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Pattern Recognition and Image Analysis

10th Iberian Conference, IbPRIA 2022
Aveiro, Portugal, May 4–6, 2022
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Preface

When, in July 2019, during the 9th edition of IbPRIA in Madrid, the city of Aveiro was announced as the 2021 location for the 10th edition, we were all far from imagining what was to come: in March 2020, the world almost came to a halt. Like many other activities, scientific conferences also had to adapt to the new reality and became remote. The 10th edition of IbPRIA was scheduled to occur in June 2021. However, after an illusive return to a certain normality by the end of 2020, soon it was realized that having a face to face conference would be highly improbable. Therefore, in January 2021, in agreement with both supporting associations, AERFAI and APRP, the conference was postponed to May 2022. Instead of keeping the original date and running the conference remotely, the main reason for this decision was our strong belief that one of the key aims of IbPRIA is to give researchers the opportunity to be together for three days, fostering new collaborations. This is also why the conference is single track, and tutorials and lunches are included in the registration. There is no excuse for not expanding our network of fellow researchers!

So, it is indeed a great pleasure to be here, in the beautiful city of Aveiro, receiving all of you for what we believe will be a very rewarding event. After nine editions, always occurring in odd years, namely in Andraxt (2003), Estoril (2005), Girona (2007), Póvoa de Varzim (2009), Las Palmas de Gran Canaria (2011), Madeira (2013), Santiago de Compostela (2015), Faro (2017), and Madrid (2019), this edition happens in an even year, almost three years after the previous one. However, the odd-year tradition will be resumed with IbPRIA 2023, in Spain!

IbPRIA is an international conference co-organized by the Portuguese APRP (Associação Portuguesa de Reconhecimento de Padrões) and Spanish AERFAI (Asociación Española de Reconocimiento de Formas y Análisis de Imágenes) chapters of IAPR (International Association for Pattern Recognition). For this edition, we received 72 full paper submissions, from which we selected 26 to be presented in oral sessions. Also, 28 papers were accepted for poster presentation. There were submissions from authors in 15 countries, showing that, although most of the contributions come traditionally from Portugal and Spain, there is a good level of interest in IbPRIA from researchers in other countries. On average, each paper received three reviews, mostly from members of the Program Committee. The final decision of acceptance was made by the editors of this volume, leaving out a number of very interesting papers that could not be accommodated in the final program.

Of course, a successful event depends on the invaluable effort of many people, including authors, reviewers, chairs, and members of the conference committees. A special thanks to the invited speakers, Bob Fisher, Isabel Trancoso, and Battista Biggio, and tutorial presenters Hermann Ney and Gregory Rogez. A final word to the outstanding

members of the local committee, the real force behind the organization of IbPRIA 2022. Thanks!

May 2022

Armando J. Pinho
Petia Georgieva
Luís F. Teixeira
Joan Andreu Sánchez

Organization

IbPRIA 2022 was co-organized by the Spanish AERFAI and the Portuguese APRP chapters of IAPR (International Association for Pattern Recognition), and locally organized by IEETA (Institute of Electronics and Informatics Engineering of Aveiro), University of Aveiro, Portugal.

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APRP – Associação Portuguesa de Reconhecimento de Padrões
FCT – Fundação para a Ciência e a Tecnologia, Portugal
UA – University of Aveiro, Portugal

Plenary Talks

The Vision Subsystems in the TrimBot2020 Gardening Robot

Robert Fisher

School of Informatics, University of Edinburgh, UK

Abstract. The TrimBot2020 gardening robot was designed to work outdoors in varying lighting conditions. The robot also needed to perform various tasks: model the garden, navigate without collisions, itentify and servo the vehicle to trimming locations, and identify and servo the cutters to trimming targets. Each of these tasks led to a different computer vision approach. This talk will give an overview of each of the systems, which included 2D intensity, 2D-to-3D, and 3D point cloud processing, using both traditional and deepnet algorithms.

Speech as Personal Identifiable Information

Isabel Trancoso

IST, University of Lisbon, Portugal

Abstract. Speech is the most natural and immediate form of communication. It is ubiquitous. The tremendous progress in language technologies that we have witnessed in the past few years has led to the use of speech as input/output modality in a panoplia of applications which have been mostly reserved for text until recently. Many of these applications run on cloud-based platforms that provide remote access to powerful models in what is commonly known as Machine Learning as a Service (MLaaS), enabling the automation of time-consuming tasks (such as transcribing speech), and help users to perform everyday tasks (e.g. voice-based virtual assistants). When a biometric signal such as speech is sent to a remote server for processing, however, this input signal can be used to determine information about the user, including his/her preferences, personality traits, mood, health, political opinions, among other data such as gender, age range, height, accent, education level, etc. Although there is a growing society awareness about user data protection (the GDPR in Europe is such an example), most users of such remote servers are unaware of the amount of information that can be extracted from a handful of their sentences - in particular, about their health status. In fact, the potential of speech as a biomarker for health has been realised for diseases affecting respiratory organs, such as Obstructive Sleep Apnea or COVID-19, for mood disorders such as Depression, and Bipolar Disease, and neurodegenerative diseases such as Parkinson's or Alzheimer's disease. The potential for mining this type of information from speech is however largely unknown. The current state of the art in speaker recognition is also largely unknown. Many research studies with humans involve speech recordings. In the past, such recordings were stored, claiming that all user information is anonymised, but given that recent challenges in speaker recognition involve corpora of around 6,000 speakers, this anonymity may nowadays be questionable. Users are also generally unaware of the potential misuse of their speech data for voice cloning from a handful of utterances. This enormous potential can be used for impersonation attacks that may be harmfully used for defamation, misinformation or incrimination. Moreover, this potential also raises crucial spoofing concerns for automatic speaker verification systems. Machine Learning as a Service has been used to process different types of signal, namely using cryptographic techniques such as homomorphic encryption, secure

multiparty computation, distance preserving hashing techniques, or differential privacy, among others. Their use for remote speech processing, however, raises many problems, namely in terms of computational and transmission costs, and their use may also imply some performance degradation. The discussion of all these issues thus requires joining forces of different research communities - speech, cryptographic, usability - but also the legal and the policy and non-legal governance communities. Their different taxonomy is probably the first obstacle to conquer. The GDPR contains few norms that have direct applicability to inferred data, requiring an effort of extensive interpretation of many of its norms, with adaptations, to guarantee the effective protection of people's rights in an era where speech must be legally regarded as PII (Personal Identifiable Information).

Machine Learning Security: Attacks and Defenses

Battista Biggio

Department of Electrical and Electronic Engineering,
University of Cagliari, Italy

Abstract. In this talk, I will briefly review some recent advancements in the area of machine learning security, including attacks and defenses, with a critical focus on the main factors which are hindering progress in this field. These include the lack of an underlying, systematic and scalable framework to properly evaluate machine-learning models under adversarial and out-of-distribution scenarios, along with suitable tools for easing their debugging. The latter may be helpful to unveil flaws in the evaluation process, as well as the presence of potential dataset biases and spurious features learned during training. I will finally report concrete examples of what our laboratory has been recently working on to enable a first step towards overcoming these limitations, in the context of different applications, including malware detection.

Invited Tutorials

Speech Recognition and Machine Translation: From Bayes Decision Theory to Machine Learning and Deep Neural Networks

Hermann Ney

RWTH Aachen University, Germany

Abstract. The last 40 years have seen a dramatic progress in machine learning and statistical methods for speech and language processing like speech recognition, handwriting recognition and machine translation. Many of the key statistical concepts had originally been developed for speech recognition. Examples of such key concepts are the Bayes decision rule for minimum error rate and sequence-to-sequence processing using approaches like the alignment mechanism based on hidden Markov models and the attention mechanism based on neural networks.

Recently the accuracy of speech recognition, handwriting recognition machine translation could be improved significantly by the use of artificial neural networks and specific architectures, such as deep feed-forward multi-layer perceptrons and recurrent neural networks, attention and transformer architectures. We will discuss these approaches in detail and how they form part of the probabilistic approach.

Human 3D Sensing from Monocular Visual Data Using Classification Techniques

Gregory Rogez

NAVER LABS Europe, Grenoble, France

Abstract. In this tutorial, I will explain how the complex and severely ill-posed problem of 3D human pose estimation from monocular images can be tackled as a detection problem using standard object classifiers. I will review the classification-based techniques that were proposed over the past 15 years to handle different levels of the human body including full-body, upper body, face and hands. I will discuss advantages and drawbacks of classification approaches and present in detail some solutions involving training data synthesis, CNN architectures, distillation and transformers.

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