

## BOOK REVIEWS

### Pattern Recognition and Image Processing

Edited by Sing-Tze Bow, 584 pages, ISBN 0-8247-8583-5, Marcel Dekker, 270 Madison Avenue, New York 10016 (1992) \$150 hardcover.

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This book is divided into four parts: Decision Theoretic Pattern Recognition (Chaps. 1 through 7), Data Preprocessing for Pictorial Recognition (Chaps. 8 through 10), Applications (Chap. 11), and Practical Concern on the Image Processing and Pattern Recognition (Chap. 12). In addition there are six appendices on topics that range from computer system architecture to matrix manipulation.

Chapter 1 attempts to describe a pattern recognition system in general terms. This is probably the weakest chapter of the book. The text does not flow smoothly and although several applications are described, no references are given to assist the reader interested in investigating an application further.

Chapter 2 focuses on nonparametric decision classification. Linear discriminant functions, piecewise linear discriminant functions, and nonlinear discriminant functions are discussed. Adequate examples are given to clarify the concepts, but again no references are given.

Chapter 3 describes nonparametric training of discriminant functions and gives several techniques for finding the actual weight vector by using the training examples. Included in the discussion are gradient descent techniques and minimum-squared error procedures. Again, this material is covered very briefly, and the interested reader might wish to consider supplementing this material with other texts, such as *Adaptive Signal Processing* by Widrow [IEEE Press, New York (1985)] or Duda and Hart's classic text, *Pattern Classification and Scene Analysis* [Wiley, New York (1973)].

Chapter 4 discusses statistical discriminant functions. Statistical decision theory is introduced and loss functions, Bayes's dis-

criminant functions, and maximum likelihood decision are discussed. Several examples are provided in the text that illustrate the important concepts.

Clustering analysis and nonsupervised learning are discussed in Chap. 5. The material in this chapter is covered more thoroughly than the material in the previous chapters (Chap. 5 is twice as long as the previous chapters). Besides providing a good basic introduction to clustering techniques, the chapter offers excellent examples of the Batchelor and Wilkins's algorithm and the ISODATA algorithm. Material is also presented on graph theoretic methods with suitable examples.

Chapter 6, Dimensionality Reduction and Feature Selection, states that "Much work has been done in finding the dependencies of the probabilities of misclassification on the dimensionality of the feature vector, the number of training samples, and the true parameters of the class-conditional densities," and it again surprises this reviewer that this chapter is only 10 pages long.

Chapter 7 is a brief survey of neural networks. If the reader has minimum interest in this area the material is adequate; otherwise, I would suggest that the reader seek out one of the current texts on neural networks, such as *Introduction to the Theory of Neural Computation* by Hertz, Krogh, and Palmer [Addison-Wesley, Reading, MA (1991)].

Chapter 8, Image Transform and Preprocessing in the Transform Domain, starts Part 2. The material in this chapter is covered in much more detail than any of the previous chapters. There are more than 60 figures in this chapter alone. The chapter starts with a general introduction to Fourier transforms, including the functional properties of the 2-D Fourier transform. Several of the figures illustrate transform pairs of simple images, such as rectangles, ellipsoids with uniform and Gaussian-distributed intensity, rotated rectangles, etc. The effect of aperture size on sampling is also discussed and illustrated. The chapter concludes with a discussion of several other transforms, including Walsh and Karhunen-Loeve.

Preprocessing in the spatial domain is covered in Chap. 9. The style of this chapter is very similar to the previous chapter, in that there are again more than 60 figures that illustrate the subject matter of the text. Ad-

equating coverage of a wide range of spatial processing techniques is given, including contrast stretching, thresholding, histogram equalization, edge sharpening, and thinning. The only shortcomings of this chapter are the brief coverage given to morphological processing and the lack of references. There is also a very short section on texture analysis.

The last chapter in Part 2 is on pictorial data preprocessing and shape analysis. In this chapter the concepts of quad-tree data structures, chain codes, polygon approximation of curves, and B-splines are introduced. Material on shape descriptors is also included.

Part 3 focuses on applications. The applications include document understanding (both text and symbol), industrial inspection, remote sensing, and vision. The examples are thorough enough to give the reader a good feel for the application of the methods developed in the previous chapters. Also, references are effectively used in this section.

Part 4 is rather awkwardly titled "Practical Concern on the Image Processing and Pattern Recognition." This part includes only one very brief chapter on computer system architectures for image processing. There is little more to this chapter than a definition of MIMD, SIMD, and systolic array architectures.

Overall, Dr. Bow has undertaken a monumental task; each part of the book could be a book in itself, and in one respect that is the major shortcoming of the book. The major contributions of this text to the field of pattern recognition are Parts 2 and 3. The material presented on preprocessing in the transform and spatial domains provides a solid foundation for more advanced reading in these areas. I believe that this text can serve as a good supplemental text for an upper-level undergraduate course.

*Roger S. Gaboriski received his BS and MS degrees from the State University of New York at Buffalo and his PhD from the University of Maryland, all in electrical engineering. He was employed by the National Security Agency from 1974 to 1984. Since 1984 he has been a member of the technical staff at the Eastman Kodak Research Laboratory and has worked in the areas of image compression, document understanding, and image understanding.*