National Taiwan University) City-Scale Multi-camera Vehicle Tracking by Semantic Attribute Parsing and Cross-Camera Tracklet Matching 2456.... Yuhang He (Xi'an Jiaotong University), Jie Han (Xi'an Jiaotong University), Wentao Yu (Xi'an Jiaotong University), Xiaopeng Hong (Xi'an Jiaotong University), Xing Wei (Xi'an Jiaotong University), and Yihong Gong (Xi'an Jiaotong University) A Vehicle Counts by Class Framework Using Distinguished Regions Tracking at Multiple Intersections .2466..... Nam Bui (Korea Institute of Science and Technology Information, Korea), Hongsuk Yi (Korea Institute of Science and Technology Information, Korea), and Jiho Cho (Korea Institute of Science and Technology Information, Korea) Dual Embedding Expansion for Vehicle Re-Identification .2475..... Clint Sebastian (VCA Group, Eindhoven University of Technology; Cyclomedia B.V), Raffaele Imbriaco (VCA Group, Eindhoven University of Technology), Egor Bondarev (VCA Group, Eindhoven University of Technology), and Peter H. N. de With (VCA Group, Eindhoven University of Technology; Cyclomedia B.V)

Multi-domain Learning and Identity Mining for Vehicle Re-Identification .2485..... Shuting He (Zhejiang University; Alibaba Group), Hao Luo (Zhejiang University; Alibaba Group), Weihua Chen (Alibaba Group), Miao Zhang (Zhejiang University), Yuqi Zhang (Alibaba Group), Fan Wang (Alibaba Group), Hao Li (Alibaba Group), and Wei Jiang (Zhejiang University) Further Non-Local and Channel Attention Networks for Vehicle Re-Identification .2494..... Kai Liu (Beijing University of Posts and Telecommunications, Beijing, China; Beijing Key Laboratory of Network System and Network Culture, Beijing, China), Zheng Xu (Beijing University of Posts and Telecommunications, Beijing, China; Beijing Key Laboratory of Network System and Network Culture, Beijing, China), Zhaohui Hou (Beijing University of Posts and Telecommunications, Beijing, China: Beijing Key Laboratory of Network System and Network Culture, Beijing, China), Zhicheng Zhao (Beijing University of Posts and Telecommunications, *Beijing, China; Beijing Key Laboratory of Network System and Network* Culture, Beijing, China), and Fei Su (Beijing University of Posts and Telecommunications, Beijing, China; Beijing Key Laboratory of Network System and Network Culture, Beijing, China) Multi-granularity Tracking with Modularlized Components for Unsupervised Vehicles Anomaly Detection .2501..... Yingying Li (Baidu Inc.), Jie Wu (Sun Yat-sen University), Xue Bai (Baidu Inc.), Xipeng Yang (Baidu Inc.), Xiao Tan (Baidu Inc.), Guanbin Li (Sun Yat-sen University), Shilei Wen (Baidu Inc.), Hongwu Zhang (Baidu Inc.), and Errui Ding (Baidu Inc.) ELECTRICITY: An Efficient Multi-camera Vehicle Tracking System for Intelligent City .2511..... Yijun Qian (Language Technologies Institute, Carnegie Mellon University), Lijun Yu (Language Technologies Institute, Carnegie Mellon University), Wenhe Liu (Language Technologies Institute, Carnegie Mellon University), and Alexander G. Hauptmann (Language Technologies Institute, Carnegie Mellon University) Vehicle Re-Identification Based on Complementary Features .2520..... Cunyuan Gao (China University of Mining and Technology, China), Yi Hu (China University of Mining and Technology, China), Yi Zhang (China University of Mining and Technology, China), Rui Yao (China University of Mining and Technology, China), Yong Zhou (China University of Mining and Technology, China), and Jiaqi Zhao (China University of Mining and Technology, China) Towards Real-Time Traffic Movement Count and Trajectory Reconstruction Using Virtual Traffic Lanes .2527..... Awad Abdelhalim (Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA) and Montasir Abbas (Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA) Zero-VIRUS: Zero-Shot Vehicle Route Understanding System for Intelligent Transportation .2534 Lijun Yu (Language Technologies Institute, Carnegie Mellon University), Qianyu Feng (Language Technologies Institute, Carnegie Mellon University; University of Technology Sydney), Yijun Qian (Language Technologies Institute, Carnegie Mellon University), Wenhe Liu (Language Technologies Institute, Carnegie Mellon University), and Alexander G. Hauptmann (Language Technologies Institute, Carnegie Mellon University)

Determining Vehicle Turn Counts at Multiple Intersections by Separated Vehicle Classes Using CNNs .2544..... Ján Folenta (Graph@FIT, Brno University of Technology, Czech Republic), Jakub Španhel (Graph@FIT, Brno University of Technology, Czech Republic), Vojtech Bartl (Graph@FIT, Brno University of Technology, Czech Republic), and Adam Herout (Graph@FIT, Brno University of Technology, Czech Republic) Going Beyond Real Data: A Robust Visual Representation for Vehicle Re-Identification .2550. Zhedong Zheng (Baidu Inc.; University of Technology Sydney), Minyue Jiang (Baidu Inc.), Zhigang Wang (Baidu Inc.), Jian Wang (Baidu Inc.), Zechen Bai (Baidu Inc.), Xuanmeng Zhang (Baidu Inc.; Zhejiang University), Xin Yu (University of Technology Sydney), Xiao Tan (Baidu Inc.), Yi Yang (University of Technology Sydney), Shilei Wen (Baidu Inc.), and Errui Ding (Baidu Inc.) Countor: Count Without Bells and Whistles .2559..... Andres Ospina (CSAI Engie, France) and Felipe Torres (Universidad de los Andes, Colombia) VOC-ReID: Vehicle Re-Identification Based on Vehicle-Orientation-Camera .2566..... Xiangyu Zhu (RuiYan Technology), Zhenbo Luo (RuiYan Technology), Pei *Fu (RuiYan Technology), and Xiang Ji (RuiYan Technology)* Vehicle Re-Identification in Multi-camera Scenarios Based on Ensembling Deep Learning Features 2574 Paula Moral (Video Processing and Understanding Lab, Universidad Autónoma de Madrid, Madrid, Spain), Álvaro García-Martín (Video Processing and Understanding Lab, Universidad Autónoma de Madrid, Madrid, Spain), and José M. Martínez (Video Processing and Understanding Lab, Universidad Autónoma de Madrid, Madrid, Spain) Fractional Data Distillation Model for Anomaly Detection in Traffic Videos .2581..... Linu Shine (College of Engineering Trivandrum, Kerala, India), Vaishnav M A (College of Engineering Trivandrum, Kerala, India), and Jiji C.V. (College of Engineering Trivandrum, Kerala, India) StRDAN: Synthetic-to-Real Domain Adaptation Network for Vehicle Re-Identification .2590.... Sangrok Lee (MODULABS), Eunsoo Park (MODULABS), Hongsuk Yi (Korea Institute of Science and Technology Information), and Sang Hun Lee (Kookmin University) Robust and Fast Vehicle Turn-Counts at Intersections via an Integrated Solution From Detection, Tracking and Trajectory Modeling .2598..... Zhihui Wang (Didi Chuxing), Bing Bai (Didi Chuxing), Yujun Xie (Didi Chuxing), Tengfei Xing (Didi Chuxing), Bineng Zhong (Huaqiao University), Qingin Zhou (Huggigo University), Yiping Meng (Didi Chuxing), Bin Xu (Didi Chuxing), Zhichao Song (Didi Chuxing), Pengfei Xu (Didi Chuxing), Runbo Hu (Didi Chuxing), and Hua Chai (Didi

Chuxing)

iTASK – Intelligent Traffic Analysis Software Kit .2607..... Minh-Triet Tran (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam; John von Neumann Institute, Ho Chi Minh City, Vietnam), Tam V. Nguyen (University of Dayton, U.S.), Trung-Hieu Hoang (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Trung-Nghia Le (National Institute of Informatics, Japan), Khac-Tuan Nguyen (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Dat-Thanh Dinh (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Thanh-An Nguyen (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Hai-Dang Nguyen (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Xuan-Nhat Hoang (University of Science, Ho Chi Minh City, Vietnam: Vietnam National University, Ho Chi Minh City, Vietnam), Trong-Tung Nguyen (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Viet-Khoa Vo-Ho (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Trong-Le Do (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Lam Nguyen, Minh-Quan Le (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Hoang-Phuc Nguyen-Dinh (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Trong-Thang Pham (Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Xuan-Vy Nguyen (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), E-Ro Nguyen (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Quoc-Cuong Tran (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Hung Tran (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Hieu Dao (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Mai-Khiem Tran (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), *Quang-Thuc Nguyen (University of Science, Ho Chi Minh City, Vietnam;* Vietnam National University, Ho Chi Minh City, Vietnam), Tien-Phat Nguyen (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), The-Anh Vu-Le (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), Gia-Han Diep (University of Science, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam), and Minh N. Do (University of Illinois at Urbana-Champaign)

Robust Movement-Specific Vehicle Counting at Crowded Intersections .26.1.7..... Zhongji Liu (Baidu Inc.), Wei Zhang (Baidu Inc.), Xu Gao (Baidu Inc.), Hao Meng (Baidu Inc.), Xiao Tan (Baidu Inc.), Xiaoxing Zhu (Baidu Inc.), Zhan Xue (Baidu Inc.), Xiaoqing Ye (Baidu Inc.), Hongwu Zhang (Baidu Inc.), Shilei Wen (Baidu Inc.), and Errui Ding (Baidu Inc.) Temporal Attention .2626.....
 Viktor Eckstein (Fraunhofer IOSB, Karlsruhe, Germany; Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany), Arne Schumann (Fraunhofer IOSB, Karlsruhe, Germany; Fraunhofer Center for Machine Learning), and Andreas Specker (Fraunhofer IOSB, Karlsruhe, Germany; Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany)
 Attribute-Guided Feature Extraction and Augmentation Robust Learning for Vehicle Re-Identification .2632.... Chaoran Zhuge (University of Science and Technology of China), Yujie Peng (School of Computer Science and Engineering, Beihang university),

Large Scale Vehicle Re-Identification by Knowledge Transfer From Simulated Data and

- Yadong Li (School of Computer Science and Engineering, Beihang university), Jiangbo Ai (University of Electronic Science and Technology of China), and Junru Chen (Xidian University)
- Al City Challenge 2020 Computer Vision for Smart Transportation Applications .2638...... Ming-Ching Chang (University at Albany – SUNY, NY, USA), Chen-Kuo Chiang (National Chung Cheng University, Taiwan), Chun-Ming Tsai (University of Taipei, Taiwan), Yun-Kai Chang (National Chung Cheng University, Taiwan), Hsuan-Lun Chiang (National Chung Cheng University, Taiwan), Yu-An Wang (National Chung Cheng University, Taiwan), Shih-Ya Chang (National Chung Cheng University, Taiwan), Shih-Ya Chang (National Chung Cheng University, Yun-Lun Li (National Chung Cheng University, Taiwan), Ming-Shuin Tsai (National Chung Cheng University, Taiwan), and Hung-Yu Tseng (National Chung Cheng University, Taiwan)

Towards Real-Time Systems for Vehicle Re-Identification, Multi-camera Tracking, and Anomaly Detection .2648.....

Neehar Peri (Center for Automation Research, UMIACS, University of Maryland, College Park), Pirazh Khorramshahi (Center for Automation Research, UMIACS, University of Maryland, College Park), Sai Saketh Rambhatla (Center for Automation Research, UMIACS, University of Maryland, College Park), Vineet Shenoy (Center for Automation Research, UMIACS, University of Maryland, College Park), Saumya Rawat (Center for Automation Research, UMIACS, University of Maryland, College Park), Jun-Cheng Chen (Research Center for Information Technology Innovation, Academia Sinica), and Rama Chellappa (Center for Automation Research, UMIACS, University of Maryland, College Park)

Fast Unsupervised Anomaly Detection in Traffic Videos .2658..... Keval Doshi (University of South Florida) and Yasin Yilmaz (University of South Florida)

The 4th AI City Challenge .2665..... Milind Naphade (NVIDIA Corporation, CA, USA), Shuo Wang (NVIDIA Corporation, CA, USA), David C. Anastasiu (Santa Clara University, CA, USA), Zheng Tang (Amazon, WA, USA), Ming-Ching Chang (University at Albany, SUNY, NY, USA), Xiaodong Yang (QCraft, CA, USA), Liang Zheng (Australian National University, Australia), Anuj Sharma (Iowa State University, IA, USA), Rama Chellappa (University at Maryland, College Park, MD, USA), and Pranamesh Chakraborty (Indian Institute of Technology Kanpur, India)

OmniCV: Omnidirectional Computer Vision in Research and Industry

Toward Real-World Panoramic Image Enhancement .2675 Yupeng Zhang (Ricoh Software Research Center (Beijing) Co., Ltd. Haidian District, Beijing, China), Hengzhi Zhang (Ricoh Software Research Center (Beijing) Co., Ltd. Haidian District, Beijing, China), Daojing Li (Ricoh Software Research Center (Beijing) Co., Ltd. Haidian District, Beijing, China), Liyan Liu (Ricoh Software Research Center (Beijing) Co., Ltd. Haidian District, Beijing, China), Hong Yi (Ricoh Software Research Center (Beijing) Co., Ltd. Haidian District, Beijing, China), Wei Wang (Ricoh Software Research Center (Beijing) Co., Ltd. Haidian District, Beijing, China), Hiroshi Suitoh (Ricoh Company, Ltd. Tokyo, Japan), and Makoto Odamaki (Ricoh Company, Ltd. Tokyo, Japan)
A Deep Physical Model for Solar Irradiance Forecasting with Fisheye Images .2685 Vincent Le Guen (EDF R&D, Chatou, France; CEDRIC, Conservatoire National des Arts et Métiers, Paris, France) and Nicolas Thome (CEDRIC, Conservatoire National des Arts et Métiers, Paris, France)
Upright and Stabilized Omnidirectional Depth Estimation for Wide-Baseline Multi-camera Inertial Systems .2689 Changhee Won (MultiplEYE Co., Ltd, Seoul, Korea; Department of Computer Science, Hanyang University, Seoul, Korea), Hochang Seok (Department of Computer Science, Hanyang University, Seoul, Korea), and Jongwoo Lim (MultiplEYE Co., Ltd., Seoul, Korea; Department of Computer Science, Hanyang University, Seoul, Korea)
 ArUcOmni: Detection of Highly Reliable Fiducial Markers in Panoramic Images .26.93 Jaouad Hajjami (Forssea Robotics, Paris, France; L@bISEN, Vision-AD team, Brest, France), Jordan Caracotte (UPJV, MIS lab, Amiens, France), Guillaume Caron (CNRS-AIST JRL, Tsukuba, Japan; UPJV, MIS lab, Amiens, France), and Thibault Napoléon (L@bISEN, Vision-AD team, Brest, France)
RAPiD: Rotation-Aware People Detection in Overhead Fisheye Images .27.00 Zhihao Duan (Boston University), Ozan Tezcan (Boston University), Hayato Nakamura (Boston University), Prakash Ishwar (Boston University), and Janusz Konrad (Boston University)
Unsupervised Learning of Metric Representations with Slow Features from Omnidirectional Views .27.10 Mathias Franzius (Honda Research Institute Europe GmbH, Germany), Benjamin Metka (Frankfurt University of Applied Sciences, Germany), Muhammad Haris (Frankfurt University of Applied Sciences, Germany), and Ute Bauer-Wersing (Frankfurt University of Applied Sciences,

Germany)

Deep Lighting Environment Map Estimation from Spherical Panoramas .27.19..... Vasileios Gkitsas (Information Technologies Institute (ITI), Centre for Research and Technology Hellas (CERTH)), Nikolaos Zioulis (Information Technologies Institute (ITI), Centre for Research and Technology Hellas (CERTH); Signals, Systems and Radiocommunications Department (SSRD), Universidad Polit´ecnica de Madrid (UPM)), Federico Alvarez (Signals, Systems and Radiocommunications Department (SSRD), Universidad Polit´ecnica de Madrid (UPM)), Dimitrios Zarpalas (Information Technologies Institute (ITI), Centre for Research and Technology Hellas (CERTH)), and Petros Daras (Information Technologies Institute (ITI), Centre for Research and Technology Hellas (CERTH))

WMF: Media Forensics

Detecting CNN-Generated Facial Images in Real-World Scenarios .2729 Nils Hulzebosch (University of Amsterdam; Dutch National Police), Sarah Ibrahimi (University of Amsterdam; Dutch National Police), and Marcel Worring (University of Amsterdam)
PipeNet: Selective Modal Pipeline of Fusion Network for Multi-modal Face Anti-Spoofing .2739 Qing Yang (Intel, China), Xia Zhu (Intel, USA), Jong-Kae Fwu (Intel, USA), Yun Ye (Intel, China), Ganmei You (Intel, China), and Yuan Zhu (Intel, China)
The Role of 'Sign' and 'Direction' of Gradient on the Performance of CNN .2748 Akshay Agarwal (IIIT-Delhi, India), Richa Singh (IIT Jodhpur, India), and Mayank Vatsa (IIT Jodhpur, India)
Adversarial Attack on Deep Learning-Based Splice Localization .2757 Andras Rozsa (Verisk Analytics, Jersey City, NJ), Zheng Zhong (Verisk Analytics, Jersey City, NJ), and Terrance E. Boult (UCCS VAST Lab, Colorado Springs, CO)
 Multi-modal Face Anti-Spoofing Based on Central Difference Networks .27.66 Zitong Yu (CMVS, University of Oulu), Yunxiao Qin (Northwestern Polytechnical University), Xiaobai Li (CMVS, University of Oulu), Zezheng Wang (n/a), Chenxu Zhao (Mininglamp Academy of Sciences, Mininglamp Technology), Zhen Lei (Authenmetric), and Guoying Zhao (CMVS, University of Oulu)
Fake News Detection Using Higher-Order User to User Mutual-Attention Progression in Propagation Paths .27.75
Towards Untrusted Social Video Verification to Combat Deepfakes via Face Geometry Consistency .2784 Eleanor Tursman (Brown University), Marilyn George (Brown University), Seny Kamara (Brown University), and James Tompkin (Brown University)
OC-FakeDect: Classifying Deepfakes Using One-Class Variational Autoencoder .27.9.4 Hasam Khalid (Computer Science and Engineering Department, Sungkyunkwan University, South Korea) and Simon S. Woo (Computer Science and Engineering Department, Sungkyunkwan University, South Korea)

Evading Deepfake-Image Detectors with White- and Black-Box Attacks .2804 Nicholas Carlini (Google Brain, Mountain View, CA) and Hany Farid (University of California, Berkeley, Berkeley, CA)
Detecting Deep-Fake Videos from Phoneme-Viseme Mismatches .28.14 Shruti Agarwal (University of California, Berkeley, Berkeley, CA, USA), Hany Farid (University of California, Berkeley, Berkeley, CA, USA), Ohad Fried (Stanford University, Stanford, CA, USA), and Maneesh Agrawala (Stanford University, Stanford, CA, USA)
Forgery Detection in Hyperspectral Document Images Using Graph Orthogonal Nonnegative Matrix Factorization .2823 Abderrahmane Rahiche (Synchromedia Laboratory, École de Technologie Supérieure (ETS), Montreal, Canada) and Mohamed Cheriet (Synchromedia Laboratory, École de Technologie Supérieure (ETS), Montreal, Canada)
Manipulation Detection in Satellite Images Using Deep Belief Networks .2832 János Horváth (Purdue University, Indiana, USA), Daniel Mas Montserrat (Purdue University, Indiana, USA), Hanxiang Hao (Purdue University, Indiana, USA), and Edward J. Delp (Purdue University, Indiana, USA)
DeepFake Detection by Analyzing Convolutional Traces .28 <u>4</u> 1 Luca Guarnera (University of Catania - iCTLab, Catania, Italy), Oliver Giudice (University of Catania, Catania, Italy), and Sebastiano Battiato (University of Catania - iCTLab, Catania, Italy)
 Deepfakes Detection with Automatic Face Weighting .285.1 Daniel Mas Montserrat (Purdue University, USA), Hanxiang Hao (Purdue University, USA), Sri K. Yarlagadda (Purdue University, USA), Sriram Baireddy (Purdue University, USA), Ruiting Shao (Purdue University, USA), János Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Janos Horváth (Purdue University, USA), Emily Bartusiak (Purdue University, USA), Emily Bartusiak
Detecting Video Speed Manipulation .2860. Brian C. Hosler (Brian C. Hosler and Matthew C. Stamm, Drexel University, Philadelphia, PA) and Matthew C. Stamm (Brian C. Hosler and Matthew C. Stamm, Drexel University, Philadelphia, PA)
Detecting GANs and Retouching Based Digital Alterations via DAD-HCNN .28.70 Anubhav Jain (IIIT-Delhi, India), Puspita Majumdar (IIIT-Delhi, India), Richa Singh (IIT Jodhpur, India), and Mayank Vatsa (IIT Jodhpur, India)

EDLCV: Efficient Deep Learning for Computer Vision

BAMSProd: A Step Towards Generalizing the Adaptive Optimization Methods to Deep Binary Model .2880.... Junjie Liu (Canon Information Technology (Beijing) Co., LTD), Dongchao Wen (Canon Information Technology (Beijing) Co., LTD), Deyu Wang (Canon Information Technology (Beijing) Co., LTD), Wei Tao (Canon Information Technology (Beijing) Co., LTD), Wei Tao (Canon Information Technology (Beijing) Co., LTD), Tse-Wei Chen (Device Technology Development Headquarters, Canon Inc.), Kinya Osa (Device Technology Development Headquarters, Canon Inc.), and Masami Kato (Device Technology Development Headquarters, Canon Inc.)

Dynamic Inference: A New Approach Toward Efficient Video Action Recognition .2890..... Wenhao Wu (MMLab, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China; University of Chinese Academy of Sciences, China), Dongliang He (Department of Computer Vision Technology (VIS), Baidu Inc., China), Xiao Tan (Department of Computer Vision Technology (VIS), Baidu Inc., China), Shifeng Chen (MMLab, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China), Yi Yang (University of Technology Sydney, Australia), and Shilei Wen (Department of Computer Vision Technology (VIS), Baidu Inc., China) Learning Low-Rank Deep Neural Networks via Singular Vector Orthogonality Regularization and Singular Value Sparsification .2899..... Huanrui Yang (Department of Electrical and Computer Engineering, Duke University), Minxue Tang (Department of Electronic Engineering, Tsinghua University), Wei Wen (Department of Electrical and Computer Engineering, Duke University), Feng Yan (Computer Science and Engineering Department, University of Nevada, Reno), Daniel Hu (Newport High School, Bellevue, WA), Ang Li (Department of Electrical and Computer Engineering, Duke University), Hai Li (Department of Electrical and Computer Engineering, Duke University), and Yiran Chen (Department of Electrical and Computer Engineering, Duke University) Low-Bit Quantization Needs Good Distribution .2909..... Haibao Yu (SenseTime Research), Tuopu Wen (Tsinghua University), Guangliang Cheng (SenseTime Research), Jiankai Sun (The Chinese University of Hong Kong), Qi Han (SenseTime Research), and Jianping Shi (SenseTime Research) Attentive Semantic Preservation Network for Zero-Shot Learning .29.19..... Zigian Lu (Zhejiang University), Yunlong Yu (Zhejiang University), Zhe-Ming Lu (Zhejiang University), Feng-Li Shen (Zhejiang University), and Zhongfei Zhang (Binghamton University) Mimic the Raw Domain: Accelerating Action Recognition in the Compressed Domain .2926... Barak Battash (Intel, Haifa, Israel), Haim Barad (Intel, Haifa, Israel), Hanlin Tang (Intel Labs, San Francisco, CA), and Amit Bleiweiss (Intel, Haifa, Israel) Constraint-Aware Importance Estimation for Global Filter Pruning Under Multiple Resource Constraints 2935..... Yu-Cheng Wu (NTU IoX Center, National Taiwan University; Graduate Institute of Electronic Engineering, National Taiwan University), Chih-Ting Liu (NTU IoX Center, National Taiwan University; Graduate Institute of Electronic Engineering, National Taiwan University), Bo-Ying Chen (NTU IoX Center, National Taiwan University; Graduate Institute of Electronic Engineering, National Taiwan University), and Shao-Yi Chien (NTU IoX Center, National Taiwan University; Graduate Institute of Electronic Engineering, National Taiwan University) FoNet: A Memory-Efficient Fourier-Based Orthogonal Network for Object Recognition .2944. Feng Wei (York University, Canada), Uyen Trang Nguyen (York University, Canada), and Hui Jiang (York University, Canada)

Computer-Aided Diagnosis System of Lung Carcinoma Using Convolutional Neural Networks 2953

Fangjian Han (Lensee Bio-Technology Co.Ltd., Ningbo, China), Li Yu (Lensee Bio-Technology Co.Ltd., Ningbo, China), and Yi Jiang (2ⁿnd Xiangya Hospital of Central South University, Changsha, China)

Fast Hardware-Aware Neural Architecture Search .2959..... Li Lyna Zhang (Microsoft Research), Yuqing Yang (Microsoft Research), Yuhang Jiang (Tsinghua University), Wenwu Zhu (Tsinghua University), and Yunxin Liu (Microsoft Research)

Learning Sparse Neural Networks Through Mixture-Distributed Regularization .2968..... Chang-Ti Huang (National Taiwan University, Taipei, Taiwan), Jun-Cheng Chen (Academia Sinica, Taipei, Taiwan), and Ja-Ling Wu (National Taiwan University, Taipei, Taiwan)

LSQ+: Improving Low-Bit Quantization Through Learnable Offsets and Better Initialization .2978 Yash Bhalgat (Qualcomm AI Research, Qualcomm Technologies, Inc.), Jinwon Lee (Qualcomm AI Research, Qualcomm Technologies, Inc.), Markus Nagel (Qualcomm AI Research, Qualcomm Technologies Netherlands B.V.), Tijmen Blankevoort (Qualcomm AI Research, Qualcomm Technologies Netherlands B.V.), and Nojun Kwak (Seoul National University)

Least Squares Binary Quantization of Neural Networks .2986..... Hadi Pouransari (Apple Inc., USA), Zhucheng Tu (Apple Inc., USA), and Oncel Tuzel (Apple Inc., USA)

RefineDetLite: A Lightweight One-Stage Object Detection Framework for CPU-Only Devices .2997 Chen Chen (Tencent TEG AI), Mengyuan Liu (Tencent TEG AI), Xiandong Meng (The Hong Kong University of Science and Technology), Wanpeng Xiao (Tencent TEG AI), and Qi Ju (Tencent TEG AI)

Randaugment: Practical Automated Data Augmentation with a Reduced Search Space .3008. Ekin D. Cubuk (Google Research, Brain Team), Barret Zoph (Google Research, Brain Team), Jonathon Shlens (Google Research, Brain Team), and Quoc V. Le (Google Research, Brain Team)

Any-Width Networks .30.18. Thanh Vu (University of North Carolina at Chapel Hill, Chapel Hill, NC), Marc Eder (University of North Carolina at Chapel Hill, Chapel Hill, NC), True Price (University of North Carolina at Chapel Hill, Chapel Hill, NC), and Jan-Michael Frahm (University of North Carolina at Chapel Hill, Chapel Hill, NC)

AdaMT-Net: An Adaptive Weight Learning Based Multi-task Learning Model for Scene

Understanding .3027.... Ankit Jha (Centre of Studies in Resources Engineering, IIT Bombay, Mumbai, India), Awanish Kumar (Deptt. of Electrical Engineering, IIT Bombay, Mumbai, India), Biplab Banerjee (Centre of Studies in Resources Engineering, IIT Bombay, Mumbai, India), and Subhasis Chaudhuri (Deptt. of Electrical Engineering, IIT Bombay, Mumbai, India)

Ternary MobileNets via Per-Layer Hybrid Filter Banks .3036..... Dibakar Gope (Arm ML Research Lab), Jesse Beu (Arm ML Research Lab), Urmish Thakker (Arm ML Research Lab), and Matthew Mattina (Arm ML Research Lab)

Data-Free Network Quantization With Adversarial Knowledge Distillation .3047..... Yoojin Choi (SoC R&D, Samsung Semiconductor Inc., San Diego, CA), Jihwan Choi (DGIST, Korea), Mostafa El-Khamy (SoC R&D, Samsung Semiconductor Inc., San Diego, CA), and Jungwon Lee (SoC R&D, Samsung Semiconductor Inc., San Diego, CA) Now That I Can See, I Can Improve: Enabling Data-Driven Finetuning of CNNs on the Edge .3058 Aditya Rajagopal (Imperial College London) and Christos-Savvas Bouganis (Imperial College London) Structured Weight Unification and Encoding for Neural Network Compression and Acceleration.... 3068 Wei Jiang (Tencent America LLC., Palo Alto, CA), Wei Wang (Tencent America LLC., Palo Alto, CA), and Shan Liu (Tencent America LLC., Palo Alto, CA) Neural Network Compression Using Higher-Order Statistics and Auxiliary Reconstruction Losses .3077..... Christos Chatzikonstantinou (Information Technologies Institute, Centre for Research and Technology Hellas, Greece), Georgios Th. Papadopoulos (Information Technologies Institute, Centre for Research and Technology Hellas, Greece), Kosmas Dimitropoulos (Information Technologies Institute, Centre for Research and Technology Hellas, Greece), and Petros Daras (Information Technologies Institute, Centre for Research and Technology Hellas, Greece) Monte Carlo Gradient Quantization .3087..... Gonçalo Mordido (Hasso Plattner Institute, Potsdam, Germany), Matthijs Van Keirsbilck (NVIDIA, Berlin, Germany), and Alexander Keller (NVIDIA, Berlin, Germany) Dithered Backprop: A Sparse and Quantized Backpropagation Algorithm for More Efficient Deep Neural Network Training .30.96..... Simon Wiedemann (Department of Video Coding & Analytics, Fraunhofer Heinrich-Hertz Institut, Berlin, Germany), Temesgen Mehari (Department of Video Coding & Analytics, Fraunhofer Heinrich-Hertz Institut, Berlin, Germany), Kevin Kepp (Department of Video Coding & Analytics, Fraunhofer Heinrich-Hertz Institut, Berlin, Germany), and Wojciech Samek (Department of Video Coding & Analytics, Fraunhofer *Heinrich-Hertz Institut, Berlin, Germany)* Learning Sparse & Ternary Neural Networks With Entropy-Constrained Trained Ternarization (EC2T) .3105..... Arturo Marban (Department of Video Coding & Analytics, Fraunhofer Heinrich-Hertz Institut, Berlin, Germany), Daniel Becking (Department of Video Coding & Analytics, Fraunhofer Heinrich-Hertz Institut, Berlin, Germany), Simon Wiedemann (Department of Video Coding & Analytics, Fraunhofer Heinrich-Hertz Institut, Berlin, Germany), and Wojciech Samek (Department of Video Coding & Analytics, Fraunhofer Heinrich-Hertz Institut, Berlin, Germany) Intelligent Scene Caching to Improve Accuracy for Energy-Constrained Embedded Vision .31.14 Benjamin Simpson (University of Michigan), Ekdeep Lubana (University of Michigan), Yuchen Liu (University of Michigan), and Robert Dick (University of Michigan)

Adaptive Posit: Parameter Aware Numerical Format for Deep Learning Inference on the Edge 3123

Hamed F. Langroudi (Neuromorphic AI Lab, University of Texas at San Antonio, TX, USA; Rochester Institute of Technology, NY, USA), Vedant Karia (Neuromorphic AI Lab, University of Texas at San Antonio, TX, USA), John L. Gustafson (National University of Singapore, Singapore), and Dhireesha Kudithipudi (Neuromorphic AI Lab, University of Texas at San Antonio, TX, USA)

ISIC: Skin Image Analysis

Illumination-Based Transformations Improve Skin Lesion Segmentation in Dermoscopic Images ... 3132

Kumar Abhishek (School of Computing Science, Simon Fraser University, Canada), Ghassan Hamarneh (School of Computing Science, Simon Fraser University, Canada), and Mark S. Drew (School of Computing Science, Simon Fraser University, Canada)

- Meta-DermDiagnosis: Few-Shot Skin Disease Identification Using Meta-Learning .31.42...... Kushagra Mahajan (TCS Research, New Delhi, India), Monika Sharma (TCS Research, New Delhi, India), and Lovekesh Vig (TCS Research, New Delhi, India)
- On Out-of-Distribution Detection Algorithms with Deep Neural Skin Cancer Classifiers .3152. Andre G. C. Pacheco (Federal University of Espirito Santo - Vitória, Brazil), Chandramouli S. Sastry (Dalhousie University - Halifax, Canada; Vector Institute - Toronto, Canada), Thomas Trappenberg (Dalhousie University - Halifax, Canada), Sageev Oore (Dalhousie University - Halifax, Canada; Vector Institute - Toronto, Canada), and Renato A. Krohling (Federal University of Espirito Santo – Vitória, Brazil)

Interpreting Mechanisms of Prediction for Skin Cancer Diagnosis Using Multi-task Learning .3162 Davide Coppola (Bioinformatics Institute, A*STAR, Singapore), Hwee Kuan Lee (Bioinformatics Institute, A*STAR, Singapore), and Cuntai Guan (NTU, Singapore)

Agreement Between Saliency Maps and Human-Labeled Regions of Interest: Applications to Skin Disease Classification .31.72.

Nalini Singh (MIT), Kang Lee (Google Research), David Coz (Google Health), Christof Angermueller (Google Research), Susan Huang (n/a), Aaron Loh (Google Health), and Yuan Liu (Google Health)

Less Is More: Sample Selection and Label Conditioning Improve Skin Lesion Segmentation .3182 Vinicius Ribeiro (School of Electrical and Computing Engineering (FEEC)), Sandra Avila (Institute of Computing(IC) RECOD Lab., University of Campinas (UNICAMP), Brazil), and Eduardo Valle (School of Electrical and Computing Engineering (FEEC))

Debiasing Skin Lesion Datasets and Models? Not So Fast .3.192..... Alceu Bissoto (Institute of Computing (IC)), Eduardo Valle (School of Electrical and Computing Engineering (FEEC) RECOD Lab., University of Campinas (UNICAMP), Brazil), and Sandra Avila (Institute of Computing (IC)) How Important Is Each Dermoscopy Image? <u>3202</u>..... Catarina Barata (Institute for Systems and Robotics, Lisbon, Portugal) and Carlos Santiago (Institute for Systems and Robotics, Lisbon, Portugal) Uncertainty Estimation in Deep Neural Networks for Dermoscopic Image Classification .321.1 Marc Combalia (Hospital Clínic de Barcelona, Barcelona, Spain), Ferran Hueto (Massachusetts Institute of Technology, Boston, EEUU), Susana Puig (Hospital Clínic de Barcelona, Barcelona, Spain), Josep Malvehy (Hospital Clínic de Barcelona, Barcelona, Spain), and Verónica Vilaplana Learning a Meta-Ensemble Technique for Skin Lesion Classification and Novel Class Detection .3221..... Subhranil Bagchi (Department of Computer Science and Engineering, Indian Institute of Technology Ropar, India), Anurag Banerjee (Department of Computer Science and Engineering, Indian Institute of Technology Ropar, India), and Deepti R. Bathula (Department of *Computer Science and Engineering, Indian Institute of Technology* Ropar, India)

DV: DeepVision

Homogeneous Linear Inequality Constraints for Neural Network Activations .3229..... Thomas Frerix (Technical University of Munich), Matthias Nießner (Technical University of Munich), and Daniel Cremers (Technical University of Munich)

SUW-Learn: Joint Supervised, Unsupervised, Weakly Supervised Deep Learning for Monocular Depth Estimation .3235.....

. Haoyu Ren (SOC R&D, Samsung Semiconductor, Inc., California, USA), Aman Raj (University of San Diego, California, USA), Mostafa El-Khamy (SOC R&D, Samsung Semiconductor, Inc., California, USA), and Jungwon Lee (SOC R&D, Samsung Semiconductor, Inc., California, USA)

Top-Down Networks: A Coarse-to-Fine Reimagination of CNNs .3244..... Ioannis Lelekas (Computer Vision Lab, Delft University of Technology, Netherlands), Nergis Tomen (Computer Vision Lab, Delft University of Technology, Netherlands), Silvia L. Pintea (Computer Vision Lab, Delft University of Technology, Netherlands), and Jan C. van Gemert (Computer Vision Lab, Delft University of Technology, Netherlands)

MUTE: Inter-Class Ambiguity Driven Multi-hot Target Encoding for Deep Neural Network Design .3254..... Mayoore S. Jaiswal (IBM, Austin, TX), Bumsoo Kang (KAIST, Daejeon, South Korea), Jinho Lee (Yonsei University, Seoul, South Korea), and Minsik Cho (IBM, Austin, TX) SmoothMix: A Simple Yet Effective Data Augmentation to Train Robust Classifiers .3264..... Jin-Ha Lee (University of Science and Technology; Electronics and Telecommunications Research Institute, Daejeon, South Korea), Muhammad Zaigham Zaheer (University of Science and Technology; Electronics and Telecommunications Research Institute, Daejeon, South Korea), Marcella Astrid (University of Science and Technology; Electronics and Telecommunications Research Institute, Daejeon, South Korea), and Seung-Ik Lee (University of Science and Technology; Electronics and Telecommunications Research Institute, Daejeon, South Korea) S2LD: Semi-Supervised Landmark Detection in Low-Resolution Images and Impact on Face Verification .3275..... Amit Kumar (Center for Automation Research, UMIACS, University of Maryland, College Park) and Rama Chellappa (Center for Automation Research, UMIACS, University of Maryland, College Park) P2L: Predicting Transfer Learning for Images and Semantic Relations .3284..... Bishwaranjan Bhattacharjee (IBM T.J. Watson Research Center), John R. Kender (Columbia University), Matthew Hill (IBM T.J. Watson Research Center), Parijat Dube (IBM T.J. Watson Research Center), Siyu Huo (IBM T.J. Watson Research Center), Michael R. Glass (IBM T.J. Watson Research Center), Brian Belgodere (IBM T.J. Watson Research Center), Sharath Pankanti (IBM T.J. Watson Research Center), Noel Codella (IBM T.J. Watson Research Center), and Patrick Watson (Minerva Project) Semi-Supervised Learning with Scarce Annotations .3294..... Sylvestre-Alvise Rebuffi (Visual Geometry Group, University of Oxford), Sebastien Ehrhardt (Visual Geometry Group, University of Oxford), Kai Han (Visual Geometry Group, University of Oxford), Andrea Vedaldi (Visual Geometry Group, University of Oxford), and Andrew Zisserman (Visual Geometry Group, University of Oxford) Spatio-Temporal Action Detection and Localization Using a Hierarchical LSTM .3303..... Akshaya Ramaswamy (Embedded Systems and Robotics TCS Research and Innovation, Bangalore, India), Karthik Seemakurthy (Embedded Systems and Robotics TCS Research and Innovation, Bangalore, India), Jayavardhana Gubbi (Embedded Systems and Robotics TCS Research and Innovation, Bangalore, India), and Balamuralidhar Purushothaman (Embedded Systems and Robotics TCS Research and Innovation, Bangalore, India) Can We Learn Heuristics for Graphical Model Inference Using Reinforcement Learning? .33.13 Safa Messaoud (University of Illinois at Urbana-Champaign), Maghav Kumar (University of Illinois at Urbana-Champaign), and Alexander G. Schwing (University of Illinois at Urbana-Champaign) Distilling Knowledge From Refinement in Multiple Instance Detection Networks .3324..... Luis Felipe Zeni (Institute of Informatics, Federal University of Rio Grande do Sul, Brazil) and Claudio R. Jung (Institute of Informatics, Federal University of Rio Grande do Sul, Brazil) Robust One Shot Audio to Video Generation .3334..... Neeraj Kumar (n/a), Srishti Goel (n/a), Ankur Narang (n/a), and Mujtaba Hasan (n/a)

Deflating Dataset Bias Using Synthetic Data Augmentation .3.3.4.4.... Nikita Jaipuria (Ford Greenfield Labs, Palo Alto), Xianling Zhang (Ford Greenfield Labs, Palo Alto), Rohan Bhasin (Ford Greenfield Labs, Palo Alto), Mayar Arafa (Ford Greenfield Labs, Palo Alto), Punarjay Chakravarty (Ford Greenfield Labs, Palo Alto), Shubham Shrivastava (Ford Greenfield Labs, Palo Alto), Sagar Manglani (Ford Greenfield Labs, Palo Alto), and Vidya N. Murali (Ford Greenfield Labs, Palo Alto)

AML-CV: Adversarial Machine Learning in Computer Vision

Noise is Inside Me! Generating Adversarial Perturbations with Noise Derived From Natural Filters .3354.
Akshay Agarwal (IIIT-Delhi, India), Mayank Vatsa (IIT Jodhpur, India), Richa Singh (IIT Jodhpur, India), and Nalini K. Ratha (IBM TJ Watson Research Center, USA)
Learning Ordered Top-k Adversarial Attacks via Adversarial Distillation .3364 Zekun Zhang (Department of ECE and the Visual Narrative Initiative, NC State University) and Tianfu Wu (Department of ECE and the Visual Narrative Initiative, NC State University)
Adversarial Fooling Beyond "Flipping the Label" .33.74 Konda Reddy Mopuri (Video Analytics Lab, Indian Institute of Science, Benguluru), Vaisakh Shaj (Video Analytics Lab, Indian Institute of Science, Benguluru), and R. Venkatesh Babu (Video Analytics Lab, Indian Institute of Science, Benguluru)
Improving the Affordability of Robustness Training for DNNs .3383 Sidharth Gupta (University of Illinois at Urbana-Champaign), Parijat Dube (IBM Research), and Ashish Verma (IBM Research)
A Cyclically-Trained Adversarial Network for Invariant Representation Learning .3.3.93 Jiawei Chen (Boston University), Janusz Konrad (Boston University), and Prakash Ishwar (Boston University)
Role of Spatial Context in Adversarial Robustness for Object Detection .3403 Aniruddha Saha (University of Maryland, Baltimore County), Akshayvarun Subramanya (University of Maryland, Baltimore County), Koninika Patil (University of Maryland, Baltimore County), and Hamed Pirsiavash (University of Maryland, Baltimore County)
Extensions and Limitations of Randomized Smoothing for Robustness Guarantees .3413 Jamie Hayes (University College London)
Systematic Evaluation of Backdoor Data Poisoning Attacks on Image Classifiers .3422 Loc Truong (Western Washington University), Chace Jones (Western Washington University), Brian Hutchinson (Western Washington University; Pacific Northwest National Laboratory), Andrew August (Pacific Northwest National Laboratory), Brenda Praggastis (Pacific Northwest National Laboratory), Robert Jasper (Pacific Northwest National Laboratory), Nicole Nichols (Pacific Northwest National Laboratory), and Aaron Tuor (Pacific Northwest National Laboratory)

Probing for Artifacts: Detecting Imagenet Model Evasions .3432 Jeremiah Rounds (Pacific Northwest National Laboratory), Addie Kingsland (Pacific Northwest National Laboratory), Michael J. Henry (Pacific Northwest National Laboratory,), and Kayla R. Duskin (Pacific Northwest National Laboratory)
Robust Assessment of Real-World Adversarial Examples <u>3442</u> . Brett Jefferson (Pacific Northwest National Laboratory) and Carlos Ortiz Marrero (Pacific Northwest National Laboratory)
Vulnerability of Person Re-Identification Models to Metric Adversarial Attacks .3450 Quentin Bouniot (CEA, LIST, Vision and Learning Lab for Scene Analysis, France), Romaric Audigier (CEA, LIST, Vision and Learning Lab for Scene Analysis, France), and Angélique Loesch (CEA, LIST, Vision and Learning Lab for Scene Analysis, France)
Live Trojan Attacks on Deep Neural Networks .3460. Robby Costales (Columbia University), Chengzhi Mao (Columbia University), Raphael Norwitz (Nutanix, Inc.), Bryan Kim (Stanford University), and Junfeng Yang (Columbia University)

Biometrics

On Improving the Generalization of Face Recognition in the Presence of Occlusions .3470.... Xiang Xu (Computational Biomedicine Lab, University of Houston), Nikolaos Sarafianos (Computational Biomedicine Lab, University of Houston), and Ioannis A. Kakadiaris (Computational Biomedicine Lab, University of Houston)

Latent Fingerprint Image Enhancement Based on Progressive Generative Adversarial Network 3481

Xijie Huang (Department of Instrument Science and Engineering, School of EIEE, Shanghai Jiao Tong University, Shanghai, China), Peng Qian (Department of Instrument Science and Engineering, School of EIEE, Shanghai Jiao Tong University, Shanghai, China), and Manhua Liu (Department of Instrument Science and Engineering, School of EIEE, Shanghai Jiao Tong University, Shanghai, China)

- Domain Agnostic Feature Learning for Image and Video Based Face Anti-Spoofing <u>3490</u>...... Suman Saha (ETH Zurich), Wenhao Xu (ETH Zurich), Menelaos Kanakis (ETH Zurich), Stamatios Georgoulis (ETH Zurich), Yuhua Chen (ETH Zurich), Danda Pani Paudel (ETH Zurich), and Luc Van Gool (KU Leuven & ETH Zurich)
- Triple-GAN: Progressive Face Aging with Triple Translation Loss .3500..... Han Fang (Beijing University of Posts and Telecommunications), Weihong Deng (Beijing University of Posts and Telecommunications), Yaoyao Zhong (Beijing University of Posts and Telecommunications), and Jiani Hu (Beijing University of Posts and Telecommunications)

Plastic Surgery: An Obstacle for Deep Face Recognition? .35.10 Christian Rathgeb (da/sec – Biometrics and Internet Security Research Group, Hochschule Darmstadt, Germany), Didem Dogan (da/sec – Biometrics and Internet Security Research Group, Hochschule Darmstadt, Germany), Fabian Stockhardt (da/sec – Biometrics and Internet Security Research Group, Hochschule Darmstadt, Germany), Maria De Marsico (Dipartimento di Informatica, Sapienza Università di Roma, Italy), and Christoph Busch (da/sec – Biometrics and Internet Security Research Group, Hochschule Darmstadt, Germany)
Offline Signature Verification on Real-World Documents .3518 Deniz Engin (Yapı Kredi Technology), Alperen Kantarcı (Istanbul Technical University), Seçil Arslan (Yapı Kredi Technology), and Hazım Kemel Ekenel (Istanbul Technical University)
FEHash: Full Entropy Hash for Face Template Protection .3527 Thao M. Dang (Chonnam National University, Gwangju, South Korea), Lam Tran (Chonnam National University, Gwangju, South Korea), Thuc D. Nguyen (University of Science, VNU-HCMC, Vietnam), and Deokjai Choi (Chonnam National University, Gwangju, South Korea)
Defending Black Box Facial Recognition Classifiers Against Adversarial Attacks .3537 Rajkumar Theagarajan (University of California, Riverside) and Bir Bhanu (University of California, Riverside)
Adversarial Light Projection Attacks on Face Recognition Systems: A Feasibility Study .3548 Dinh-Luan Nguyen (Visa Research, USA; Michigan State University, USA), Sunpreet S. Arora (Visa Research, USA), Yuhang Wu (Visa Research, USA), and Hao Yang (Visa Research, USA)
Seamless Payment System Using Face and Low-Energy Bluetooth .3557 Yeongnam Chae (Rakuten Institute of Technology, Tokyo), Kelvin Cheng (Rakuten Institute of Technology, Tokyo), Pankaj Wasnik (Rakuten Institute of Technology, Bengaluru), and Björn Stenger (Rakuten Institute of Technology, Tokyo)
Seeing Red: PPG Biometrics Using Smartphone Cameras .35.65 Giulio Lovisotto (University of Oxford, UK), Henry Turner (University of Oxford, UK), Simon Eberz (University of Oxford, UK), and Ivan Martinovic (University of Oxford, UK)
Quality Guided Sketch-to-Photo Image Synthesis .3575 Uche Osahor (West Virginia University), Hadi Kazemi (West Virginia University), Ali Dabouei (West Virginia University), and Nasser Nasrabadi (West Virginia University)
An A-Contrario Biometric Fusion Approach .3585 Luis Di Martino (IIE, Universidad de la Rep´ublica, Uruguay; Digital Sense, Uruguay), Javier Preciozzi (IIE, Universidad de la Rep´ublica, Uruguay; Digital Sense, Uruguay), Rafael Grompone von Gioi (Centre Borelli, ENS Paris-Saclay, Universit´e Paris-Saclay, France), Guillermo Garella (IIE, Universidad de la Rep´ublica, Uruguay; Digital Sense, Uruguay), Alicia Fernández (IIE, Universidad de la Rep´ublica, Uruguay), and Federico Lecumberry (IIE, Universidad de la Rep´ublica, Uruguay)

Class-Balanced Training for Deep Face Recognition .3594 Yaobin Zhang (Beijing University of Posts and Telecommunications) and Weihong Deng (Beijing University of Posts and Telecommunications)
A Comprehensive Study on Loss Functions for Cross-Factor Face Recognition .3604 Gee-Sern Jison Hsu (National Taiwan University of Science and Technology, Taipei, Taiwan), Hung-Yi Wu (National Taiwan University of Science and Technology, Taipei, Taiwan), and Moi Hoon Yap (Manchester Metropolitan University, Manchester, UK)
Fold Electrocardiogram Into a Fingerprint .3.6.12. Po-Ya Hsu (University of California, San Diego), Po-Han Hsu (University of California, San Diego), and Hsin-Li Liu (Central Taiwan University of Science and Technology)
 When Person Re-Identification Meets Changing Clothes .3620 Fangbin Wan (School of Data Science, Fudan University; indicates equal contributions), Yang Wu (Kyoto University), Xuelin Qian (School of Computer Science, Fudan University), Yixiong Chen (School of Data Science, Fudan University), and Yanwei Fu (School of Data Science, Fudan University)

Diff-CVML: Differential Geometry in Computer Vision and Machine Learning

Representations, Metrics and Statistics for Shape Analysis of Elastic Graphs .3629..... Xiaoyang Guo (Florida State University, USA) and Anuj Srivastava (Florida State University, USA)

PI-Net: A Deep Learning Approach to Extract Topological Persistence Images .3639..... Anirudh Som (School of Arts, Media and Engineering, Arizona State University; School of Electrical, Computer and Energy Engineering, Arizona State University), Hongjun Choi (School of Arts, Media and Engineering, Arizona State University; School of Electrical, Computer and Energy Engineering, Arizona State University), Karthikeyan Natesan Ramamurthy (IBM Research), Matthew P. Buman (College of Health Solutions, Arizona State University), and Pavan Turaga (School of Arts, Media and Engineering, Arizona State University; School of Electrical, Computer and Energy Engineering, Arizona State University)

Hierarchical Image Classification Using Entailment Cone Embeddings .3649..... Ankit Dhall (ETH Zurich), Anastasia Makarova (ETH Zurich), Octavian Ganea (MIT), Dario Pavllo (ETH Zurich), Michael Greeff (ETH Zurich), and Andreas Krause (ETH Zurich)

AMC-Loss: Angular Margin Contrastive Loss for Improved Explainability in Image
Hongjun Choi (Geometric Media Lab, School of Arts, Media and Engineering, Arizona State University; School of Electrical, Computer and Energy Engineering, Arizona State University), Anirudh Som (Geometric Media Lab, School of Arts, Media and Engineering, Arizona State University; School of Electrical, Computer and Energy Engineering, Arizona State University), and Pavan Turaga (Geometric Media Lab, School of Arts, Media and Engineering, Arizona State University; School of Electrical, Computer and Energy Engineering, Arizona State University)
Smooth Summaries of Persistence Diagrams and Texture Classification .3.667 Yu-Min Chung (University of North Carolina at Greensboro, USA), Michael Hull (University of North Carolina at Greensboro, USA), and Austin Lawson (University of North Carolina at Greensboro, USA)
Gromov-Wasserstein Averaging in a Riemannian Framework .3676 Samir Chowdhury (Stanford University, Department of Psychiatry and Behavioral Sciences) and Tom Needham (Florida State University, Department of Mathematics)
The Weighted Euler Curve Transform for Shape and Image Analysis .3685 Qitong Jiang (The Ohio State University, Department of Mathematics), Sebastian Kurtek (The Ohio State University, Department of Statistics), and Tom Needham (Florida State University, Department of Mathematics)
An Interface Between Grassmann Manifolds and Vector Spaces .3695 Lincon S. Souza (Graduate School of Science and Technology, University of Tsukuba), Naoya Sogi (Graduate School of Science and Technology, University of Tsukuba), Bernardo B. Gatto (Center for Artificial Intelligence Research (C-AIR), University of Tsukuba), Takumi Kobayashi (National Institute of Advanced Industrial Science and Technology (AIST)), and Kazuhiro Fukui (Graduate School of Science and Technology, University of Tsukuba; Center for Artificial Intelligence Research (C-AIR), University of Tsukuba)
Simplifying Transformations for a Family of Elastic Metrics on the Space of Surfaces .3705 Zhe Su (Department of Mathematics, Florida State University, Tallahassee, FL), Martin Bauer (Department of Mathematics, Florida State University, Tallahassee, FL), Eric Klassen (Department of Mathematics, Florida State University, Tallahassee, FL), and Kyle Gallivan (Department of Mathematics, Florida State University, Tallahassee, FL)
Metric Learning with A-Based Scalar Product for Image-Set Recognition .37.15 Naoya Sogi (Graduate School of Science and Technology, University of Tsukuba), Lincon S. Souza (Graduate School of Science and Technology, University of Tsukuba), Bernardo B. Gatto (Center for Artificial Intelligence Research (C-AIR), University of Tsukuba), and Kazuhiro Fukui (Graduate School of Science and Technology, University of Tsukuba; Center for Artificial Intelligence Research (C-AIR), University of Tsukuba)

A Geometric ConvNet on 3D Shape Manifold for Gait Recognition .3725 Nadia Hosni (CRISTAL, University of Manouba, Tunisia; University of Lille, France) and Boulbaba Ben Amor (Inception Institute of Artificial Intelligence, UAB)
A Generic Unfolding Algorithm for Manifolds Estimated by Local Linear Approximations .3735 Jonas Nordhaug Myhre (UiT the Arctic University of Norway), Matineh Shaker (Microsoft AI & Research), Mustafa Devrim Kaba (Johns Hopkins University), Robert Jenssen (UiT the Arctic University of Norway), and Deniz Erdogmus (Northeastern University)
Persistent Homology-Based Projection Pursuit .3744 Oleg Kachan (Skolkovo Institute of Science and Technology, Russia)
Curvature: A Signature for Action Recognition in Video Sequences .3752 He Chen (Johns Hopkins University) and Gregory S. Chirikjian (National University of Singapore, Johns Hopkins University)
Coarse-to-Fine Hamiltonian Dynamics of Hierarchical Flows in Computational Anatomy .3.7.6.0 Michael I. Miller (Johns Hopkins University, USA), Daniel J. Tward (Johns Hopkins University, USA), and Alain Trouvé (Ecole Normale Superieure, France)
Infinitesimal Drift Diffeomorphometry Models for Population Shape Analysis .37.66 Brian C. Lee (Johns Hopkins University, USA), Daniel J. Tward (Johns Hopkins University, USA), Zhiyi Hu (Johns Hopkins University, USA), Alain Trouvé (Université Paris-Saclay, France), and Michael I. Miller (Johns Hopkins University, USA)
Deep Low-Rank Subspace Clustering .37.76. Mohsen Kheirandishfard (Department of Computer Science and Engineering, University of Texas at Arlington, USA), Fariba Zohrizadeh (Department of Computer Science and Engineering, University of Texas at Arlington, USA), and Farhad Kamangar (Department of Computer Science and Engineering, University of Texas at Arlington, USA)
Deep Learning of Warping Functions for Shape Analysis .3782 Elvis Nunez (Department of Applied Mathematics and Statistics, Johns Hopkins University; Ahmanson Lovelace Brain Mapping Center, Department of Neurology, UCLA) and Shantanu H. Joshi (Ahmanson Lovelace Brain Mapping Center, Department of Neurology, UCLA; Department of Bioengineering, UCLA)

UG2: Bridging the Gap Between Computational Photography and Visual Recognition

VDFlow: Joint Learning for Optical Flow and Video Deblurring .3808..... Yanyang Yan (SKLOIS, IIE, CAS; University of Chinese Academy of Sciences), Qingbo Wu (SKLOIS, IIE, CAS; University of Chinese Academy of Sciences), Bo Xu (Yunnan Normal University), Jingang Zhang (University of Chinese Academy of Sciences), and Wenqi Ren (SKLOIS, IIE, CAS)

A Point Light Source Interference Removal Method for Image Dehazing .3817..... Yanyang Yan (SKLOIS, IIE, CAS), Shengdong Zhang (Wuhan University), Mingye Ju (Nanjing University of Posts and Telecommunications), Wenqi Ren (SKLOIS, IIE, CAS), Rui Wang (SKLOIS, IIE, CAS), and Yuanfang Guo (School of Computer Science and Engineering, Beihang University)

CVSports: Computer Vision in Sports

Utilizing Mask R-CNN for Waterline Detection in Canoe Sprint Video Analysis .3826..... Marie-Sophie von Braun (Laboratory for Biosignal Processing Leipzig University of Applied Sciences), Patrick Frenzel (Laboratory for Biosignal Processing Leipzig University of Applied Sciences), Christian Käding (Institute for Applied Training Science Leipzig), and Mirco Fuchs (Laboratory for Biosignal Processing Leipzig University of Applied Sciences)

VR Alpine Ski Training Augmentation Using Visual Cues of Leading Skier .3836..... Erwin Wu (Tokyo Institute of Technology, Tokyo, Japan), Takayuki Nozawa (Tokyo Institute of Technology, Tokyo, Japan), Florian Perteneder (Tokyo Institute of Technology, Tokyo, Japan), and Hideki Koike (Tokyo Institute of Technology, Tokyo, Japan)

Multimodal and Multiview Distillation for Real-Time Player Detection on a Football Field .3846 Anthony Cioppa (University of Liège), Adrien Deliège (University of Liège), Noor Ul Huda (Aalborg University), Rikke Gade (Aalborg University), Marc Van Droogenbroeck (University of Liège), and Thomas B. Moeslund (Aalborg University)

Event Detection in Coarsely Annotated Sports Videos via Parallel Multi-receptive Field 1D Convolutions .3856.....

Kanav Vats (University of Waterloo, Waterloo, Ontario, Canada), Mehrnaz Fani (University of Waterloo, Waterloo, Ontario, Canada), Pascale Walters (University of Waterloo, Waterloo, Ontario, Canada), David A. Clausi (University of Waterloo, Waterloo, Ontario, Canada), and John Zelek (University of Waterloo, Waterloo, Ontario, Canada)

TTNet: Real-Time Temporal and Spatial Video Analysis of Table Tennis .3866..... Roman Voeikov (OSAI), Nikolay Falaleev (OSAI), and Ruslan Baikulov (OSAI)

Using Player's Body-Orientation to Model Pass Feasibility in Soccer .38.75..... Adrià Arbués-Sangüesa (Universitat Pompeu Fabra), Adrian Martín (Universitat Pompeu Fabra), Javier Fernández (Futbol Club Barcelona), Coloma Ballester (Universitat Pompeu Fabra), and Gloria Haro (Universitat Pompeu Fabra) A Non-Invasive Vision-Based Approach to Velocity Measurement of Skeleton Training .3885.. *Murray Evans (Centre for the Analysis of Motion Entertainment Research and Applications (CAMERA), Department of Computer Science), Laurie Needham (CAMERA, Department of Health, University of Bathh), Steffi L. Colyer (CAMERA, Department of Health, University of Bathh), and Darren P. Cosker (CAMERA, Department of Computer Science, University of Bath)*

A System for Acquisition and Modelling of Ice-Hockey Stick Shape Deformation From Player Shot Videos .3893.....

Kaustubha Mendhurwar (Concordia University), Gaurav Handa (Concordia University), Leixiao Zhu (Concordia University), Sudhir Mudur (Concordia University), Etienne Beauchesne (Concordia University), Marc LeVangie (CCM Hockey), Aiden Hallihan (CCM Hockey), Abbas Javadtalab (Concordia University), and Tiberiu Popa (Concordia University)

Decoupling Video and Human Motion: Towards Practical Event Detection in Athlete Recordings.... 3901

Moritz Einfalt (University of Augsburg, Augsburg, Germany) and Rainer Lienhart (University of Augsburg, Augsburg, Germany)

As Seen on TV: Automatic Basketball Video Production Using Gaussian-Based Actionness and Game States Recognition .3911.

Julian Quiroga (Computer Vision, Genius Sports, Medellín, Colombia), Henry Carrillo (Computer Vision, Genius Sports, Medellín, Colombia), Edisson Maldonado (Computer Vision, Genius Sports, Medellín, Colombia), John Ruiz (Computer Vision, Genius Sports, Medellín, Colombia), and Luis M. Zapata (Computer Vision, Genius Sports, Medellín, Colombia)

Improved Soccer Action Spotting Using Both Audio and Video Streams .3921..... Bastien Vanderplaetse (ISIA Lab, University of Mons, Belgium) and Stéphane Dupont (ISIA Lab, University of Mons, Belgium)

Group Activity Detection From Trajectory and Video Data in Soccer <u>.</u>3932..... Ryan Sanford (Sportlogiq, Montreal, Canada), Siavash Gorji (Sportlogiq, Montreal, Canada), Luiz G. Hafemann (Sportlogiq, Montreal, Canada), Bahareh Pourbabaee (Sportlogiq, Montreal, Canada), and Mehrsan Javan (Sportlogiq, Montreal, Canada)

FALCONS: FAst Learner-Grader for CONtorted Poses in Sports <u>.3941</u>..... Mahdiar Nekoui (University of Alberta), Fidel Omar Tito Cruz (Universidad Nacional de Ingeniería), and Li Cheng (University of Alberta)

VL3W: Visual Learning With Limited Labels: Zero-Shot, Few-Shot, Any-Shot, and Cross-Domain Few-Shot Learning

Activity-Aware Attributes for Zero-Shot Driver Behavior Recognition <u>.3950</u>..... Simon Reiβ (Karlsruhe Institute of Technology, Germany), Alina Roitberg (Karlsruhe Institute of Technology, Germany), Monica Haurilet (Karlsruhe Institute of Technology, Germany), and Rainer Stiefelhagen (Karlsruhe Institute of Technology, Germany)

Diagnosing Rarity in Human-Object Interaction Detection .3956 Mert Kilickaya (QUvA Deep Vision Lab, Amsterdam, Netherlands) and Arnold Smeulders (QUvA Deep Vision Lab, Amsterdam, Netherlands)
Pose-Guided Knowledge Transfer for Object Part Segmentation .3961 Shujon Naha (Luddy School of Informatics, Computing, and Engineering, Indiana University), Qingyang Xiao (Luddy School of Informatics, Computing, and Engineering, Indiana University), Prianka Banik (Luddy School of Informatics, Computing, and Engineering, Indiana University), Md Alimoor Reza (Luddy School of Informatics, Computing, and Engineering, Indiana University), and David J. Crandall (Luddy School of Informatics, Computing, and Engineering, Indiana University)
MA3: Model Agnostic Adversarial Augmentation for Few Shot Learning .3966 Rohit Jena (Carnegie Mellon University), Shirsendu Sukanta Halder (Carnegie Mellon University), and Katia Sycara (Carnegie Mellon University)
ePillID Dataset: A Low-Shot Fine-Grained Benchmark for Pill Identification .3.9.7.1 Naoto Usuyama (Microsoft Healthcare), Natalia Larios Delgado (Microsoft Healthcare), Amanda K. Hall (Microsoft Healthcare), and Jessica Lundin (Work done at Microsoft)
Image2Audio: Facilitating Semi-Supervised Audio Emotion Recognition with Facial Expression Image .3978 Gewen He (Florida State University), Xiaofeng Liu (Harvard University; Carnegie Mellon University), Fangfang Fan (Harvard University), and Jane You (HK PolyU)
Auto-Annotation Quality Prediction for Semi-Supervised Learning with Ensembles .3984 Dror Simon (Technion, Israel), Miriam Farber (Amazon.com), and Roman Goldenberg (Amazon.com)
CLAREL: Classification via Retrieval Loss for Zero-Shot Learning .3989 Boris N. Oreshkin (Element AI), Negar Rostamzadeh (Element AI), Pedro O. Pinheiro (Element AI), and Christopher Pal (Element AI)
Unsupervised Batch Normalization .3994 Mustafa Taha Koçyiğit (University of Edinburgh, UK), Laura Sevilla-Lara (University of Edinburgh, UK), Timothy M. Hospedales (University of Edinburgh, UK), and Hakan Bilen (University of Edinburgh, UK)
Take the Scenic Route: Improving Generalization in Vision-and-Language Navigation .4000 Felix Yu (Princeton University), Zhiwei Deng (Princeton University), Karthik Narasimhan (Princeton University), and Olga Russakovsky (Princeton University)
An Embarrassingly Simple Baseline to One-Shot Learning .4005 Chen Liu (School of Data Science, Fudan University), Chengming Xu (School of Data Science, Fudan University), Yikai Wang (School of Data Science, Fudan University; Shanghai Key Lab of Intelligent Information Processing, Fudan University), Li Zhang (Department of Engineering Science, University of Oxford), and Yanwei Fu (School of Data Science, Fudan University; MOE Frontiers Center for Brain Science, Fudan University; Shanghai Key Lab of Intelligent Information Processing, Fudan University)

Towards Fine-Grained Sampling for Active Learning in Object Detection .4010 Sai Vikas Desai (Indian Institute of Technology, Hyderabad, India) and Vineeth N Balasubramanian (Indian Institute of Technology, Hyderabad, India)
Zero-Shot Learning in the Presence of Hierarchically Coarsened Labels .4015 Colin Samplawski (University of Massachusetts Amherst), Erik Learned-Miller (University of Massachusetts Amherst), Heesung Kwon (US Army Research), and Benjamin M. Marlin (University of Massachusetts Amherst)
Cross-Domain Knowledge Transfer for Prediction of Chemosensitivity in Ovarian Cancer Patients .4020 Asfand Yaar (Department of Computer and Information Sciences, Pakistan Institute of Engineering and Applied Sciences, Pakistan), Amina Asif (Department of Computer Science, National University of Computer and Emerging Sciences, Islamabad, Pakistan), Shan E Ahmed Raza (Tissue Image Analytics Lab & PathLAKE CoE, Department of Computer Science, University of Warwick, UK), Nasir Rajpoot (Tissue Image Analytics Lab & PathLAKE CoE, Department of Computer Science, University of Warwick, UK), and Fayyaz Minhas (Tissue Image Analytics Lab & PathLAKE CoE, Department of Computer Science, University of Warwick, UK)
Selecting Auxiliary Data Using Knowledge Graphs for Image Classification With Limited Labels .4026 Elaheh Raisi (Brown University) and Stephen H. Bach (Brown University)
Relative Position and Map Networks in Few-Shot Learning for Image Classification .4032 Zhiyu Xue (University of Electronic Science and Technology of China), Zhenshan Xie (University of Electronic Science and Technology of China), Zheng Xing (University of Electronic Science and Technology of China), and Lixin Duan (University of Electronic Science and Technology of China)
Any-Shot Sequential Anomaly Detection in Surveillance Videos <u>.4037</u> Keval Doshi (University of South Florida) and Yasin Yilmaz (University of South Florida)
 Alleviating Semantic-Level Shift: A Semi-Supervised Domain Adaptation Method for Semantic Segmentation .4043. Zhonghao Wang (C3SR, UIUC), Yunchao Wei (ReLER, UTS), Rogerio Feris (IBM Research), Jinjun Xiong (IBM Research), Wen-mei Hwu (C3SR, UIUC), Thomas S. Huang (C3SR, UIUC), and Honghui Shi (University of Oregon; C3SR, UIUC)
Self-Supervised Learning of Local Features in 3D Point Clouds .4048 Ali Thabet (King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia), Humam Alwassel (King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia), and Bernard Ghanem (King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia)
A Simple Discriminative Dual Semantic Auto-Encoder for Zero-Shot Classification .4053 Yang Liu (State Key Laboratory of ISN, Xidian University, China), Jin Li (Interactive Entertainment Group, Tencent Inc., China), and Xinbo Gao (State Key Laboratory of ISN, School of Electronic Engineering, Xidian University, China)

ViSeR: Visual Self-Regularization .4058. Hamid Izadinia (University of Washington) and Pierre Garrigues (Twitter)

Context-Guided Super-Class Inference for Zero-Shot Detection <u>.4064</u>..... Yanan Li (Artificial Intelligence Institute, Zhejiang Lab), Yilan Shao (Artificial Intelligence Institute, Zhejiang Lab), and Donghui Wang (Artificial Intelligence Institute, Zhejiang Lab)

Rethinking Segmentation Guidance for Weakly Supervised Object Detection .4069...... Ke Yang (Artificial Intelligence Research Center, National Innovation Institute of Defense Technology, China), Peng Zhang (National University of Defense Technology, China), Peng Qiao (National University of Defense Technology, China), Zhiyuan Wang (Artificial Intelligence Research Center, National Innovation Institute of Defense Technology, China), Huadong Dai (Artificial Intelligence Research Center, National Innovation Institute of Defense Technology, China), Tianlong Shen (Artificial Intelligence Research Center, National Innovation Institute of Defense Technology, China), Dongsheng Li (National University of Defense Technology, China), and Yong Dou (National University of Defense Technology, China)

MULWS: Multimodal Learning

CPARR: Category-Based Proposal Analysis for Referring Relationships .40.74 Chuanzi He (University of Southern California), Haidong Zhu (University of Southern California), Jiyang Gao (University of Southern California), Kan Chen (University of Southern California), and Ram Nevatia (University of Southern California)
Improved Active Speaker Detection Based on Optical Flow .4084 Chong Huang (University of California, Santa Barbara) and Kazuhito Koishida (Microsoft Corporation)
Interactive Video Retrieval with Dialog .4091 Sho Maeoki (The University of Tokyo), Kohei Uehara (The University of Tokyo), and Tatsuya Harada (The University of Tokyo; RIKEN)
Self-Supervised Object Detection and Retrieval Using Unlabeled Videos <u>4100</u> Elad Amrani (IBM Research AI; Technion), Rami Ben-Ari (IBM Research AI), Inbar Shapira (IBM Research AI), Tal Hakim (IBM Research AI), and Alex Bronstein (Technion)
Quality and Relevance Metrics for Selection of Multimodal Pretraining Data .41.09 Roshan Rao (UC Berkeley), Sudha Rao (Microsoft Research), Elnaz Nouri (Microsoft Research), Debadeepta Dey (Microsoft Research), Asli Celikyilmaz (Microsoft Research), and Bill Dolan (Microsoft Research)
Multi-modal Dense Video Captioning .41.1.7. Vladimir Iashin (Tampere University) and Esa Rahtu (Tampere University)

Cross-Modal Variational Alignment of Latent Spaces <u>4127</u> . Thomas Theodoridis (Information Technologies Institute, Centre for Research and Technology Hellas, Thessaloniki, Greece), Theocharis Chatzis (Information Technologies Institute, Centre for Research and Technology Hellas, Thessaloniki, Greece), Vassilios Solachidis (Information Technologies Institute, Centre for Research and Technology Hellas, Thessaloniki, Greece), Kosmas Dimitropoulos (Information Technologies Institute, Centre for Research and Technology Hellas, Thessaloniki, Greece), and Petros Daras (Information Technologies Institute, Centre for Research and Technology Hellas, Thessaloniki, Greece), and Petros Daras (Information Technologies Institute, Centre for Research and Technology Hellas, Thessaloniki, Greece)	
Exploring Phrase Grounding Without Training: Contextualisation and Extension to Text-Based Image Retrieval .4137. Letitia Parcalabescu (Computational Linguistics Department, Heidelberg University) and Anette Frank (Computational Linguistics Department, Heidelberg University)	
Classification-Aware Semi-Supervised Domain Adaptation .4.1.4.7. Gewen He (Florida State University), Xiaofeng Liu (Harvard University; Carnegie Mellon University), Fangfang Fan (Harvard University), and Jane You (HK PolyU)	

CVMI: Computer Vision for Microscopy Image Analysis

Analyzing U-Net Robustness for Single Cell Nucleus Segmentation From Phase Contrast Images.... 4157

Chenyi Ling (Software and Systems Division, Information Technology Lab, NIST), Michael Majurski (Software and Systems Division, Information Technology Lab, NIST), Michael Halter (Material Measurement Lab, NIST), Jeffrey Stinson (Material Measurement Lab, NIST), Anne Plant (Material Measurement Lab, NIST), and Joe Chalfoun (Software and Systems Division, Information Technology Lab, NIST)

Celeganser: Automated Analysis of Nematode Morphology and Age .4164..... Linfeng Wang (University of California, Irvine), Shu Kong (Carnegie Mellon University), Zachary Pincus (Washington University in St. Louis), and Charless Fowlkes (University of California, Irvine)

Estimation of Orientation and Camera Parameters from Cryo-Electron Microscopy Images with Variational Autoencoders and Generative Adversarial Networks .41.74..... Nina Miolane (Stanford University), Frédéric Poitevin (Stanford University), Yee-Ting Li (SLAC National Accelerator), and Susan Holmes (Stanford University)

WISH: Efficient 3D Biological Shape Classification Through Willmore Flow and Spherical Harmonics Decomposition .4184.....

Marco Agus (HBKU VIC - CRS4, Doha, Qatar Cagliari, Italy), Enrico Gobbetti (VIC - CRS4, Cagliari, Italy), Giovanni Pintore (VIC - CRS4, Cagliari, Italy), Corrado Calì (Istituto Di Neuroscienze Cavalieri Ottolenghi - UniTO, Italy), and Jens Schneider (HBKU, Doha, Qatar)

Feedback U-Net for Cell Image Segmentation .4195..... Eisuke Shibuya (Meijo University, Japan) and Kazuhiro Hotta (Meijo University, Japan)

Multi-object Graph-Based Segmentation with Non-overlapping Surfaces .4204 Patrick M. Jensen (Department of Applied Mathematics and Computer Science, Technical University of Denmark, Kgs. Lyngby, Denmark), Anders B. Dahl (Department of Applied Mathematics and Computer Science, Technical University of Denmark, Kgs. Lyngby, Denmark), and Vedrana A. Dahl (Department of Applied Mathematics and Computer Science, Technical University of Denmark, Kgs. Lyngby, Denmark)
Self-Supervised Feature Extraction for 3D Axon Segmentation .4213 Tzofi Klinghoffer (MIT Lincoln Laboratory, Lexington, MA), Peter Morales (MIT Lincoln Laboratory, Lexington, MA), Young-Gyun Park (MIT Institute for Medical Engineering and Science, Cambridge, MA), Nicholas Evans (MIT Institute for Medical Engineering and Science, Cambridge, MA), Kwanghun Chung (MIT Institute for Medical Engineering and Science, Cambridge, MA), and Laura J. Brattain (MIT Lincoln Laboratory, Lexington, MA)
Detection and Classification of Pollen Grain Microscope Images .4220 Sebastiano Battiato (University of Catania, Italy), Alessandro Ortis (University of Catania, Italy), Francesca Trenta (University of Catania, Italy), Lorenzo Ascari (University of Turin, Italy), Mara Politi (University of Turin, Italy), and Consolata Siniscalco (University of Turin, Italy)
CTMC: Cell Tracking with Mitosis Detection Dataset Challenge .4228 Samreen Anjum (University of Texas at Austin) and Danna Gurari (University of Texas at Austin)
A Web-Based Intelligence Platform for Diagnosis of Malaria in Thick Blood Smear Images: A Case for a Developing Country .4238 Rose Nakasi (Makerere University, Kampala, Uganda), Jeremy Francis Tusubira (Makerere University, Kampala, Uganda), Aminah Zawedde (Makerere University, Kampala, Uganda), Ali Mansourian (Lund University, Lund, Sweden), and Ernest Mwebaze (Makerere University, Kampala, Uganda)
A Topological Nomenclature for 3D Shape Analysis in Connectomics .4245 Abhimanyu Talwar (Harvard University), Zudi Lin (Harvard University), Donglai Wei (Harvard University), Yuesong Wu (Harvard University), Bowen Zheng (Harvard University), Jinglin Zhao (Harvard University), Won-Dong Jang (Harvard University), Xueying Wang (Harvard University), Jeff Lichtman (Harvard University), and Hanspeter Pfister (Harvard University)
Representation Learning of Histopathology Images Using Graph Neural Networks .4254 Mohammed Adnan (Kimia Lab, University of Waterloo, Canada; Vector Institute, Canada), Shivam Kalra (Kimia Lab, University of Waterloo, Canada), and Hamid R. Tizhoosh (Kimia Lab, University of Waterloo,

Canada; Vector Institute, Canada)

A Topological Encoding Convolutional Neural Network for Segmentation of 3D Multiphoton Images of Brain Vasculature Using Persistent Homology .4262..... Mohammad Haft-Javaherian (Harvard Medical School, USA; Massachusetts Institute of Technology, USA), Martin Villiger (Harvard Medical School, USA; Massachusetts Institute of Technology, USA), Chris B. Schaffer (Cornell University, USA), Nozomi Nishimura (Cornell University, USA), Polina Golland (Massachusetts Institute of Technology, USA), and Brett E. Bouma (Harvard Medical School, USA; Massachusetts Institute of Technology, USA) Rapid Training Data Creation by Synthesizing Medical Images for Classification and Localization .4272..... Abhishek Kushwaha (n/a), Sarthak Gupta (n/a), Anish Bhanushali (n/a), and Tathagato Rai Dastidar (n/a) Content-Based Propagation of User Markings for Interactive Segmentation of Patterned Images 4280..... Vedrana A. Dahl (Technical University of Denmark), Monica J. Emerson (Technical University of Denmark), Camilla H. Trinderup (Technical University of Denmark), and Anders B. Dahl (Technical University of Denmark)

WAD: Autonomous Driving

SMOKE: Single-Stage Monocular 3D Object Detection via Keypoint Estimation .4289..... Zechen Liu (ZongMu Tech), Zizhang Wu (ZongMu Tech), and Roland Tóth (TU/e)

Wasserstein Loss-Based Deep Object Detection 4299 Yuzhuo Han (School of Mathematical Sciences, Dalian University of Technology), Xiaofeng Liu (Beth Israel Deaconess Medical Center, Harvard Medical School, Harvard University), Zhenfei Sheng (College of Photonic and Electronic Engineering, Fujian Normal University), Yutao Ren (Wuhan University of Technology), Xu Han (Beth Israel Deaconess Medical Center, Harvard Medical School, Harvard University; John Hopkins Uniersity), Jane You (Department of Computing, The Hong Kong Polytechnic University, Hong Kong, China), Risheng Liu (School of Software Technology and the International School of Information Science, Engineering, Dalian University of Technology), and Zhongxuan Luo (School of Mathematical Sciences, Dalian University of Technology) Learning Depth-Guided Convolutions for Monocular 3D Object Detection .4306..... Mingyu Ding (The University of Hong Kong; Renmin University of China), Yugi Huo (Renmin University of China; Beijing Key Laboratory of Big Data Management and Analysis Methods, China), Hongwei Yi (Peking University), Zhe Wang (SenseTime Research), Jianping Shi (SenseTime Research), Zhiwu Lu (Renmin University of China; Beijing Key Laboratory of Big Data Management and Analysis Methods, China), and Ping Luo (The University of Hong Kong)

Feudal Steering: Hierarchical Learning for Steering Angle Prediction .4316..... Faith Johnson (Rutgers University) and Kristin Dana (Rutgers University)

Sel	f-Supervised Object Motion and Depth Estimation From Video .4326 Qi Dai (Computer Vision Lab, ETH Zurich; Institute of Geodesy and Photogrammetry, ETH Zurich), Vaishakh Patil (Computer Vision Lab, ETH Zurich), Simon Hecker (Computer Vision Lab, ETH Zurich), Dengxin Dai (Computer Vision Lab, ETH Zurich), Luc Van Gool (Computer Vision Lab, ETH Zurich; VISICS, ESAT/PSI, KU Leuven), and Konrad Schindler (Computer Vision Lab, ETH Zurich; Institute of Geodesy and Photogrammetry, ETH Zurich)
En	d-to-End Lane Marker Detection via Row-Wise Classification .4335 Seungwoo Yoo (Qualcomm Korea YH), Hee Seok Lee (Qualcomm Korea YH), Heesoo Myeong (Qualcomm Korea YH), Sungrack Yun (Qualcomm Korea YH), Hyoungwoo Park (Qualcomm Korea YH), Janghoon Cho (Qualcomm Korea YH), and Duck Hoon Kim (Qualcomm Korea YH)
An	Extensible Multi-sensor Fusion Framework for 3D Imaging .4344 Talha Ahmad Siddiqui (Carnegie Mellon University), Rishi Madhok (Carnegie Mellon University), and Matthew O'Toole (Carnegie Mellon University)
Το	pometric Imitation Learning for Route Following Under Appearance Change .4354 Shaojun Cai (UISEE Technology Inc., China) and Yingjia Wan (Chinese Academy of Sciences, China)

IMW: Image Matching: Local Features and Beyond

Two-Stage Discriminative Re-Ranking for Large-Scale Landmark Retrieval .4363..... Shuhei Yokoo (University of Tsukuba), Kohei Ozaki (Preferred Networks, Inc.), Edgar Simo-Serra (Waseda University), and Satoshi lizuka (University of Tsukuba)

Match or No Match: Keypoint Filtering Based on Matching Probability .437.1..... Alexandra I. Papadaki (Technical University Berlin, Computer Vision & Remote Sensing Department) and Ronny Hänsch (German Aerospace Center (DLR), Department SAR Technology)

Precognition: Seeing Through the Future

Alexander Schwing (University of Illinois at Urbana-Champaign)

- Glaucoma Precognition: Recognizing Preclinical Visual Functional Signs of Glaucoma .4393... Krati Gupta (School of Computing & Electrical Engineering, Indian Institute of Technology Mandi, Mandi, India; Department of Ophthalmology, University of Tennessee Health Science Center, Memphis, USA), Anshul Thakur (School of Computing & Electrical Engineering, Indian Institute of Technology Mandi, Mandi, India), Michael Goldbaum (Department of Ophthalmology, University of California, San Diego, USA), and Siamak Yousefi (Department of Ophthalmology, University of Tennessee Health Science Center, Memphis, USA; Department of Genetics, Genomics, and Informatics, University of Tennessee Health Science Center, Memphis, USA)
- A Multimodal Predictive Agent Model for Human Interaction Generation <u>.4402</u>..... *Murchana Baruah (The University of Memphis, USA) and Bonny Banerjee (The University of Memphis, USA)*
- SILA: An Incremental Learning Approach for Pedestrian Trajectory Prediction .4411..... Golnaz Habibi (MIT), Nikita Jaipuria (Ford Motor Company), and Jonathan P. How (MIT)

Anti-UAV: Catch UAVs That Want to Watch You: Detection and Tracking of Unmanned Aerial Vehicle in the Wild

IPG-Net: Image Pyramid Guidance Network for Small Object Detection .4422 Ziming Liu (Beijing Institute of Technology, Beijing, China), Guangyu Gao (Beijing Institute of Technology, Beijing, China), Lin Sun (Samsung Strategy and Innovation Center, California, US), and Li Fang (Beijing Institute of Technology, Beijing, China)
Real-Time Tracking with Stabilized Frame .4431 Zixuan Wang (School of Artificial Intelligence), Zhicheng Zhao (School of Artificial Intelligence; Beijing Key Laboratory of Network System and Network Culture, Beijing University of Posts and Telecommunications, Beijing, China), and Fei Su (School of Artificial Intelligence; Beijing Key Laboratory of Network System and Network Culture, Beijing University of Posts and Telecommunications, Beijing, China)
Effect of Annotation Errors on Drone Detection With YOLOv3 .4439 Aybora Koksal (Department of Electrical and Electronics Engineering, Center for Image Analysis (OGAM), Middle East Technical University, Ankara, Turkey), Kutalmis Gokalp Ince (Department of Electrical and Electronics Engineering, Center for Image Analysis (OGAM), Middle East Technical University, Ankara, Turkey), and Aydin Alatan (Department of Electrical and Electronics Engineering, Center for Image Analysis (OGAM), Middle East Technical University, Ankara, Turkey)
A Real-Time Robust Approach for Tracking UAVs in Infrared Videos <u>.4448</u> Han Wu (Xi'an Jiaotong University, P.R. China), Weiqiang Li (Xi'an Jiaotong University, P.R. China), Wanqi Li (Xi'an Jiaotong University, P.R. China), and Guizhong Liu (Xi'an Jiaotong University, P.R. China)

VUHCS: Towards Human-Centric Image/Video Synthesis and the Look-Into-Person Challenge

LightTrack: A Generic Framework for Online Top-Down Human Pose Tracking
Epipolar Transformer for Multi-view Human Pose Estimation
Yoga-82: A New Dataset for Fine-Grained Classification of Human Poses
 Fine-Grained Pointing Recognition for Natural Drone Guidance
The MTA Dataset for Multi-target Multi-camera Pedestrian Tracking by Weighted Distance Aggregation
Reposing Humans by Warping 3D Features

Author Index