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## B O O K R E V I E W S

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### **Digital Image Processing: Concepts, Algorithms and Scientific Applications**

Bernd Jahne, 383 pages, ISBN 3-540-53782-1, Springer-Verlag, Heidelberger Platz 3, D-1000 Berlin 33, Germany; ISBN 0-387-53782-1, Springer-Verlag, 175 Fifth Avenue, New York 10010 (1991) \$59.50 softbound.

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If you are like most of us, there are image processing books on your bookshelf that haven't been opened in years. It would be very easy to look at the table of contents of this book and dismiss it as a repackaging of all the books you currently own. That would be a mistake! This book is one I would recommend, since it presents material in uncommon ways and the mathematical approaches generally are quite good.

This book is intended for those with a desire to have image processing on a firm mathematical ground. Mathematics borrowed from physics abounds throughout the text. Discussions about motion and motion kinematics are firmly based in physics. It is rare to find discussion of the detail of image motion and to have the discussion be so well presented. The reader is led through a progressive development of the material, which firmly connects the mathematics and the subject matter. While many treatments of this material stop at rigid body motions, Jahne continues with a presentation of deformable objects. The continual connection between images and physical laws is to be applauded. Too often this link is forgotten and images become objects in isolation.

If you are looking for a book that has a compendium of image processing algorithms, then you will be quite disappointed. Contained within these pages are deeper concepts. What is here is a link between classical image processing and image understanding.

This book is neither a classical image processing text nor a text in computer vision. It is much more and fills an important niche. Like any good bridge, it has one foot on each bank. It begins with many of the elementary topics of image processing, such as pixels, image formation, and the like, but ends with topics in image understanding. Quite an achievement.

While topics of image processing are bridged, there are aspects of image processing that are unfortunately missed. For example, there is absolutely no mention of color and aspects of color on image processing, nor is there any serious reference to image compression. The inclusion of color as part of image processing has become more prominent recently. A mathematical treatment of color would have been a superb addition to the text. There is a wealth of applied higher mathematics buried in color science that would have fit into the style of this text.

A presentation of scales is made that begins to describe multigrid and multiscale analysis. I was expecting this to be a superb opening to introduce recent work in this area, and in particular the work done with wavelets. This whole topic is overlooked! For a text that is so rich in mathematical content, this was a real disappointment. Later in the text there is a small section on Gabor filters, which are an instance of wavelets, but Jahne does not point out the rich theory and potential for image processing.

While the mathematical treatment was largely coherent, there were times when I had to look through other references to determine what the author was trying to establish. The section on optical flow and motion was a case in point. After referring to other sources, I was able to determine what Jahne was attempting to describe. The section on directional quadrature filters was very difficult to understand from the presentation and the motivation was lacking. The material reappears later, and again the motivation was omitted. However, references were cited for the interested reader to explore the approach in more detail.

There is an extensive section on filter design, and much effort is made to show the richness that can be achieved from building filters from combinations of binomial filters. One could have concluded that some combination of binomial filters are all that one needs. This is not the case, and the author misses an opportunity to describe filter design using much of the previously established mathematical machinery. In particular, discussions relating a filter's frequency response and the filter's coefficients is not forthcoming. This book will not help the serious filter designer produce a filter tailored for a particular effect.

While the technical development is good, it is not even. Some sections seem to have far too much detail and others have far too little. Several of the chapters seem to finish before the full development is reached. The chapter on shape is an example of this. Many morphological operators were introduced, but the use of these operators was quite scant. An expansion of this section would have been welcomed.

I recommend this book to anyone seriously engaged in image processing. It will clearly stretch the horizon for some readers and be a good reference for others. This is not just another image processing book; it is a book worth owning and a book worth reading several times. It does not replace all of those other image processing books, but is a good addition to your collection and should be opened frequently.

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