

Advances in Face Detection and Facial Image Analysis

Michal Kawulok • M. Emre Celebi
Bogdan Smolka
Editors

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 Springer

Editors

Michał Kawulok
Automatic Control, Electronics and
Computer Science
Silesian University of Technology
Gliwice, Poland

M. Emre Celebi
Computer Science
Louisiana State University in Shreveport
Shreveport, LA, USA

Bogdan Smolka
Automatic Control, Electronics and
Computer Science
Silesian University of Technology
Gliwice, Poland

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Preface

Face detection and recognition is an active research topic of computer vision and pattern recognition. A number of novel methods that are emerging every year improve the accuracy of face and facial landmarks detection, thereby increasing the number and diversity of human face analysis applications. New research directions include, in particular, facial dynamics recognition underpinned with psychological background aimed, for example, at behavior analysis, deception detection, or diagnosis of psychological disorders.

The goal of this volume is to summarize the state of the art in face detection and analysis, taking into account the most promising advances in this field.

The volume opens with three chapters on face detection and lighting adjustment. In the chapter “A Deep Learning Approach to Joint Face Detection and Segmentation,” Luu et al. propose an algorithm for detecting faces using multiscale combinatorial grouping, deep learning (using the GPU-based Caffe framework), and one-class support vector machines. The detected faces are then refined using the modified active shape models. The effectiveness of the proposed face detection and segmentation algorithm is demonstrated on the Multiple Biometric Grand Challenge and Labeled Faces in the Wild databases.

In the chapter “Face Detection Coupling Texture, Color and Depth Data,” Nanni et al. demonstrate how to combine multiple face detectors. While it is well known that an ensemble of detectors increases the detection rate at the cost of higher false-positives, the authors discuss various filtering techniques for keeping the false-positives low. The authors also make their MATLAB code publicly available, which is a valuable contribution to the face detection community.

In the chapter “Lighting Estimation and Adjustment for Facial Images,” Jiang et al. present a lighting estimation algorithm for facial images and a lighting adjustment algorithm for video sequences. For the estimation of the illumination condition of a single image, a statistical model is proposed to reconstruct the lighting subspace. For lighting adjustment of image sequences, an entropy-based optimization algorithm, which minimizes the difference between successive images, is introduced. The effectiveness of the proposed algorithms is evaluated on face detection, recognition, and tracking.

The volume continues with three chapters on facial expression recognition and modeling. In the chapter “Advances, Challenges, and Opportunities in Automatic Facial Expression Recognition,” Martinez and Valstar discuss the state of the art in automatic facial expression recognition. The authors first present three approaches for modeling facial expressions that are commonly adopted by the researchers. They then review the existing techniques used in subsequent stages of the standard algorithmic pipeline applied to detect and analyze facial expressions. Finally, the authors outline the crucial challenges and opportunities in the field, taking into account various aspects concerned with psychology, computer vision, and machine learning.

In the chapter “Exaggeration Quantified: An Intensity-Based Analysis of Posed Facial Expressions,” Bhaskar et al. report their study on detecting posed facial expressions. The authors outline the importance of differentiating between posed and spontaneous expressions and present a new two-stage method to solve this problem. This method first determines the expression type and then classifies it as posed or spontaneous using a support vector machine.

In the chapter “Method of Modelling Facial Action Units Using Partial Differential Equations,” Ugail and Ismail et al. develop a method for modeling action units to represent human facial expressions in three dimensions using biharmonic partial differential equations. The authors represent the action units in terms of Fourier coefficients related to the boundary curves, which allows the storage of both the face and facial expressions in highly compressed form.

The volume continues with four chapters on face recognition. In the chapter “Trends in Machine and Human Face Recognition,” Mandal et al. present the state of the art in automatic machine face identification, as well as the advances in the psychological research on recognizing faces by humans. The chapter contains an interesting discussion on the most important factors that contribute to the interclass variation of human faces, such as lighting direction and facial expression, that often complicate the design of face recognition systems. The authors briefly review the history of face recognition algorithms, evaluation methodologies, and benchmarks. They also outline the current trends, including hot research topics as well as emerging benchmarks. Finally, the chapter contains an inspiring discussion concerning the psychological findings on human perception of faces, which contrasts the challenges of computer vision with those that humans encounter in recognizing faces.

In the chapter “Labeled Faces in the Wild: A Survey of Papers Published on the Benchmark,” Learned-Miller et al. provide a detailed summary of the exciting research on face recognition that has been conducted on their Labeled Faces in the Wild (LFW) database since its publication in 2007. It is fascinating to witness how researchers have made progress on this challenging benchmark over the years, reaching an impressive accuracy of 99.63% in 2015. The authors also discuss emerging databases and benchmarks, which will hopefully allow the face recognition community to identify new challenges and eventually improve the state of the art.

In the chapter “Reference-Based Pose-Robust Face Recognition,” Kafai et al. introduce a novel reference-based face recognition framework. This framework

involves the creation of a reference-based descriptor for the probe and gallery images by comparing them to a reference set, rather than comparing the probe and gallery images directly. The proposed framework is used in conjunction with various descriptors (e.g., the local binary patterns) and compared against several state-of-the-art face recognition algorithms on various public databases.

In the chapter “On the Importance of Frame Selection for Video Face Recognition,” Dhamecha et al. discuss the importance of frame selection in video face recognition, provide a brief survey of existing techniques, and present an entropy-based frame selection algorithm. The authors demonstrate the performance of the proposed algorithm on the Point-and-Shoot-Challenge database.

The volume concludes with four chapters on applications of face analysis. In the chapter “Modeling of Facial Wrinkles for Applications in Computer Vision,” Batool and Chellappa address the analysis and modeling of aging human faces. The authors focus on facial wrinkles, classified as subtle discontinuities or cracks in surrounding inhomogeneous skin texture. They review image features that can be used to capture the intensity gradients caused by facial wrinkles in the context of applications such as age estimation, facial expression analysis, and localization or detection of wrinkles and their removal for facial image retouching.

In the chapter “Communication-Aid System Using Eye-Gaze and Blink Information,” Abe et al. present a system based on a personal computer and home video camera, designed to track user’s eye gaze and blinks allowing for human-machine interaction. The authors also describe a method for the classification of eye blink types, which enables the detection of voluntary and involuntary blinks, allowing for efficient interaction with the computer for people with severe physical disabilities. The communication-aid systems in which the proposed solutions can be utilized are also discussed.

In the chapter “The Utility of Facial Analysis Algorithms in Detecting Melancholia,” Hyett et al. present an overview of the image processing/analysis algorithms for the detection and diagnosis of depressive disorders. The authors focus particularly on the differentiation of melancholia from the other non-melancholic conditions.

In the chapter “Visual Speech Feature Representations: Recent Advances,” Sui et al. summarize the latest research in the field of visual speech recognition (VSR), which has emerged to provide an alternative solution to improve speech recognition performance. VSR systems can be applied in noisy environments, where the speech recognition performance can be boosted through the fusion of audio and visual modalities. The authors survey the most recent advances in the field of visual feature extraction and also discuss future research directions.

A chapter entitled “Extended Eye Landmarks Detection for Emerging Applications,” by Florea et al., completes the volume. The authors investigate the problem of eye landmark localization and gaze direction recognition in the context of eye tracking applications. Various approaches are described and extensively tested on several image databases and compared against state-of-the-art methods.

We hope that this volume, focused on face detection and analysis, will demonstrate the significant progress that has occurred in this field in recent years. We also hope that the developments reported in this volume will motivate further research in this exciting field.

Gliwice, Poland
Shreveport, LA, USA
Gliwice, Poland

Michal Kawulok
M. Emre Celebi
Bogdan Smolka

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