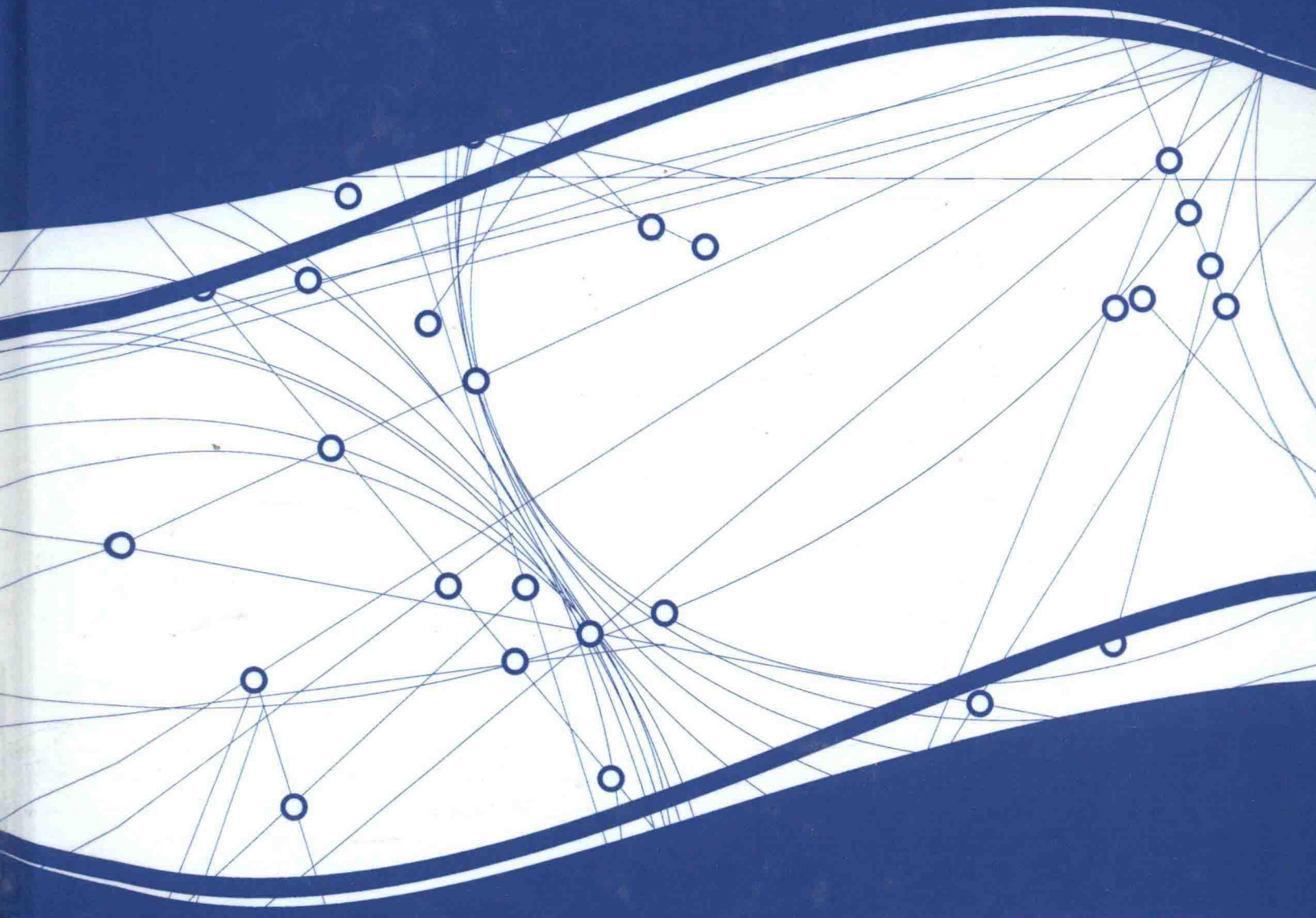
Handbook of Research on

Emerging Perspectives in Intelligent Pattern Recognition, Analysis, and Image Processing



Narendra Kumar Kamila

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Handbook of Research on Emerging Perspectives in Intelligent Pattern Recognition, Analysis, and Image Processing

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A volume in the Advances in Computational Intelligence and Robotics (ACIR) Book Series

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Foreword

Image Processing and Pattern Analysis are the two areas in applied science that have become almost indispensable in modern day to day life. The application areas are many. Use of images in medicine for diagnostic purpose is well known. Remote sensing through satellite images, biometric authentication through face and finger print recognition, video surveillance, visual inspection, automated navigation, gesture recognition and anomaly detection etc. are only to name a few. All these applications use images or sequences of images in the form of video as inputs. In most of the applications the raw input image or the image sequence is processed to have an intermediate representation, mostly symbolic, before it can be used for understanding the content of the images or video sequences. That is where the theory of learning and recognition comes into picture.

In all these applications determining the authenticity of the input data, image or video, is very essential. Also some of the critical applications may require secrecy of the image/ video data to be maintained while transmitting from one place to another. This demands watermarking as well as data hide to be effective.

Handbook of Research on Emerging Perspectives in Intelligent Pattern Recognition, Analysis, and Image Processing provides a valuable insight into the science of image data analysis as well as content recognition. The chapters contributed by various authors and classified into three different subsections, namely Image Processing and Computer Vision, Pattern Recognition, Watermarking and Face Recognition, and Bio-Imaging and Applications describe the employed techniques from the basics. I believe that the book will not only motivate the beginners in the Image Processing and Pattern Recognition domain but will act as a handbook to the researchers.

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Preface

The topic of image processing and pattern analysis plays a vital role in engineering science. Without research, technology does not carry any meaning. Similarly, without information and engineering the word "grow" has no existence in every field of life. Technology makes life better and smoother. To achieve that objective we have to value the potential global contribution of our researchers. Every day new inventions are coming to limelight enriching human life. The above topic is interrelated. Hence, our endeavor is to capture new inventions and present those to cater to the demands of global scientists and human beings at large.

It gives me a great sense of pleasure to introduce this collection of chapters to the readers of the book series *Emerging Perspectives in Intelligent Pattern Recognition, Analysis, and Image Processing*. In computer science perspective, the core of imaging science includes three intertwined computer science fields, namely: pattern recognition, image processing and computer vision. This book covers the emerging trends in these three important areas.

This book discusses the advances of image processing and pattern analysis. Moreover it aims to address how new innovation will cater to the demands of human beings and how it will help them in daily life. For example: images are already in use in card-less ATM transactions. The chapters included in this book entitled *Handbook of Research on Emerging Perspectives in Intelligent Pattern Recognition, Analysis, and Image Processing*" encompass different aspects of recent image processing and pattern analysis innovations, ranging from mobile image tracking, motion picture analysis, image data mining, warehousing, pattern classification, mobile image classification, real time application, 3D image, supporting routing protocol, advance networking for communication of multimedia image, operating system to process such image, supporting hardware architecture, brain computer interface, image restoration, segmentation and enhancement and other related topics. Additionally, the book will explore the impact of such technologies on the day to day lives.

The objective of this book is to bridge the existing gap in literature and comprehensively cover the system, processing and application aspects of both pattern recognition and image processing. Due to rapid developments in specialized areas of pattern recognition and image processing, this book takes on the form of a contributed volume where well known experts address specific research and application problems. It presents the state of the art as well as the most recent trends both in coverage and applications. It serves the needs of different readers at different levels. It can be used as stand-alone reference for masters, researchers and practitioners. For example, the researcher can use it as an up-to-date reference material since it offers a broad survey of the relevant literature. Finally, practicing engineers may find it useful in designing and implementing various pattern recognition and image processing tasks.

Pattern recognition (or pattern classification) can be defined as a process of generating a meaningful description of data and a deeper understanding of a problem through manipulation of a large set of primitive and quantifying data. The set inevitably includes image data. As a matter of fact, some of the data may come directly after the digitization of a natural image. Some of that large data set may come from statistics, documents or graphics and some are eventually expected to be in visual form. Preprocessing of these data is necessary for error corrections, for image enhancement, and for their understanding and recognition. Preprocessing operations are generally classified as low level operations while pattern recognition including analysis, description and understanding of the image (or the large data set) belongs to high level processing. The strategies and techniques chosen for the low and high level processing are interrelated and interdependent. Appropriate acquisition and preprocessing of the original data would alleviate the effort of pattern recognition to some extent. For a specific pattern recognition task we frequently require a special method of acquisition of data and its processing. However, visual experience is the principal way through which humans sense and communicate with the world around them. We are visual beings and images are increasingly made available to us in electronic digital format via digital cameras, the internet and hand held devices with large format screens. Despite much of the technology introduced in the consumer market, digital image processing remains a hot topic and promises to be one for a very long time. Of course, digital image processing has been around us for a while and indeed, its methods pervade nearly every branch of science and engineering.

However, images are not self-explanatory. Their interpretation requires professional skill that has to grow with the number of different imaging techniques. Many case reports and scientific articles about the use of images in diagnosis and therapy administration bear witness to this. The task of computer science has been, and still is, the quantification of information in the images by supporting the detection and delineation of structures from an image or from the fusion of information from different image sources. Image processing is a rapidly growing field that deals with the manipulation of an image for the purpose of either extracting information from the image or producing an alternative representation of the image. Image analysis includes modeling and analysis of the original image itself (i.e. from image space analysis to different methods to represent the image). Some of the tools used in image analysis include spectral analysis, wavelets, statistics, level-sets, rough sets, fuzzy logic and partial differential equations. On the other hand, image processing is useful in modifying the original image to improve the quality or to extract information from the given image, for example, image restoration, compression, segmentation, shape, and texture analysis. There are the two twin fields that are directly connected to image processing in contemporary computer science. In the field of these techniques enable us vision to the reconstruct 3D world from the observed 2D images and through computer graphics do the opposite i.e. designing suitable 2D scene images to simulate our 3D world. Image processing can be considered the crucial between vision and graphics.

This book purports to serve as a research reference book in the area of pattern recognition and image processing by providing useful cutting edge research information to the students, researchers, scientists, engineers and other working professionals in this area. The book provides the latest research trends and concepts to develop new methodologies and applications in the area of image representation and reconstruction and bio applications. In addition, the book also incorporates chapters related to new challenging application area of pattern recognition and image processing. Above all, each and every chapter is designed in such a way as to incorporate the latest literature review, methods and models, implementation, experimental results, performance analysis, conclusion, future work and the latest relevant references.

Pattern recognition and image processing can be applied in diverse areas to solve existing problems. This is one of the major reasons behind the subject growing so fast. The other important reason behind the quick development of this discipline is the need for solutions to practical problems.

Theory and applications are both important in pattern recognition as well as image processing. They are treated equally well in this book on a pragmatic basis. Here different types of problems of scientists and engineers are addressed concerning pattern recognition and image processing scientists and engineers. The book comprises chapters contributed by highly qualified and diverse group of authors.

It is my pleasure to present this book which includes selected chapters of internationally recognized authors on Pattern recognition, image processing and analysis. The book is intended to provide a forum for researchers, educators and professionals to share their discoveries and innovative practices with others and to explore future trends and applications in the field of pattern recognition, analysis and image processing. However, this book will also provide a forum for dissemination of knowledge on both theoretical and applied research on the above areas with an ultimate aim to bridge the gap between these coherent disciplines of knowledge. This forum accelerates interaction between the above bodies of knowledge, and fosters a unified development in the next generation pattern recognition and image processing.

The broad spectrum of this book includes the topics but not limited to:

- Mobile image tracking
- Motion picture analysis
- Image data mining, warehousing
- Pattern classification
- Pattern recognition, face recognition
- Shape, range and motion analysis
- Mobile image classification
- Real time application
- 3D image
- Supporting routing protocol
- Advance networking for communication of multimedia image
- Operating system to process such image
- Supporting hardware architecture
- Brain computer interface
- Image restoration
- Segmentation and enhancement
- Multisensory data fusion
- AI application in computer vision
- 3D vision and perception
- Signal or image processing
- Parallel computer vision
- Signature verification
- Medical imaging
- Image matching
- Cognitive vision
- Wireless sensor network application on image processing
- And related topics

ORGANIZATION OF THE BOOK

This edited book entitled *Emerging Perspectives in Intelligent Pattern Recognition, Analysis, and Image Processing* provides an overview of recent research developments in the field of pattern recognition and image processing and related applications. This book contains 19 chapters arranged under three sections, namely, section 1: Image Processing and computer vision, section 2: Pattern Recognition, watermarking and face recognition and Section 3: Bio Imaging and Applications.

Section 1: Image Processing and Computer Vision

The first chapter entitled "Image Data Mining Based on Wavelet Transform for Visualization of the Unique Characteristics of Image Data" by Belay et al. has proposed techniques to optimize and characterize the unique feature of image retrieval, which is fundamental to optimize informative mathematical representation of image objects. The authors who introduced a novel method for image database analysis under different scenarios that foster the widely access of image data are discussed in detail.

The authors of second chapter entitled "Total Variation Applications in Computer Vision" have presented a concise overview of regularization and explained the role of a particular type of regularization called total variation norm (TV-norm) in computer vision tasks. They have set up a brief discussion on the mathematical background of TV methods and established a relationship between models and a few existing methods to solve problems cast as TV-norm.

The 3rd chapter is based on Vision Enhancement in Bad Weather. Better visibility is a key requirement for passengers in bad weather. The authors have discussed different weather conditions and done a classification of fog with a comparative analysis for application point of view. Moreover, they have focused on enhancement of visibility for a degraded image due to heavy fog using computer vision method.

In contrast, in Chapter 4 the authors have proposed a distributed low-cost smart camera system to detect abnormal events by analyzing the sequential behaviors of a group of people using machine learning techniques. Moreover, this system employs a multi-camera collaboration strategy to perform collective decision making for event recognition. Their experimental results confirm the reliability and stability of the proposed system in event recognition.

Chapter 5 entitled "A Review of the State-of-the-art Algorithms for Impulse Noise Filtering" attempts to throw sufficient light on the advancement in the field of image processing by illustratively describing existing state-of-the-art filtering techniques along with their capability of denoising impulse noises.

In chapter 6, the authors have demonstrated how to increase the security level and how to improve the storage capacity of hidden data with compression techniques. The security level is increased by randomly distributing the text message over the entire image instead of clustering within specific image portions.

In Chapter 7 Karim et al. have discussed an over view on anomaly detection in hyper spectral images. The overview presents statistical methods, kernel based methods, feature selection based methods and segmentation based methods for detection. These works tend to be more geometrical or topological especially with high resolution images where the high resolution implies the presence of many materials in the same geographic area that cannot be easily distinguished by usual statistical methods.

Chapter 8 presents Cloud Based Image Fusion Using Guided Filtering. A fast and efficient image fusion technique has been proposed for creating a highly generated fused image by merging multiple corresponding images. The proposed technique is based on a two-scale decomposition of an image

into a low layer containing large scale variations, and a detail layer acquiring small scale details. Their analytical results demonstrate that the proposed technique can obtain state-of-the-art performance for image fusion of multispectral, multifocus, multimodal, and multiexposure images.

Section 2: Pattern Recognition, Watermarking, and Face Recognition

Chapter 9 discusses Minimax Probability Machine (MPM) and Extreme Learning Machine (ELM) for prediction of stability status of rock slope. The authors have considered determination of stability of rock slope as a classification problem. It is observed from their presentation and analysis that developed MPM is a robust model for prediction of stability status of rock slope.

Whereas Chapter 10 presents 3D Image acquisition and analysis of a range face images for registration and Recognition. In this chapter, the authors have made a detailed study of acquisition, visualization, 3D images, analyzing it with some fundamental image processing techniques and application in the field of biometric through face registration and recognition. This chapter also gives a brief idea of the state of the art about the research methodologies of 3D face recognition and its application.

In Chapter 11 the authors have presented a comprehensive review of face recognition approaches in unconstrained environment. The objective of this chapter is to address issues, challenges and recent advancement in face recognition algorithms which may help new researchers to do innovative research in unconstrained environment.

However, Chapter 12 presents Intelligence based adaptive digital watermarking for images in wavelet transform domain. In this chapter intelligence based watermarking schemes have been discussed in detail.

Chapter 13 tells us about the fundamental concepts on feature extraction. The goal of this chapter is to present an intensive survey of existing literature on feature extraction techniques over the last years. All these techniques and algorithms have their advantages and limitations.

Section 3: Bio Imaging and Applications

In Chapter 14 the authors have discussed the technology behind the topic entitled "Metal Artifact Reduction - A Problem of Tremendous Importance in Medical Imaging". They have proposed seeded watershed segmentation-interpolation based sinogram correction method to reduce the metal artifacts caused by metallic implants with an objective to find projection bins affected by the metallic objects in the raw projection data and to replace the corrupted values by appropriate estimates.

But the objective of Chapter 15 is to develop a fast, robust and simple framework for blood microscopic image segmentation which can assist in automated detection of hematological diseases i.e. acute lymphoblastic leukemia (ALL).

Also, Chapter 16 tells us about biometric identification system using neuro and fuzzy computational approaches. In a biometric authentication system, the design of decision support system is critical and it determines success or failure. But the authors have proposed such a system based on neuro and fuzzy system. The authors have performed experiment and found their system working well in a secure manner.

Chapter 17 deals with fuzzy logic classifier for classification and measurement of apple fruits. It is a kind of automatic system by which apples are classified into different grades.

Similarly, Chapter 18 presents a charged system search (CSS) optimization method for finding the optimal cluster centers in a given dataset.

And finally Chapter 19 concludes and talks about Learning Aided Digital Image Compression Technique for Medical Application. Learning systems like. Artificial Neural Networks (ANN), etc. have established their efficiency and reliability in achieving image compression.

This comprehensive and timely publication aims to be an essential reference source, building on the available literature in the field of image processing and pattern analysis to boost further research in this dynamic field. It is hoped that this text will provide the resources necessary for technology developers, scientists and policymakers to adopt and implement new inventions across the globe.

In short, I am very happy both with the experience and the end product of our sincere efforts. It is certain that this book will continue as an essential and indispensable resource for all concerned for some years to come.

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List of Contributors

Table of Contents