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Pattern Recognition

ICPR International Workshops and Challenges


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Editors

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Catania, Italy

Marco Bertini 
Dipartimento di Ingegneria
dell'Informazione
University of Firenze
Firenze, Italy

Roberto Vezzani 
Dipartimento di Ingegneria “Enzo Ferrari”
Università di Modena e Reggio Emilia
Modena, Italy

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Foreword by General Chairs



It is with great pleasure that we welcome you to the post-proceedings of the 25th International Conference on Pattern Recognition, ICPR2020 Virtual-Milano. ICPR2020 stands on the shoulders of generations of pioneering pattern recognition researchers. The first ICPR (then called IJCPR) convened in 1973 in Washington, DC, USA, under the leadership of Dr. King-Sun Fu as the General Chair. Since that time, the global community of pattern recognition researchers has continued to expand and thrive, growing evermore vibrant and vital. The motto of this year's conference was *Putting Artificial Intelligence to work on patterns*. Indeed, the deep learning revolution has its origins in the pattern recognition community – and the next generations of revolutionary insights and ideas continue with those presented at this 25th ICPR. Thus, it was our honor to help perpetuate this longstanding ICPR tradition to provide a lively meeting place and open exchange for the latest pathbreaking work in pattern recognition.

For the first time, the ICPR main conference employed a two-round review process similar to journal submissions, with new papers allowed to be submitted in either the first or the second round and papers submitted in the first round and not accepted allowed to be revised and re-submitted for second round review. In the first round, 1554 new submissions were received, out of which 554 (35.6%) were accepted and 579 (37.2%) were encouraged to be revised and resubmitted. In the second round, 1696 submissions were received (496 revised and 1200 new), out of which 305 (61.4%) of the revised submissions and 552 (46%) of the new submissions were accepted. Overall, there were 3250 submissions in total, and 1411 were accepted, out of which 144 (4.4%) were included in the main conference program as orals and 1263 (38.8%) as posters (4 papers were withdrawn after acceptance). We had the largest ICPR conference ever, with the most submitted papers and the most selective acceptance rates ever for ICPR, attesting both the increased interest in presenting research results at ICPR and the high scientific quality of work accepted for presentation at the conference.

We were honored to feature seven exceptional Keynotes in the program of the ICPR2020 main conference: David Doermann (Professor at the University at Buffalo), Pietro Perona (Professor at the California Institute of Technology and Amazon Fellow

at Amazon Web Services), Mihaela van der Schaar (Professor at the University of Cambridge and a Turing Fellow at The Alan Turing Institute in London), Max Welling (Professor at the University of Amsterdam and VP of Technologies at Qualcomm), Ching Yee Suen (Professor at Concordia University) who was presented with the IAPR 2020 King-Sun Fu Prize, Maja Pantic (Professor at Imperial College UK and AI Scientific Research Lead at Facebook Research) who was presented with the IAPR 2020 Maria Petrou Prize, and Abhinav Gupta (Professor at Carnegie Mellon University and Research Manager at Facebook AI Research) who was presented with the IAPR 2020 J.K. Aggarwal Prize. Several best paper prizes were also announced and awarded, including the Piero Zamperoni Award for the best paper authored by a student, the BIRPA Best Industry Related Paper Award, and Best Paper Awards for each of the five tracks of the ICPR2020 main conference.

The five tracks of the ICPR2020 main conference were: (1) Artificial Intelligence, Machine Learning for Pattern Analysis, (2) Biometrics, Human Analysis and Behavior Understanding, (3) Computer Vision, Robotics and Intelligent Systems, (4) Document and Media Analysis, and (5) Image and Signal Processing. The best papers presented at the main conference had the opportunity for publication in expanded format in journal special issues of *IET Biometrics* (tracks 2 and 3), *Computer Vision and Image Understanding* (tracks 1 and 2), *Machine Vision and Applications* (tracks 2 and 3), *Multimedia Tools and Applications* (tracks 4 and 5), *Pattern Recognition Letters* (tracks 1, 2, 3 and 4), or *IEEE Trans. on Biometrics, Behavior, and Identity Science* (tracks 2 and 3).

In addition to the main conference, the ICPR2020 program offered workshops and tutorials, along with a broad range of cutting-edge industrial demos, challenge sessions, and panels. The virtual ICPR2020 conference was interactive, with real-time live-streamed sessions, including live talks, poster presentations, exhibitions, demos, Q&A, panels, meetups, and discussions – all hosted on the Underline virtual conference platform.

The ICPR2020 conference was originally scheduled to convene in Milano, which is one of the most beautiful cities of Italy for art, culture, lifestyle – and more. The city has so much to offer! With the need to go virtual, ICPR2020 included interactive **virtual tours** of Milano during the conference coffee breaks, which we hoped would introduce attendees to this wonderful city, and perhaps even entice them to visit Milano once international travel becomes possible again.

The success of such a large conference would not have been possible without the help of many people. We deeply appreciate the vision, commitment, and leadership of the ICPR2020 Program Chairs: Kim Boyer, Brian C. Lovell, Marcello Pelillo, Nicu Sebe, René Vidal, and Jingyi Yu. Our heartfelt gratitude also goes to the rest of the main conference organizing team, including the Track and Area Chairs, who all generously devoted their precious time in conducting the review process and in preparing the program, and the reviewers, who carefully evaluated the submitted papers and provided invaluable feedback to the authors. This time their effort was considerably higher given that many of them reviewed for both reviewing rounds. We also want to acknowledge the efforts of the conference committee, including the Challenge Chairs, Demo and Exhibit Chairs, Local Chairs, Financial Chairs, Publication Chair, Tutorial Chairs, Web Chairs, Women in ICPR Chairs, and Workshop Chairs. Many thanks, also, for the efforts of the dedicated staff who performed the crucially important work

behind the scenes, including the members of the ICPR2020 Organizing Secretariat. Finally, we are grateful to the conference sponsors for their generous support of the ICPR2020 conference.

We hope everyone had an enjoyable and productive ICPR2020 conference.

Rita Cucchiara
Alberto Del Bimbo
Stan Sclaroff

Preface

The 25th International Conference on Pattern Recognition Workshops (ICPRW 2020) were held virtually in Milan, Italy and rescheduled to January 10 and January 11 of 2021 due to the Covid-19 pandemic. ICPRW 2020 included timely topics and applications of Computer Vision, Image and Sound Analysis, Pattern Recognition and Artificial Intelligence. We received 49 workshop proposals and 46 of them have been accepted, which is three times more than at ICPRW 2018. The workshop proceedings cover a wide range of areas including Machine Learning (8), Pattern Analysis (5), Healthcare (6), Human Behavior (5), Environment (5), Surveillance, Forensics and Biometrics (6), Robotics and Egovision (4), Cultural Heritage and Document Analysis (4), Retrieval (2), and Women at ICPR 2020 (1). Among them, 33 workshops are new to ICPRW. Specifically, the ICPRW 2020 volumes contain the following workshops (please refer to the corresponding workshop proceeding for details):

- CADL2020 – Workshop on Computational Aspects of Deep Learning.
- DLPR – Deep Learning for Pattern Recognition.
- EDL/AI – Explainable Deep Learning/AI.
- (Merged) IADS – Integrated Artificial Intelligence in Data Science, IWCR – IAPR workshop on Cognitive Robotics.
- ManifLearn – Manifold Learning in Machine Learning, From Euclid to Riemann.
- MOI2QDN – Metrification & Optimization of Input Image Quality in Deep Networks.
- IML – International Workshop on Industrial Machine Learning.
- MMDLCA – Multi-Modal Deep Learning: Challenges and Applications.
- IUC 2020 – Human and Vehicle Analysis for Intelligent Urban Computing.
- PATCAST – International Workshop on Pattern Forecasting.
- RRPR – Reproducible Research in Pattern Recognition.
- VAIB 2020 – Visual Observation and Analysis of Vertebrate and Insect Behavior.
- IMTA VII – Image Mining Theory & Applications.
- AIHA 2020 – Artificial Intelligence for Healthcare Applications.
- AIDP – Artificial Intelligence for Digital Pathology.
- (Merged) GOOD – Designing AI in support of Good Mental Health, CAIHA – Computational and Affective Intelligence in Healthcare Applications for Vulnerable Populations.
- CARE2020 – pattern recognition for positive teChnology And eldeRly wEllbeing.
- MADiMa 2020 – Multimedia Assisted Dietary Management.
- 3DHU 2020 – 3D Human Understanding.
- FBE2020 – Facial and Body Expressions, micro-expressions and behavior recognition.
- HCAU 2020 – Deep Learning for Human-Centric Activity Understanding.
- MPRSS - 6th IAPR Workshop on Multimodal Pattern Recognition for Social Signal Processing in Human Computer Interaction.

- CVAUI 2020 – Computer Vision for Analysis of Underwater Imagery.
- MAES – Machine Learning Advances Environmental Science.
- PRAConBE - Pattern Recognition and Automation in Construction & the Built Environment.
- PRRS 2020 – Pattern Recognition in Remote Sensing.
- WAAMI - Workshop on Analysis of Aerial Motion Imagery.
- DEEPRETAIL 2020 - Workshop on Deep Understanding Shopper Behaviours and Interactions in Intelligent Retail Environments 2020.
- MMForWild2020 – MultiMedia FORensics in the WILD 2020.
- FGVRID – Fine-Grained Visual Recognition and re-Identification.
- IWBDAF – Biometric Data Analysis and Forensics.
- RISS – Research & Innovation for Secure Societies.
- WMWB – TC4 Workshop on Mobile and Wearable Biometrics.
- EgoApp – Applications of Egocentric Vision.
- ETTAC 2020 – Eye Tracking Techniques, Applications and Challenges.
- PaMMO – Perception and Modelling for Manipulation of Objects.
- FAPER – Fine Art Pattern Extraction and Recognition.
- MANPU – coMics ANalysis, Processing and Understanding.
- PATRECH2020 – Pattern Recognition for Cultural Heritage.
- (Merged) CBIR – Content-Based Image Retrieval: where have we been, and where are we going, TAILOR – Texture Analysis, cLassificatiOn and Retrieval, VIQA – Video and Image Question Answering: building a bridge between visual content analysis and reasoning on textual data.
- W4PR - Women at ICPR.

We would like to thank all members of the workshops' Organizing Committee, the reviewers, and the authors for making this event successful. We also appreciate the support from all the invited speakers and participants. We wish to offer thanks in particular to the ICPR main conference general chairs: Rita Cucchiara, Alberto Del Bimbo, and Stan Sclaroff, and program chairs: Kim Boyer, Brian C. Lovell, Marcello Pelillo, Nicu Sebe, Rene Vidal, and Jingyi Yu. Finally, we are grateful to the publisher, Springer, for their cooperation in publishing the workshop proceedings in the series of Lecture Notes in Computer Science.

December 2020

Giovanni Maria Farinella
Tao Mei

Challenges

Competitions are effective means for rapidly solving problems and advancing the state of the art. Organizers identify a problem of practical or scientific relevance and release it to the community. In this way the whole community can contribute to the solution of high-impact problems while having fun. This part of the proceedings compiles the best of the competitions track of the *25th International Conference on Pattern Recognition (ICPR)*.

Eight challenges were part of the track, covering a wide variety of fields and applications, all of this within the scope of ICPR. In every challenge organizers released data, and provided a platform for evaluation. The top-ranked participants were invited to submit papers for this volume. Likewise, organizers themselves wrote articles summarizing the design, organization and results of competitions. Submissions were subject to a standard review process carried out by the organizers of each competition. Papers associated with seven out the eight competitions are included in this volume, thus making it a representative compilation of what happened in the ICPR challenges.

We are immensely grateful to the organizers and participants of the ICPR 2020 challenges for their efforts and dedication to make the competition track a success. We hope the readers of this volume enjoy it as much as we have.

November 2020

Marco Bertini
Hugo Jair Escalante

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