

Advances in Computer Vision and Pattern Recognition

Founding editor

Sameer Singh, Rail Vision, Castle Donington, UK

Series editor

Sing Bing Kang, Microsoft Research, Redmond, WA, USA

Advisory Board

Horst Bischof, Graz University of Technology, Austria

Richard Bowden, University of Surrey, Guildford, UK

Sven Dickinson, University of Toronto, ON, Canada

Jiaya Jia, The Chinese University of Hong Kong, Hong Kong

Kyoung Mu Lee, Seoul National University, South Korea

Yoichi Sato, The University of Tokyo, Japan

Bernt Schiele, Max Planck Institute for Computer Science, Saarbrücken, Germany

Stan Sclaroff, Boston University, MA, USA

More information about this series at <http://www.springer.com/series/4205>

Massimo Tistarelli · Christophe Champod
Editors

Handbook of Biometrics for Forensic Science

Editors

Massimo Tistarelli
University of Sassari
Alghero, Sassari
Italy

Christophe Champod
University of Lausanne
Lausanne
Switzerland

ISSN 2191-6586 ISSN 2191-6594 (electronic)
Advances in Computer Vision and Pattern Recognition
ISBN 978-3-319-50671-5 ISBN 978-3-319-50673-9 (eBook)
DOI 10.1007/978-3-319-50673-9

Library of Congress Control Number: 2016959546

© Springer International Publishing AG 2017

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

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

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

Printed on acid-free paper

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

Preface

Forensic Biometrics is a relatively novel discipline with a long-standing history. Even though this assertion may seem contradictory, it is true that biometric samples have been used in forensic examination since many decades. However, the systematic adoption of biometric technologies for criminal investigations and the incorporation in forensic processes is relatively new. In this regard, a considerable effort has been performed in the past 4 years by the European Union COST Action IC1106 “Integrating Biometrics and Forensics for the Digital Age.”

The COST IC1106 research consortium is composed of over 40 members, research institutions, and forensic laboratories mainly from Europe and also from Australia, China, and USA. Aim of the Action has been to promote synergies between the biometrics recognition and the forensics science communities. This was achieved by means of innovative networking and scientific exchange. Most of the chapters making this edited volume are the outcome of this scientific collaboration.

Today’s digital era is providing not only new computing solutions to assist forensics but also new threats and challenges, which cannot be solved with traditional approaches. These include identity-related scenarios such as attacks on security systems and the identification of abnormal/dangerous behaviors from remote cameras. New identification technologies and pattern recognition algorithms offer ways to provide proof of identity in these cases.

This book is the outcome of a strong new interdisciplinary community, which is establishing and disseminating good practice, and is stimulating novelty and interdisciplinarity in exploiting scientific possibilities.

While this trend deserves a growing attention, a strong impact is expected in many forensic scenarios, including identification at sensitive border crossing, analysis of video traces from surveillance cameras, and providing proof of evidence in court cases. This book presents a wide and in-depth view of the most advanced biometric technologies applied and purposively developed to forensic cases.

A multiview approach is presented to the reader, with each chapter being designed to cover a different subject written by authors from different research institutions, and the objective of covering the subject from different perspectives.

This comprehensive, innovative, state-of-the-art volume is designed to form and inform professionals, young researchers, and graduate students in the most advanced forensic biometrics technologies.

Alghero, Italy
June 2016

Massimo Tistarelli
Christophe Champod

Contents

1	Biometric Technologies for Forensic Science and Policing: State of the Art	1
	Christophe Champod and Massimo Tistarelli	
Part I Analysis of Fingerprints and Fingermarks		
2	Capture and Analysis of Latent Marks	19
	Mario Hildebrandt, Jana Dittmann and Claus Vielhauer	
3	Automated Fingerprint Identification Systems: From Fingerprints to Fingermarks	37
	Davide Maltoni, Raffaele Cappelli and Didier Meuwly	
4	Challenges for Fingerprint Recognition—Spoofing, Skin Diseases, and Environmental Effects	63
	Martin Drahanský, Ondřej Kanich and Eva Březinová	
5	Altered Fingerprint Detection	85
	John Ellingsgaard and Christoph Busch	
Part II Face and Video Analysis		
6	Face Sketch Recognition via Data-Driven Synthesis	127
	Nannan Wang, Shengchuan Zhang, Chunlei Peng, Jie Li and Xinbo Gao	
7	Recent Developments in Video-Based Face Recognition	149
	Jingxiao Zheng, Vishal M. Patel and Rama Chellappa	
8	Face Recognition Technologies for Evidential Evaluation of Video Traces	177
	Xingjie Wei and Chang-Tsun Li	

9	Human Factors in Forensic Face Identification	195
	David White, Kristin Norell, P. Jonathon Phillips and Alice J. O'Toole	
Part III Human Motion, Speech and Behavioral Analysis		
10	Biometric Evidence in Forensic Automatic Speaker Recognition	221
	Andrzej Drygajlo and Rudolf Haraksim	
11	On Using Soft Biometrics in Forensic Investigation	241
	Paulo Lobato Correia, Peter K. Larsen, Abdenour Hadid, Martin Sandau and Miguel Almeida	
12	Locating People in Surveillance Video Using Soft Biometric Traits	267
	Simon Denman, Michael Halstead, Clinton Fookes and Sridha Sridharan	
13	Contact-Free Heartbeat Signal for Human Identification and Forensics	289
	Kamal Nasrollahi, Mohammad A. Haque, Ramin Irani and Thomas B. Moeslund	
Part IV Statistical Analysis of Forensic Biometric Data		
14	From Biometric Scores to Forensic Likelihood Ratios	305
	Daniel Ramos, Ram P. Krish, Julian Fierrez and Didier Meuwly	
15	Dynamic Signatures as Forensic Evidence: A New Expert Tool Including Population Statistics	329
	Ruben Vera-Rodriguez, Julian Fierrez and Javier Ortega-Garcia	
Part V Ethical and Legal Issues		
16	Ethics and Policy of Forensic Biometrics	353
	Emilio Mordini	
	Index	367