BOOK REVIEWS

Digital Image Processing

William K. Pratt, 698 pages, 2nd edition, ISBN 0-4718-5766-1, John Wiley & Sons, 1 Wiley Drive, Somerset, New Jersey 08875 (1991) $69.95 hardcover.

Reviewed by Lawrence A. Ray
Eastman Kodak Research Laboratories
Imaging Science Division
901 Elmgrove Road
Rochester, New York 14653-5719

I was somewhat daunted by the task of reviewing this book because the first edition has become a classic text in image processing. I decided to approach the task by using the basic style of literary book reviews. As a result, the opinions that follow are mine, and others are welcome to disagree. If these reviews help serve to stimulate discussion, then the effort is worthwhile.

This is the second edition of a classic image processing text. It is a general reference to many topics comprising image processing. The book reads as if intended for those interested in the basics with no previous experience in the field. It comprises nearly 700 pages, spanning five sections, with many images to demonstrate the effect of various processes. The sections are: continuous image characterization, digital image characterization, discrete two-dimensional linear processing, image improvement, and image analysis. Although at first glance this appears to be a reasonable representation of image processing, as I note below, many important topics seem omitted.

Material on continuous image characterization is contained in the first section. What is a welcome addition to this section is basic color theory. Because image processing has developed with more applications requiring color, this portion of the revision is quite helpful and serves as a good introduction into the theory of color.

Digital image characterization is the topic of the second section. This section is disappointing because the material has been offered by so many other authors and this presentation seems a bit stale. Also, an overabundance of notation exists that seems to clutter the presentation of the underlying ideas.

After spending nearly 170 pages introducing the basic notions of images, the third section begins describing image processing methods. Those described are the standard methods that appear in nearly all texts on image processing. While these methods are necessary for completeness, I was hoping for a more imaginative selection of topics, such as the introduction of wavelets and Gabor functions, to name a couple. It is hard to understand the omission of ideas that have evolved over the past decade.

The fourth section on image improvement also shows its age. Much like the previous section, all the basic material is included, but little is new or nonstandard. Nowhere mentioned are methods used over the past decade. For instance, one would expect here a description of projection on convex sets (POCS). Also, the material from the first section on color theory finally is used. However, the material is quite thin, and much more could and should be added.

The final section is on image analysis, which is where the true value of this book resides. Most of the material in this section is new compared to the first edition. Image analysis has undergone rapid growth, and this is as good an introduction into the basic topics as one could reasonably expect. It is easy to find important topics that are not covered or topics that deserve more elaboration, but the inclusion of such material might itself constitute another book.

In reading the text I came to some general opinions on the choice of material presented as well as the manner in which ideas were introduced. The cover jacket proudly claims that over half of the material is either new or revised. Since thirteen years have passed since the publication of the first edition and a large body of research literature has been published in the interim, I expected to find an array of references from the 1980s. This expectation was quickly dashed as I looked through the references that follow each chapter. I was surprised to discover that most of the references predated the first edition. The author either has the opinion that nothing much has happened in the intervening thirteen years, or the revision is somewhat superficial. A point of amusement was the self-referencing of this book (the second edition) in the bibliography.

It seems that too much space is devoted to nomenclature, thus avoiding more important issues. The investment the reader makes on this formalism is not rewarded later. In fact, sometimes the formalism interferes with the basic ideas. For those new to image processing, the notation could get in the way of understanding, and for experienced image processors, the notation may be ponderous. Pages of text could be removed without diminishing any important content.

As I read the text, I encountered sections where I had more than a passing acquaintance with the material, such as the sections on quantization and vector quantization. While the basic material is indeed correct, it is not complete. The vector quantization section completely ignores the K-d tree method as well as the classic LBG method, both of which were introduced in the 1980s. Instead, the reader is taken through a description of vector quantization based on the author's work. While that is fine, ignoring what has evolved into classical methods in this area is not. Moreover, vector quantization is used primarily in image data compression, a topic otherwise ignored in this book.

The part of the quantization section that discusses the methods for color images is vague and does not use the color science introduced earlier in the text. I was a bit puzzled by this lack of connection, especially since many of the fundamentals of color were introduced nicely.

The section on image restoration gives a good introduction into this topic, and the sections on photographic models are also a welcome addition. However, the material could be broadened by mentioning some of the inherent nonlinearities of photographic systems pertaining to the development process. Also noteworthy are doubly stochastic systems such as radiography.

There are topics, such as image coding, which are completely ignored. This is surprising because many journal articles and conference papers report on current work in these fields. Because this book is a survey of image processing, I find this omission a significant shortcoming.

The very easy to understand section on image morphology attempts to include notions from topology. While this is an admirable approach, topology has precise concepts and inferences that are not respected by the author. Discussing topological invariants and indirectly linking them to convex hulls is tenuous. If Euler numbers are brought into this discussion, it should be done with more care.

In summary, my impression in reading this book is that more editing is required, more topics should be included, recent material needs to be referenced, and the nomenclature should be streamlined. I also find fault with the publisher for not proofreading the text well, because I discovered several typographical errors, and for overstating on the cover the quality and quantity of the revisions to the first edition.

Despite my criticism of this book, I still consider it to be of value to someone beginning image processing. For practitioners in the field, this second edition may not be necessary, because it does not contain enough new material to replace one's copy of the first edition.

Lawrence A. Ray received his BS degree in mathematics from Union College in Schenectady, New York, in 1971. He received MS and PhD degrees in mathematics from the University of Rochester, New York, in 1974 and 1978, respectively. Between 1986 and 1990, Ray was the senior on-site representative from Eastman Kodak at the National Center for Supercomputing Applications at the University of Illinois. Currently, he is a research associate at the Imaging Science Division of the Eastman Kodak Research Laboratories.