PROCEEDINGS OF SPIE

Mathematics of Data/Image Coding, Compression, and Encryption with Applications XII

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2–4 August 2010
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 7799

Proceedings of SPIE, 0277-786X, v. 7799

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 publisher is 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 *Mathematics of Data/Image Coding, Compression, and Encryption with Applications XII*, edited by Mark S. Schmalz, Gerhard X. Ritter, Junior Barrera, Jaakko T. Astola, Proceedings of SPIE Vol. 7799 (SPIE, Bellingham, WA, 2010) Article CID Number.

ISSN 0277-786X
ISBN 9780819482952

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
SPIE.org

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIEDigitalLibrary.org

Paper Numbering: 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:

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Introduction

Image compression, encryption, and pattern recognition are emerging as crucial supporting technologies for numerous applications in diverse fields. Traditionally, image compression is directed toward decreasing data burden, thus increasing storage efficiency, effective communication channel bandwidth, and data security. Illustrative applications include videotelephony, remote sensing, Internet delivery of still imagery and video, as well as storage, retrieval, and processing of medical, military, or environmental image processing. Increasingly, image compression is being used to precondition data prior to processing – a wide range of research has addressed the benefits of developing special compression transforms that extract key object features from compressed sensor datastreams.

Researchers are focusing, in general, on the quantification of error in compression and, in particular, error in decompressed imagery. An example of this is the development of theory for successive approximations that support iterative or recursive representation of imaging data, and partitioning of remote sensing datacubes into spectral regions and features of mission-specific interest. Although numerous perceptual measures have been developed for assessing image quality in decompressed imagery, there remain few measures that address non-perceptual problems such as local (e.g., feature-specific) distortion in objects or classes of objects typically present in medical or military images. Additional problems in image and video quality measures include correspondence with human evaluations of image quality, as well as the poorly understood phenomenon of semantic correspondence between images or video sequences. Illustrative applications in medical imaging, military target recognition, or security applications integrate compression and digital watermarking.

A key topic of interest emphasizes how semantic properties of image data jointly support compression and pattern recognition. As shown in our previous conferences, the union of semantic pattern recognition and compression increasingly offers useful insights into this challenging problem.

This conference on the mathematics of data and image pattern recognition, compression, and encryption addresses theory, design, analysis, and testing of pattern recognition, compression, and encryption (e.g., watermarking) algorithms. In response to conference presenters' and attendees' requests in this and previous years, we continue to emphasize security, watermarking, and theory/practice of error measurement. Example applications include semantic analysis and compression (e.g., for surveillance and remote sensing data and imagery), as well as survivable watermarks. Thus, the first session of this conference addresses several theoretical issues in imaging theory, in particular,

model-based analysis and optimization of perspective and reconstruction transforms, hyperspectral imaging, and image indexing.

The second session continues the initial theme of imaging theory, with models for Wiener and adaptive state estimation for adaptive radar processing, as well as information-theoretic analysis of edge detection. A summary of ongoing research in the theory of image algebra, with implementation in terms of the Matlab language, is also given.

The third and fourth sessions address pattern recognition theory, emphasizing techniques for successive approximation applied to the design of metamaterials, and 3D object recognition with little information. Classification based on decision trees for character recognition and online video indexing is also featured.

The fifth session addresses crucial areas of compression theory and algorithm design, namely, the analysis of compression transforms for emitter location (TDOA and FDOA), fast Fourier transformation for compression, and efficient, lossless compression of hyperspectral data. A tutorial overview of semantic compression is also given. Session six continues this emphasis with theoretical developments in error modeling and analysis. Topics include running approximation theory for extended filter banks with nonlinear analysis filters, error analysis of filtering in medical imaging, and image registration using pattern recognition theory.

The seventh and eighth sessions return to the central theme of compression and error estimation theory, with wavelet and cosine transform embedded watermarking, error reduction in three-dimensional metrology, and error analysis with performance estimation for image registration. Papers in these areas are well represented in the poster session.

Throughout its 13-year history, this conference has successfully convened numerous scientific researchers from international institutions to discuss development of theory, analysis, and test technology for data/image pattern recognition, segmentation, understanding, compression, coding, and encryption. Despite their success in defining and resolving several important problems in image and video representation, as well as very low-rate compression, much research remains in the basic mathematical nature, characterization, and performance analysis of pattern recognition and compression algorithms. For example, how can data semantics be best represented to facilitate semantic analysis and compression of digital imagery, as well as fast reconstruction? A continuing topic of interest is the survivability of digital watermarks in practical image processing contexts.

The next conference in this series, scheduled for SPIE Optics + Photonics 2011, will continue the topical focus of this conference, extending the area of pattern recognition to further analyze semantic compression of still images and video, as well as forensic watermarking. The continued emphasis on theory and algorithms

for data security will motivate engineers, scientists, and algorithm designers to investigate new areas of compression, coding, and encryption technologies. Further emphasis will be directed toward theory and algorithms that support exploitation of compressed digital signals and imagery from sensor networks. Sensing and processing using compressed hyperspectral datastreams are planned topics for our 2011 conference. We also plan to continue emphasizing error analysis and performance metrics for compression, computation, and image/video perception, with illustrative examples in military, law enforcement, medical, environmental, and commercial imagery and video.

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