# PREFACE

Hyperspectral imaging has witnessed exponential growth over the past years. Its applications to new areas are still yet to be explored. Many hyperspectral imaging techniques have been developed and also reported in various venues. My first book, *Hyperspectral Imaging: Techniques for Spectral Detection and Classification* (referred to as Chang (2003)), published by Kluwer Academic/Plenum Publishers (now Springer-Verlag) in 2003 was written in an attempt to summarize the research conducted in my laboratory, Remote Sensing Signal and Image Processing Laboratory (RSSIPL) by then and to provide readers with a glimpse of this fascinating and excited area. Amazingly, this area has advanced so rapidly that many signal processing techniques developed for hyperspectral signal and image processing have continuously emerged after Chang (2003) was published. In order to catch up this trend, I make another bold attempt to write this book to accomplish three goals. One is to continue exploring new statistical signal processing algorithms in this area for various applications. Another is to supplement Chang (2003) where many potential and yet promising research efforts were only briefly mentioned in Chapter 18 but were not be able to be included at the time Chang (2003) was written. A third goal is to distinguish this book from Chang (2003) in many ways. Unlike Chang (2003) whose main theme is hyperspectral target detection and classification from a view point of subpixel amd mixed pixel analysis, this book is focused on a more in-depth treatment of hyperspectral signature analysis and characterization from a statistical signal processing point of view. Specifically, many topics that are not covered in Chang (2003) but have recently received considerable interests will be included in great detail in this book. Of particular interest are endmember extraction, pixel extraction and information analysis, hyperspectral image compression, hyperspectral signature coding and characterization as well as applications of two new concepts of virtual dimensionality (VD) and 3-diemsnional receiver operating characteristics (3D ROC) analysis which are first introduced but have not been explored in Chang (2003). In addition, two interesting and unique additions to this book is extensive studies of using synthetic image-based computer simulations for performance evaluation and an appendix, Algorithm Compendium which compiles recently developed signal processing algorithms developed in the RSSIPL as well as others available in the literature, both of which are believed to be useful and beneficial in algorithm design and analysis. Specifically, the new added appendix offers a valuable guide for those who are interested in designing and developing hyperspectral imaging techniques for data exploration. This book also expands its coverage to address many

issues which are not investigated and explored in Chang (2003). Therefore, this book has very little overlap with that covered in Chang (2003) and can be used in conjunction with Chang (2003) where the latter provides necessary basic background in design and development of statistical signal processing algorithms for hyperspectral image analysis, especially for subpixel detection and mixed pixel classification. For readers who have been involving and are familiar with hyperspectral imaging techniques, this book presents recent advances in design and analysis of signal processing algorithms that have been and currently being investigated in the Remote Sensing Signal and Image Processing Laboratory and can be further used for a reference book. On the other hand, for readers who are new, this book can be used to serve as a source to find topics that may interest them.

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