

Pierre Soille

Morphological Image Analysis

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Principles and Applications

With 221 Figures and 12 Tables



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Preface

In 1992, by the time I was finishing my doctorate thesis jointly at the *Ecole des Mines de Paris* and the *Université catholique de Louvain*, my former colleague Jean-François Rivest and I have had the opportunity to organise a tutorial course about morphological image processing during an international conference held in The Hague. The success of this course as well as others organised later in Sydney, Delft, Québec City, and Brisbane rapidly convinced me that there was a need for an application-oriented book presenting the principles and latest developments of morphological image analysis. The intent of the present book is to fulfill this need.

The book is self-contained in the sense that it is accessible to engineers, scientists, and practitioners having no prior experience with morphology. In addition, most necessary background notions about digital image processing are covered. The emphasis being put on the techniques useful for solving practical problems rather than the theory underlying mathematical morphology, no special knowledge about set theory and topology is required. Nevertheless, the book goes well beyond an introduction to mathematical morphology. Indeed, starting from the fundamental transformations, more elaborate methods which have proven their practical usefulness are explained. This is achieved through a step by step process pursued until the most recent advances.

The successful completion of this book has been very challenging because there are now many teams around the world participating to the fruitful development of morphology and working on a wide variety of topics ranging from the definition of new filters to the design of novel algorithmic techniques. Inevitably, some subjects are more detailed than others due to my own experience and research activities. Bibliographical notes and references are included at the end of each chapter to help the reader finding further readings on a specific theme. The total number of distinct references equals 364. Each chapter dealing with a well defined topic, only 30 of references appear on more than one chapter.

Acknowledgements are due to all people involved with image analysis and whom I met since 1988 when I begun my research activities in this fascinating field. Their dedication to both applied and theoretical research has been a constant source of inspiration for the writing of this book. Naming all these

people would be a very difficult and dangerous exercise since I would surely forget some of them. Nevertheless, I wish to express my deep acknowledgements to Jean Serra's group of the *Centre de Morphologie Mathématique* of the *Ecole des Mines de Paris* which I worked with during four years. This book would never have been published without the very fruitful discussions and joint research projects I have had with the group members and the many people who visited the *Centre* during my stay. Mark Berman's image analysis group of the *Commonwealth Scientific and Industrial Research Organisation, Mathematical and Information Sciences* (Sydney) which I visited in 1992–1993 and September 1997 also deserves special thanks. The comments and suggestions of all group members concerning preliminary versions of this book helped me a lot. Moreover, their constant interest in my book project motivated me to pursue it. The pattern recognition department of the *Fraunhofer-Institut für Produktionsanlagen und Konstruktionstechnik* (Berlin) which I visited in 1993 and 1995 has been a real chance for me to be confronted with the many technical aspects regarding the application of image analysis to industrial applications. Thanks a lot to Bertram Nickolay and all members of his department. I am also indebted to Tilman Jochems for many advises and helpful discussions following the reading of a draft copy of this book. Piero Zamperoni[†] from the *Technische Universität Braunschweig* deserves my deep gratitude for its kind encouragements, the very careful reading of the German version of this book, and the many discussions and thorough suggestions. Thanks are also due to Bernd Jähne from the *Universität Heidelberg* and Paul Whelan from the *Dublin City University* for their interest in my book project. In addition, I wish to acknowledge the *Ecole des Mines d'Alès* and its *Laboratoire de Génie Informatique et d'Ingénierie de la Production*, site EERIE (Nîmes) where I have been lecturing and pursuing my research activities during the period 1995–1998.

I would like to conclude in gratitude to Sabine Müller who shared with me the necessary motivation for successfully achieving this book. In addition, the former German version of this book would never have been written without her help. For comments and suggestions aiming at improving and extending the present book, I would like to thank all readers in advance.

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