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# <<图像处理中的数学问题>>

## 图书基本信息

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## 前言

It is surprising when we realize just how much we are surrounded by images. Images allow US not only to perform complex tasks on a daily basis, but also to communicate, transmit information, and represent and under. stand the world around US. Just think、for instance、about digital television, medical imagery,and video surveillance. The tremendous development in information technology accounts for most of this. we are now able to handle more and more data. Many day. to-day tasks are now fully or partially accomplished with the help of computers. Whenever images are involved we are entering the domains of computer vision and image processing. The requirements for this are reliability and speed. Efficient algorithms have to be proposed to process these digital data. It is also important to rely on a well-established theory to iustifv the well-founded nature of the methodology. Among the numerous approaches that have been suggested, we focus on partial difierential equations(PDEs), and variational approaches in this book. Traditionally applied in physics. these methods have been successfully and widely transferred to computer vision over the last decade. One of the main interests in using PDEs iS that the theory behind the concept iS well established. Of course. PDEs are written in a continuous setting referring to analogue images, and once the existence and the uniqueness have been proven . we need to discretize them in order to find a numerical solution. It iS our conviction that reasoning within a continuous frame work makes the underStanding of physical realities easier and stimulates the intuition necessary to propose new models. We hope that this book will illustrate this idea effectively.

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## 内容概要

Introduction、The Image Society、What Is a Digital Image、About Partial Differential Equations（PDEs）、Detailed Plan、Mathematical Preliminaries、How to Read This Chapter、The Direct Method in the Calculus of Vgriations、Topologies on Banach Spaces、Convexity and Lower Semicontinuity、Rclaxation、Aboutr-Convergence、The Space of Functions of Bounded Variation、Basic Definitions on Measures、Definition ofBV（Ω）、Properties ofBV（Ω）、Convex Functions of Measures、Viscosity Solutions in PDEs等等。

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## 章节摘录

插图：The message we wish to convey iS that the intuition that lcads to certain formulations and the underlying theoretical study are often complementary. Developing a theoretical justification of a problem is not simply " art for art's sake. " In particular, a deep understanding of the theoretical difficulties may lead to the development of suitable numerical schemes or different models. This book iS concerned with the mathematical study of certain image processing problems. Thus we target two audiences：The first iS the mathematical community. and we show the contribution of mathematics to this domain by studying classical and challenging problems that come from computer vision. It is also the occasion to highlight some difficult and unsolved theoretical questions. The second is the computer vision community：we present a clear. selLC0ntained. and global overview of the mathematics involved for the problems of image restoration, image segmentation, sequence analysis, and image classification. We hope that this work will serve as a useful source of reference and inspiration for fellow researchers in applied mathematics and computer vision, as well as being a basis for advanced courses within these fields. This book iS divided into seven main parts. Chapter 1 introduces the subject and gives a detailed plan of the book. In Chapter 2, most of the mathematical notions used therein are recalled in an educative fashion and illustrated in detail. In Chapters 3 and 4 we examine how PDES and variational methods can be Successfully applied in the restoration and segmentation of one image. Chapter 5 is more applied, and some challenging computer vision problems are described, such as inpainting, sequence analysis, classification or vector-valued image processing. Since the final goal of any approach is to compute a numerical solution, we propose an introduction to the method of finite difierences in the Appendix.

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