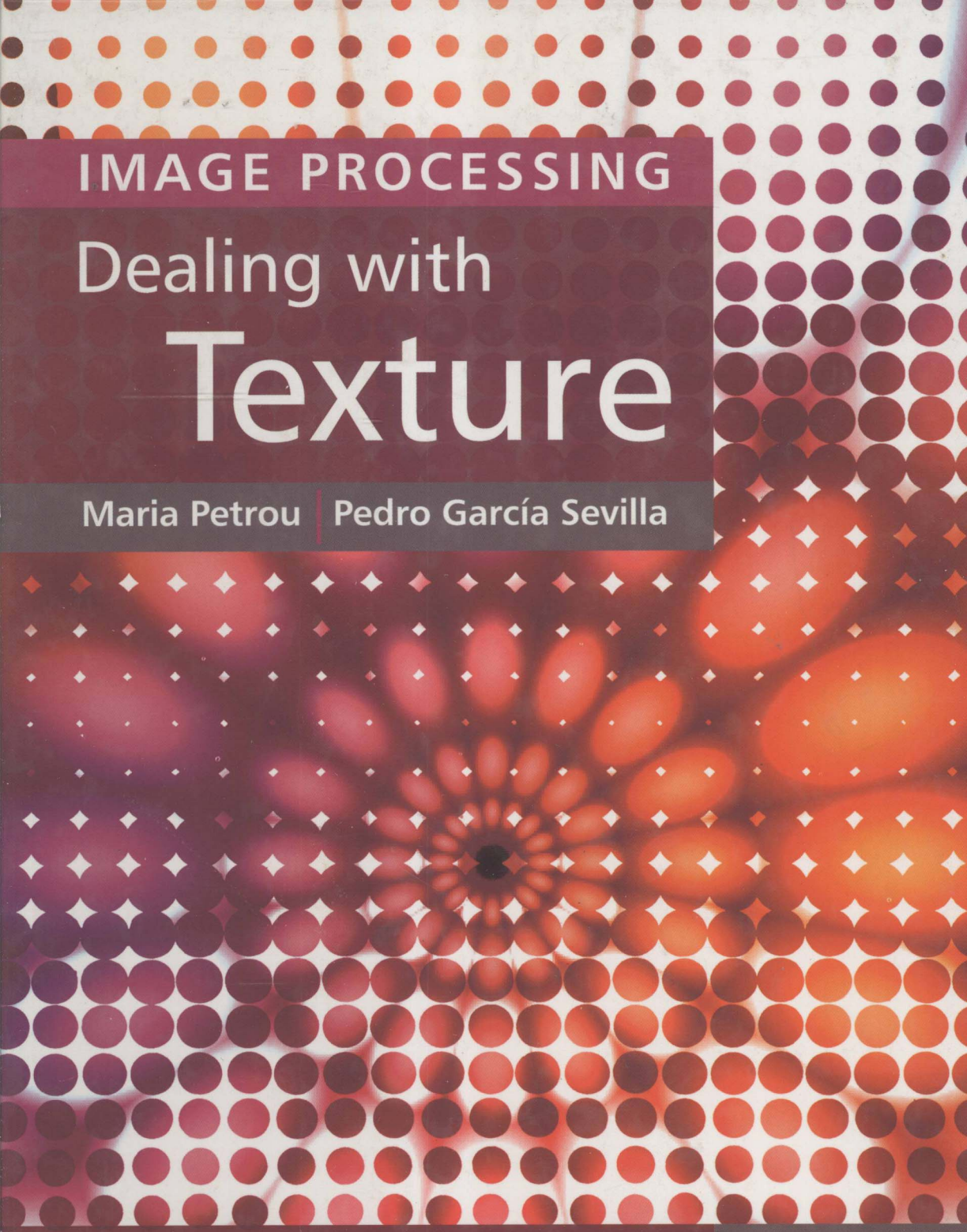
IMAGE PROCESSING

Dealing with Texture

Maria Petrou | Pedro García Sevilla



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Dealing with Texture

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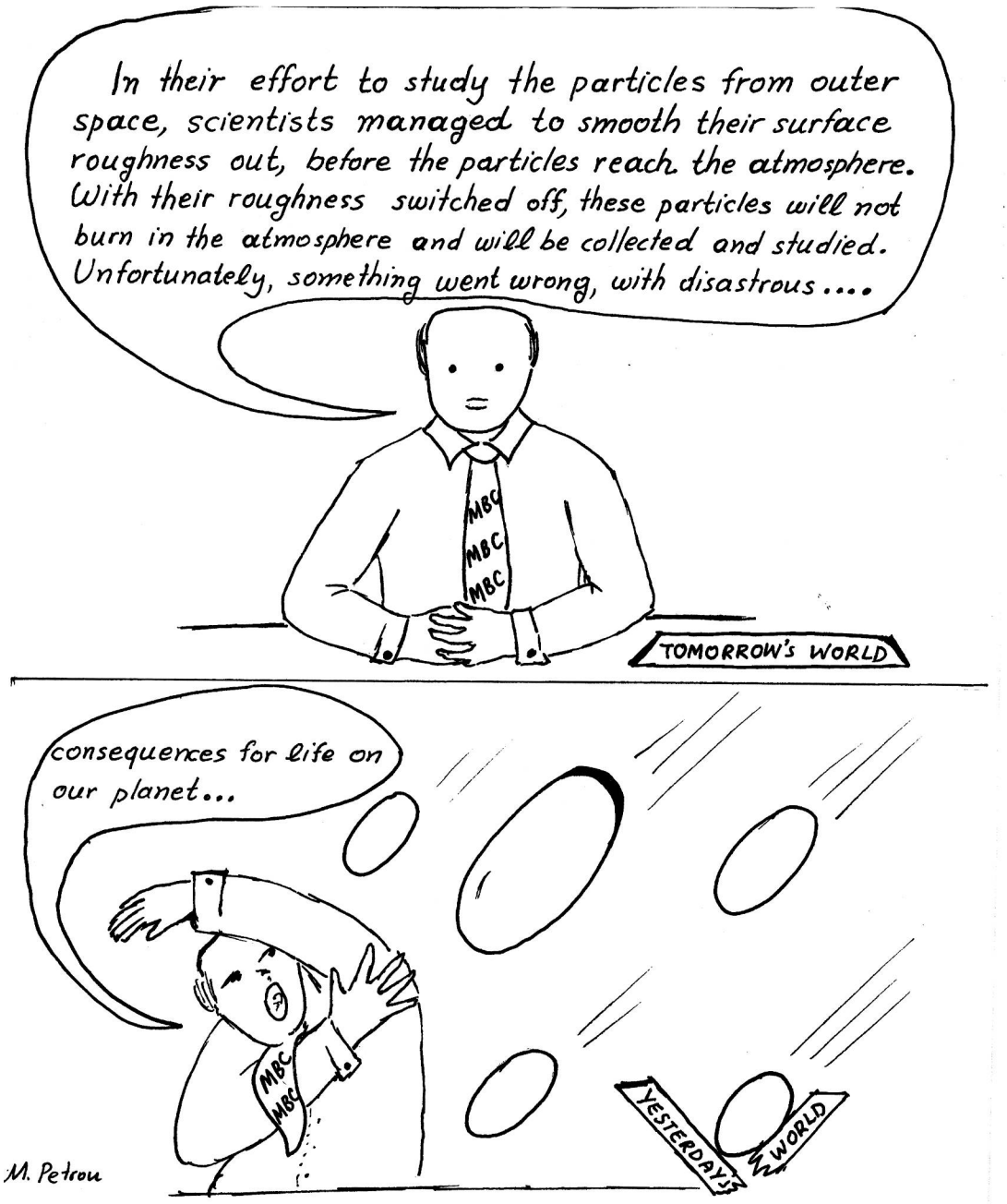
Image Processing

Maria Petrou wishes to dedicate this book to her grandmother Maria Pyrrou Voziki, who having never been to school, managed to teach herself the three Rs. Due to her own unquenched thirst for education and knowledge, she started teaching her granddaughter the letters of the alphabet when she was only 18 months old!

Pedro García Sevilla wishes to dedicate this book to all his family for their love and support and especially to his parents, Francisco and María, for all the sacrifices they made for the education of their children, and to his wife Isabel for her infinite love, patience and energy.



A tragic story unfolds on planet Mondrianus because scientists decided to do away with texture...

Preface

It is often said that everybody knows what texture is but nobody can define it. Here is an unconventional definition: texture is what makes life beautiful; texture is what makes life interesting and texture is what makes life possible. Texture is what makes Mozart's music beautiful, the masterpieces of the art of the Renaissance classical and the facades of Barcelona's buildings attractive. Variety in detail is what keeps us going from one day to the next and the roughness of the world is what allows us to walk, communicate and exist. If surfaces were smooth, friction would not exist, the Earth would be bombarded by asteroids and life would not have developed. If surfaces were smooth, pencils would not write, cars would not run, and feet would not keep us upright.

Texture is all around us, and texture is also on the images we create. Just as variation in what we do allows us to distinguish one day in our life from another, texture allows us to identify what we see. And if texture allows us to distinguish the objects around us, it cannot be ignored by any automatic system for vision. Thus, texture becomes a major part of Image Processing, around which we can build the main core of Image Processing research achievements.

This book is exactly trying to do this: it uses texture as the motivation to present some of the most important topics of Image Processing that have preoccupied the Image Processing research community in the recent years. The book covers the topics which have already been well established in Image Processing research and it has an important ambition: it tries to cover them in depth and be self-contained so that the reader does not need to open other books to understand them.

The book is written on two levels. The top, easy level, is for the reader who is simply interested in learning the basics. This level is appropriate for an undergraduate or Master's level course. The second level goes in depth, demonstrating and proving theorems and concepts. This level is appropriate for research students. **Examples that refer to the advanced level are marked with a B and the theory of this level is presented in boxes with a grey background.** In a sense, the book is an interlacing of mainstream material and appendices that cover advanced or even peripheral issues.

The book aspires to be a classical textbook on Image Processing and not an account of the state of the art. So, the reader who hopes to find here the latest algorithms proposed, will be disappointed.

A large part of this book was written when the first co-author was on sabbatical at the Informatics and Telematics Institute in Thessaloniki, Greece. The support of the Institute as well as the support of our home institutions, namely the University of Surrey for the first co-author when writing this book, and the University Jaume I, throughout this endeavour is gratefully acknowledged.

We would also like to thank the Media Lab of the Massachusetts Institute of Technology for allowing us to use five images from the VisTex database, the Signal and Image Processing Institute of the University of Southern California for allowing us to use three images from their USC-SIPI Image database, and Dr Xavier Llado who supplied the images shown in figures 1.5 and 1.6.

For the accompanying website please visit www.wiley.com/go/texture.

Maria Petrou and Pedro García Sevilla

Contents

Chapter 1

Introduction

What is texture?

Texture is the variation of data at scales smaller than the scales of interest. For example, in figure 1.1 we show the image of a person wearing a Hawaiian shirt. If we are interested in identifying the person, the pattern on the shirt is considered as texture. If we are interested in identifying a flower or a bird on the shirt, each flower or bird of the pattern is a non-textured object at the scale of this image, as we can hardly see any details inside it.

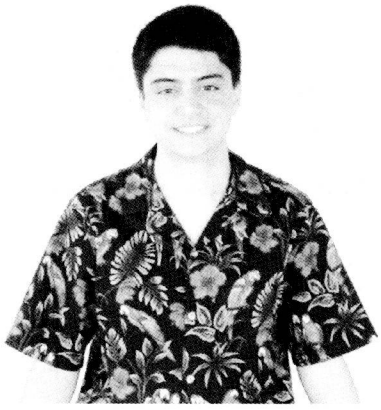


Figure 1.1: Costas in bloom.

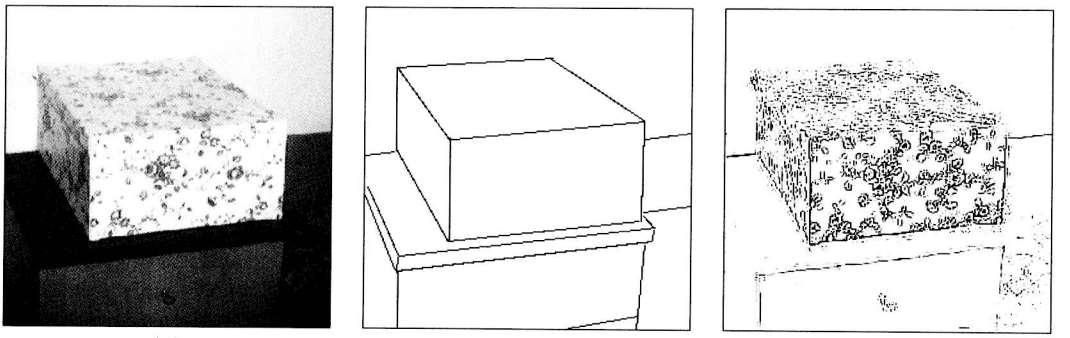
Why are we interested in texture?

We are interested in texture for two reasons:

- Texture may be a nuisance in an automatic vision system. For example, if we were to recognise an object from its shape, texture would create extra lines in the edge map of

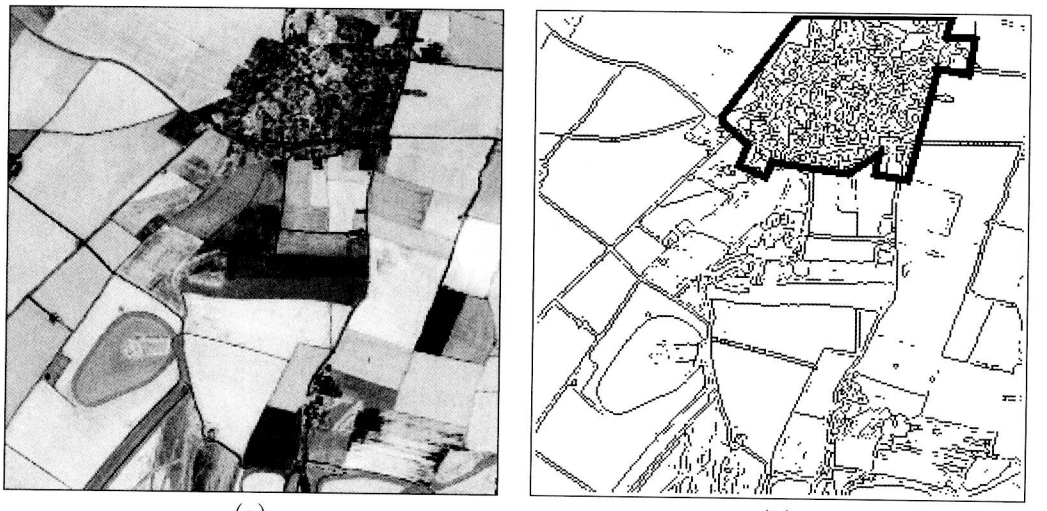
the object and the shape recognition algorithm would be confused. This is demonstrated in figure 1.2.

- Texture may be an important cue in object recognition as it tells us something about the material from which the object is made. For example, in the image of figure 1.3 we may discriminate the city from the woods and the fields, from the type of variation the image shows at scales smaller than the objects we are talking about.



(a) (b) (c)

Figure 1.2: (a) An original image. (b) Manually extracted edge map. (c) The automatic edge extraction algorithm is confused by the presence of texture on the box.



(a) (b)

Figure 1.3: (a) Bluebury from an aeroplane. (b) Edge map where the urban area has been annotated. Other texture patches correspond to woods.