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# BOOK REVIEW

**Image Analysis and Mathematical Morphology, Volume 2: Theoretical Advances,** JEAN SERRA (Ed.), Academic Press, New York, 1988. 411 pages + xi, $89.50.

An algebraic system of operators, such as those of mathematical morphology, is useful because compositions of its operators can be formed which, when acting on complex shapes, are able to decompose them into their meaningful parts and to separate the meaningful parts from their extraneous parts. Such a system of operators and their compositions permits the underlying shapes to be identified and reconstructed as well as possible from their distorted noisy forms. Furthermore, each shape can be understood in terms of a decomposition, each entity of the decomposition being some suitably simple shape.

What the algebra of convolution does for linear systems, the algebra of mathematical morphology does for shape. Since shape is a prime carrier of information in machine vision, there should be little surprise about the importance of mathematical morphology. Morphological operations can simplify image data, preserving their essential shape characteristics, and eliminate irrelevancies. As the identification and decomposition of objects, object features, object surface defects, and assembly defects correlate directly with shape, it is only natural that mathematical morphology has an essential structural role to play in machine vision.

Serra's 1988 book can be thought of as the second volume to the 1982 Academic Press book *Image Analysis and Mathematical Morphology* authored by Serra. It generalizes the morphological operations to lattice structures. It discusses the lattices of increasing morphological operators and the special role which generalized openings and closings play in such an operator lattice. The chapters entitled "Morphological Filters" by Serra and "Filters and Lattices" by Matheron are particularly relevant to image processing and computer vision. The book gives an extensive treatment to skeletons, random functions, and convex sets. The book should appeal to people in image processing, computer vision, pattern recognition, probability theory, and spatial statistics.

The book is quite mathematical. Its style, language, mathematical sophistication, and difficulty of translating its theoretical contents to vision applications may be too much for those people who are accustomed to an experimental approach in which the software is most everything and the problem the software solves cannot be precisely stated.

The techniques of mathematical morphology are important because of the rich and extensive theoretical framework it provides in which to understand and pose vision problems. The theory developed by Serra and colleagues will be around, learned, and used long after the experimental computer vision approaches which do not tie into theory are obsolete and forgotten.

The chapter titles are: *Mathematical Morphology for Complete Lattices*, *Mathematical Morphology for Boolean Lattices*, *Dilations on Topological Spaces*, *Examples of Structuring Functions and Their Uses*, *Introduction of Morphological Filters*, *Filters and Lattices*, *Strong Filters and Connectivity*, *The Centre and Self-Dual Filtering*, *Dilation and Filtering for Numerical Functions*, *Alternating Sequential Filters*, *Exam-*



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in the original image (a) and in the background component, $s_{mn}$, after decomposition (b). In image 15c one can see both the number of false pulses due to the noise and the destruction of the continuous lines. Image (d) is rather more legible.

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*ples of Topological Properties of Skeletons*, *On the Negligibility of the Skeleton and the Absolute Continuity of Erosions*, *Skeletons in Digital Spaces*, *Measurements on Numerical Functions*, *Boolean Random Functions*, *Convexity and Symmetry*: *Part* 1, *Convexity and Symmetry*: *Part* 2, *and Boolean Texture Analysis and Synthesis*.

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# BOOK RECEIVED FOR REVIEW

**Digital Image Processing (2nd ed.)**. Rafael C. Gonzalez and Paul Wintz. Addison–Wesley, Reading, MA, 1987, xviii + 503 pp., $42.95.

The first edition of this well-known textbook appeared in 1977. This new edition is 72 pages longer and contains much new material, which is summarized in the preface as follows:

| | Chapter Title | New topics |
|---|---|---|
| 2 | Digital Image Fundamentals | Geometric relationships between pixels; arithmetic and logic operations via mask processing; imaging geometry: geometric operations, camera modeling, stereo imaging |
| 3 | Image Transforms | Hough transforms |
| 4 | Image Enhancement | Local enhancement techniques; generation of spatial convolution masks from filters specified in the frequency domain |
| 5 | Image Restoration | Image warping |
| 6 | Image Encoding | |
| 7 | Image Segmentation | Adaptive thresholding; use of object motion in segmentation |
| 8 | Representation and Description | Boundary descriptors; skeletonizing techniques; textural descriptors; descriptions of similarity |



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