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

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Introduction

Image compression, encryption, and pattern recognition are emerging as crucial supporting technologies for numerous applications in fields as diverse as military imaging, medical technology, video transmission and gaming, and generative multimedia. Image compression is directed toward decreasing data burden, thus increasing storage efficiency, as well as supporting increases in effective communication channel bandwidth and data security. Applications considered in this conference include 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. One example 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 subjective (e.g., perceptual) measures have been developed for assessing image quality in decompressed imagery, few measures objectively 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 effect of compression error on pattern classification, for example, in medical imaging, military target recognition, or security applications that integrate compression and digital watermarking.

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 analysis and measurement, in the context of higher-level processes such as pattern classification. Example applications include pattern recognition in high noise and clutter, as well as survivable watermarks. Thus, the first session of this conference addresses several theoretical issues in pattern recognition, in particular, emerging types of neural networks that perform accurately in high noise and clutter.

The second session continues the previous year's theme of error analysis, with models for information-theoretic analysis of recursive filters, and analysis of multidimensional band-limited signals.

The third and fourth sessions address imaging theory, emphasizing techniques for successive approximation applied to model-based image understanding, and 3D object recognition from CAD models. Multidimensional feature extraction and edge pattern analysis are also featured applications.

The poster session addresses the application of compression and pattern recognition to solar imaging and distributed sensor systems, with medical sensors as an illustrative application.

Throughout its 14-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. However, much research remains in the basic mathematical nature, characterization, and performance analysis of pattern recognition and compression algorithms. For example, how can data semantics facilitate analysis and compression of digital imagery? How can we structure our compression and pattern recognition algorithms to combine adaptive learning approaches with adaptive segmentation techniques? A continuing topic of interest is the merging of compression and pattern recognition to facilitate eventual successes in image understanding.

The next conference in this series will take place at SPIE Optics+Photonics in 2013. It will continue the topical focus of this conference, extending the area of pattern recognition to further analyze semantics of audio and video signals, as well as placing emphasis upon error analysis in the survivability of 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 2013 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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