PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 6505

, "Front Matter: Volume 6505," Proc. SPIE 6505, Security, Steganography, and Watermarking of Multimedia Contents IX, 650501 (5 March 2007); doi: 10.1117/12.731272

SPIE.

Event: Electronic Imaging 2007, 2007, San Jose, CA, United States

Security, Steganography, and Watermarking of Multimedia Contents IX

Edward J. Delp III
Ping Wah Wong
Editors

29 January–1 February 2007
San Jose, California, USA

Sponsored and Published by
IS&T—The Society of Imaging Science and Technology
SPIE—The International Society for Optical Engineering

SPIE Vol. 6505

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publishers are not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Security, Steganography, and Watermarking of Multimedia Contents IX*, edited by Edward J. Delp III, Ping Wah Wong, Proceedings of SPIE-IS&T Electronic Imaging, SPIE Vol. 6505, Article CID Number (2007).

ISSN 0277-786X
ISBN 9780819466181

Copublished by

SPIE—The International Society for Optical Engineering

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone 1 360/676-3290 (Pacific Time) · Fax 1 360/647-1445

<http://www.spie.org>

and

IS&T—The Society for Imaging Science and Technology

7003 Kilworth Lane, Springfield, Virginia, 22151 USA

Telephone 1 703/642-9090 (Eastern Time) · Fax 1 703/642-9094

<http://www.imaging.org>

Copyright © 2007, The Society of Photo-Optical Instrumentation Engineers and The Society for Imaging Science and Technology.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE and IS&T subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at <http://www.copyright.com>. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/07/\$18.00.

Printed in the United States of America.

Contents

ix	Conference Committee
xi	Introduction

SESSION 1 STEGANALYSIS

650502	Practical methods for minimizing embedding impact in steganography [6505-01] J. Fridrich, T. Filler, SUNY Binghamton (USA)
650503	Merging Markov and DCT features for multi-class JPEG steganalysis [6505-02] T. Pevný, J. Fridrich, Binghamton Univ., SUNY (USA)
650504	Batch steganography and the threshold game [6505-03] A. D. Ker, Oxford Univ. (United Kingdom)
650505	Mel-cepstrum based steganalysis for VoIP steganography [6505-04] C. Kraetzer, J. Dittmann, Otto-von-Guericke-Univ. of Magdeburg (Germany)
650506	Optimally weighted least-squares steganalysis [6505-05] A. D. Ker, Oxford Univ. (United Kingdom)
650507	Blind source separation for steganalytic secret message estimation [6505-06] A. Ambalavanan, R. Chandramouli, Stevens Institute of Technology (USA)

SESSION 2 AUDIO

650508	Robust message authentication code algorithm for digital audio recordings [6505-07] S. Zmudzinski, M. Steinebach, Fraunhofer Institute for Secure Information Technology (Germany)
650509	Blind audio watermark synchronization by passive audio fingerprinting [6505-08] M. Steinebach, S. Zmudzinski, Fraunhofer Institute for Secure Information Technology (Germany)

Pagination: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication.

SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages.

- 65050A **Audio watermarking robust to geometrical distortions based on dyadic wavelet transform** [6505-09]
Y. Wang, S. Wu, Sun Yat-Sen Univ. (China); J. Huang, Guangdong Province Key Lab. of Information Security (China)

SESSION 3 **ATTACKS**

- 65050B **Efficient non-interactive zero-knowledge watermark detector robust to sensitivity attacks** [6505-10]
J. R. Troncoso, F. Pérez-González, Univ. of Vigo (Spain)
- 65050C **Reverse-engineering a detector with false alarms** [6505-11]
S. Craver, J. Yu, Binghamton Univ. (USA)
- 65050D **On distortion measures associated to random desynchronization attacks** [6505-12]
F. Balado, Univ. College Dublin (Ireland); F. Pérez-González, Univ. of Vigo (Spain)
- 65050E **Fast and automatic watermark resynchronization based on Zernike moments** [6505-13]
X. Kang, C. Liu, Sun Yat-Sen Univ. (China); W. Zeng, Univ. of Missouri-Columbia (USA); J. Huang, C. Liu, Sun Yat-Sen Univ. (China)

SESSION 4 **THEORETICAL METHODS**

- 65050F **Security of spread-spectrum-based data hiding** [6505-14]
L. Pérez-Freire, Univ. of Vigo (Spain); P. Moulin, Univ. of Illinois at Urbana-Champaign (USA); F. Pérez-González, Univ. of Vigo (Spain)
- 65050G **Trellis coded modulation to improve dirty paper trellis watermarking** [6505-16]
C. K. Wang, G. Doërr, I. Cox, Univ. College London (United Kingdom)
- 65050H **Cramér-Rao bound on watermark desynchronization parameter estimation accuracy** [6505-17]
S. Sadasivam, P. Moulin, Beckman Institute, Univ. of Illinois at Urbana-Champaign (USA)
- 65050I **A novel interpretation of content authentication** [6505-18]
P. Comesaña, Univ. College Dublin (Ireland) and Univ. de Vigo (Spain); F. Balado, Univ. College Dublin (Ireland); F. Pérez-González, Univ. de Vigo (Spain)
- 65050J **Capacity and optimal collusion attack channels for Gaussian fingerprinting games** [6505-19]
Y. Wang, P. Moulin, Beckman Institute, Univ. of Illinois at Urbana-Champaign (USA)
- 65050K **Sphere packing lower bound on fingerprinting error probability** [6505-20]
N. Kiyavash, Univ. of Illinois at Urbana-Champaign (USA); P. Moulin, Beckman Institute, Univ. of Illinois at Urbana-Champaign (USA)

SESSION 5 BENCHMARKING

- 65050L **Nested object watermarking: comparison of block-luminance and blue channel LSB wet paper code image watermarking** [6505-21]
C. Vielhauer, J. Dittmann, Univ. of Magdeburg (Germany)
- 65050M **Deterring watermark collusion attacks using signal processing techniques** [6505-22]
A. N. Lemma, M. van der Veen, Philips Research Europe (Netherlands)
- 65050N **Experimental study on watermark interference in multiple re-watermarking** [6505-23]
D. Mark, Carinthia Tech Institute (Austria); A. Uhl, Carinthia Tech Institute (Austria) and Salzburg Univ. (Austria); H. Wernisch, Salzburg Univ. (Austria)
- 65050O **Evaluation of standard watermarking techniques** [6505-24]
E. Marini, Univ. de Nantes (France) and Univ. degli Studi di Roma Tre (Italy); F. Autrusseau, P. Le Callet, Univ. de Nantes (France); P. Campisi, Univ. degli Studi di Roma Tre (Italy)

SESSION 6 FORENSICS I

- 65050P **Digital imaging sensor identification (further study)** [6505-25]
M. Chen, J. Fridrich, M. Goljan, SUNY Binghamton (USA)
- 65050Q **Joint forensics and watermarking approach for video authentication** [6505-26]
S. Thiemert, H. Liu, M. Steinebach, L. Croce-Ferri, Fraunhofer-Gesellschaft (Germany)
- 65050R **Image splicing detection using 2D phase congruency and statistical moments of characteristic function** [6505-27]
W. Chen, Y. Q. Shi, New Jersey Institute of Technology (USA); W. Su, U.S. Intelligence & Information Warfare Directorate (USA)

SESSION 7 FORENSICS II

- 65050S **Robust scanner identification based on noise features** [6505-28]
H. Gou, A. Swaminathan, M. Wu, Univ. of Maryland, College Park (USA)
- 65050T **Detection of malevolent changes in digital video for forensic applications** [6505-29]
N. Mondaini, R. Caldelli, A. Piva, Univ. di Firenze (Italy); M. Barni, Univ. di Siena (Italy); V. Cappellini, Univ. di Firenze (Italy)
- 65050U **Forensic classification of imaging sensor types** [6505-30]
N. Khanna, A. K. Mikkilineni, G. T. C. Chiu, J. P. Allebach, E. J. Delp, Purdue Univ. (USA)

SESSION 8 NATURAL LANGUAGE WATERMARKING

- 65050V **Information hiding through errors: a confusing approach** [6505-31]
M. Topkara, U. Topkara, M. J. Atallah, Purdue Univ. (USA)
- 65050W **A comprehensive bibliography of linguistic steganography** [6505-32]
R. Bergmair, Univ. of Cambridge (United Kingdom)

- 65050X **Syntactic tools for text watermarking** [6505-33]
H. M. Meral, E. Sevinç, E. Ünkar, B. Sankur, A. S. Özsoy, T. Güngör, Boğaziçi Univ. (Turkey)
- 65050Y **The syntax of concealment: reliable methods for plain text information hiding** [6505-34]
B. Murphy, C. Vogel, Trinity College Dublin (Ireland)
- 65050Z **Statistically constrained shallow text marking: techniques, evaluation paradigm, and results** [6505-35]
B. Murphy, C. Vogel, Trinity College Dublin (Ireland)

SESSION 9 BIOMETRICS

- 650510 **Adaptive and distributed cryptography for signature biometrics protection** [6505-36]
P. Campisi, E. Maiorana, M. Gonzalez Prats, A. Neri, Univ. degli Studi Roma Tre (Italy)
- 650512 **Analyzing a multimodal biometric system using real and virtual users** [6505-38]
T. Scheidat, C. Vielhauer, Univ. of Magdeburg (Germany)
- 650513 **Digital watermarking of biometric speech references: impact to the EER system performance** [6505-39]
A. Lang, J. Dittmann, Otto-von-Guericke-Univ. of Magdeburg (Germany)
- 650514 **How to protect biometric templates** [6505-40]
Y. Sutcu, Q. Li, N. Memon, Polytechnic Univ. (USA)
- 650515 **Error exponent analysis of person identification based on fusion of dependent/independent modalities** [6505-41]
O. Koval, S. Voloshynovskiy, T. Pun, CUI-Univ. of Geneva (Switzerland)

SESSION 10 BOWS

- 650516 **The first BOWS contest (Break Our Watermarking System)** [6505-42]
A. Piva, Univ. of Florence (Italy); M. Barni, Univ. of Siena (Italy)
- 650517 **The good, the bad, and the ugly: three different approaches to break their watermarking system** [6505-43]
G. Le Guelvouit, France Telecom R&D (France); T. Furon, INRIA (France); F. Cayre, LIS (France)
- 650518 **Watermarking attack: BOWS contest** [6505-44]
J. Bennour, J.-L. Dugelay, F. Matta, Institut Eurecom (France)
- 650519 **Tangential sensitivity analysis of watermarks using prior information** [6505-45]
J. W. Earl, Cambridge Univ. (United Kingdom)
- 65051A **Tackling BOWS with the sensitivity attack** [6505-46]
A. Westfeld, Technische Univ. Dresden (Germany)
- 65051B **Two different approaches for attacking BOWS** [6505-47]
P. Comesaña, F. Pérez-González, Univ. de Vigo (Spain)

- 65051C **How we broke the BOWS watermark** [6505-48]
S. Craver, I. Atakli, J. Yu, Binghamton Univ. (USA)

SESSION 11 VIDEO

- 65051D **Adaptive MPEG-2 video data hiding scheme** [6505-49]
A. Sarkar, U. Madhow, S. Chandrasekaran, B. S. Manjunath, Univ. of California, Santa Barbara (USA)
- 65051E **Digital video watermarking in P-frames** [6505-50]
M. Noorkami, R. M. Mersereau, Georgia Institute of Technology (USA)
- 65051F **Framework for combined video frame synchronization and watermark detection** [6505-51]
E. Hauer, T. Bölke, M. Steinebach, Fraunhofer IPSI (Germany)

SESSION 12 FORENSICS III

- 65051G **Source digital camcorder identification using sensor photo response non-uniformity** [6505-53]
M. Chen, J. Fridrich, M. Goljan, J. Lukáš, SUNY Binghamton (USA)
- 65051H **Blind identification of cellular phone cameras** [6505-54]
O. Çeliktutan, Bogazici Univ. (Turkey); I. Avcıbaşı, Baskent Univ. (Turkey); B. Sankur, Bogazici Univ. (Turkey)
- 65051I **Forensics for flatbed scanners** [6505-55]
T. Gloe, E. Franz, A. Winkler, Technische Univ. Dresden (Germany)
- 65051J **Intrinsic fingerprints for image authentication and steganalysis** [6505-56]
A. Swaminathan, M. Wu, K. J. R. Liu, Univ. of Maryland, College Park (USA)
- 65051K **Scanner identification using sensor pattern noise** [6505-57]
N. Khanna, A. K. Mikkilineni, G. T. C. Chiu, J. P. Allebach, E. J. Delp, Purdue Univ. (USA)
- 65051L **A generalized Benford's law for JPEG coefficients and its applications in image forensics** [6505-58]
D. Fu, Y. Q. Shi, New Jersey Institute of Technology (USA); W. Su, U.S. Army Communication-Electronics RD&E Ctr. (USA)

SESSION 13 EMBEDDING I

- 65051N **Distortion-free robust watermarking: a case study** [6505-60]
D. Coltuc, LIS, National Polytechnic Institute of Grenoble (France) and Valahia Univ. Targoviste (Romania); J.-M. Chassery, LIS, National Polytechnic Institute of Grenoble (France)
- 65051O **Hidden context highlighting with JPEG2000 imagery** [6505-61]
R. Rosenbaum, H. Schumann, Univ. of Rostock (Germany)

SESSION 14 EMBEDDING II

- 65051Q **Perceptual data hiding in tree structured Haar transform domain** [6505-63]
M. Cancellaro, M. Carli, Univ. of Roma Tre (Italy); K. Egiazarian, J. Astola, Tampere Univ. of Technology (Finland)

SESSION 15 OTHER DOMAINS

- 65051R **A method of text watermarking using presuppositions** [6505-65]
O. Vybornova, B. Macq, Univ. Catholique de Louvain (Belgium)
- 65051S **An evaluation of lightweight JPEG2000 encryption with anisotropic wavelet packets**
[6505-66]
D. Engel, A. Uhl, Univ. of Salzburg (Austria)
- 65051T **Tamper-proofing of electronic and printed text documents via robust hashing and data-hiding** [6505-67]
R. Villán, S. Voloshynovskiy, O. Koval, F. Deguillaume, T. Pun, Univ. of Geneva (Switzerland)
- 65051U **Channel model and operational capacity analysis of printed text documents** [6505-68]
A. K. Mikkilineni, P.-J. Chiang, G. T. C. Chiu, J. P. Allebach, E. J. Delp, Purdue Univ. (USA)
- 65051V **Watermarking geographic vector-data using a variable strip-size scheme** [6505-69]
M. Voigt, Technical Univ. Darmstadt (Germany)
- 65051W **Authentication of H.264 streams by direct watermarking of CAVLC blocks** [6505-70]
B. G. Mobasser, Y. N. Raikar, Villanova Univ. (USA)

Author Index

Conference Committee

Symposium Chairs

Michael A. Kriss, Consultant (USA)
Robert A. Sprague, Consultant (USA)

Conference Chairs

Edward J. Delp III, Purdue University (USA)
Ping Wah Wong, Nethra Imaging (USA)

Conference Cochairs

Nasir D. Memon, Polytechnic University (USA)
Jana Dittmann, Otto-von-Guericke-Universität Magdeburg (Germany)

Program Committee

Adnan M. Alattar, Digimarc Corporation (USA)
Oscar C. L. Au, The Hong Kong University of Science and Technology (Hong Kong China)
Mauro Barni, Università degli Studi di Siena (Italy)
Jeffrey A. Bloom, Thomson Corporate Research (USA)
Gordon W. Braudaway, IBM Corporation (USA)
Ee-Chien Chang, National University of Singapore (Singapore)
Ingemar J. Cox, University College London (United Kingdom)
Ahmet M. Eskicioglu, The City University of New York (USA)
Jessica Fridrich, Binghamton University, SUNY (USA)
Teddy Furon, Institut National de Recherche en Informatique et en Automatique (France)
Ton Kalker, Hewlett-Packard Company (USA)
Reginald L. Lagendijk, Technische Universiteit Delft (Netherlands)
Benoît Macq, Université Catholique de Louvain (Belgium)
Bangalore S. Manjunath, University of California, Santa Barbara (USA)
Pierre Moulin, Beckman Institute, University of Illinois at Urbana-Champaign (USA)
Fernando Pérez-González, Universidade de Vigo (Spain)
Rei Safavi-Naini, University of Wollongong (Australia)
Bülent Sankur, Boğaziçi University (Turkey)
Gaurav Sharma, University of Rochester (USA)
Claus Vielhauer, Otto-von-Guericke-Universität Magdeburg (Germany)
Sviatoslav V. Voloshynovskiy, Université de Genève (Switzerland)
Min Wu, University of Maryland, College Park (USA)

Session Chairs

- 1 Steganalysis
Jessica Fridrich, Binghamton University, SUNY (USA)
- 2 Audio
Bertrand Chupeau, THOMSON (France)
- 3 Attacks
Reginald L. Lagendijk, Technische Universiteit Delft (Netherlands)
- 4 Theoretical Methods
Sviatoslav V. Voloshynovskiy, Université de Genève (Switzerland)
- 5 Benchmarking
Jana Dittmann, Otto-von-Guericke-Universität Magdeburg (Germany)
- 6 Forensics I
Nasir D. Memon, Polytechnic University (USA)
- 7 Forensics II
Jessica Fridrich, Binghamton University, SUNY (USA)
- 8 Natural Language Watermarking
Mercan Topkara, Purdue University (USA)
Edward J. Delp III, Purdue University (USA)
- 9 Biometrics
Claus Viehauer, Otto-von-Guericke-Universität Magdeburg (Germany)
- 10 BOWS
Mauro Barni, Università degli Studi di Siena (Italy)
Fernando Pérez-González, Universidade de Vigo (Spain)
- 11 Video
Adnan M. Alattar, Digimarc Corporation (USA)
- 12 Forensics III
Chad D. Heitzenrater, Air Force Research Laboratory (USA)
- 13 Embedding I
Benoît Macq, Université Catholique de Louvain (Belgium)
- 14 Embedding II
Benoît Macq, Université Catholique de Louvain (Belgium)
- 15 Other Domains
Edward J. Delp III, Purdue University (USA)

Introduction

Welcome to the Security, Steganography, and Watermarking of Multimedia Contents Conference!

This is our ninth year of the conference. We had more than 110 papers submitted. Of these, 70 papers from more than 14 countries were presented at this year's meeting. The goal of the meeting, as always, was to provide a forum for the discussion of issues in multimedia security. At the conference we had papers that addressed protecting audio, image, and video content, along with many interesting papers in cryptography and applications. We had special sessions on natural language watermarking and forensics. As we say every year, we have come a long way in protecting our "digital future" but we still have a lot of work to do. We would like to thank the Program Committee for their help in reviewing the papers and their advice on the final program. We look forward to seeing you in 2008 in San Jose!

Edward J. Delp
Ping Wah Wong
Jana Dittmann
Nasir D. Memon