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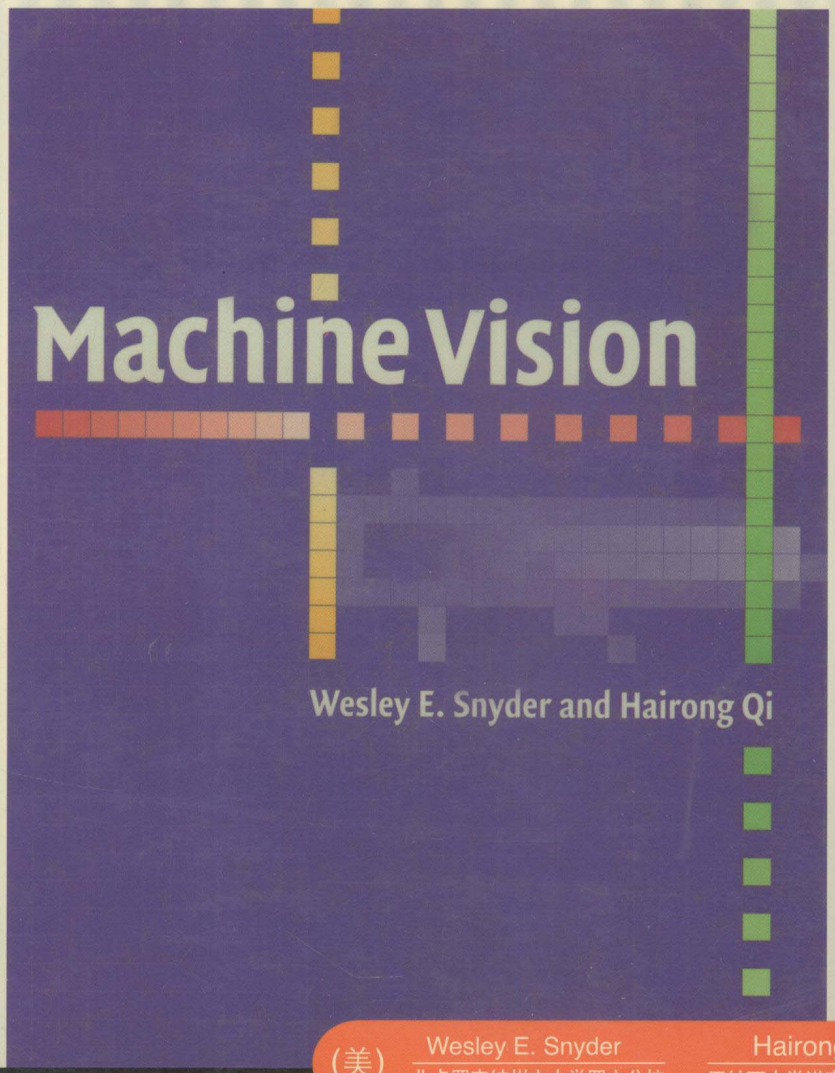
（英文版）



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Machine Vision

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China Machine Press

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出版者的话

文艺复兴以降，源远流长的科学精神和逐步形成的学术规范，使西方国家在自然科学的各个领域取得了垄断性的优势；也正是这样的传统，使美国在信息技术发展的六十多年间名家辈出、独领风骚。在商业化的进程中，美国的产业界与教育界越来越紧密地结合，计算机学科中的许多泰山北斗同时身处科研和教学的最前线，由此而产生的经典科学著作，不仅擘划了研究的范畴，还揭橥了学术的源变，既遵循学术规范，又自有学者个性，其价值并不会因年月的流逝而减退。

近年，在全球信息化大潮的推动下，我国的计算机产业发展迅猛，对专业人才的需求日益迫切。这对计算机教育界和出版界都既是机遇，也是挑战；而专业教材的建设在教育战略上显得举足轻重。在我国信息技术发展时间较短、从业人员较少的现状下，美国等发达国家在其计算机科学发展的几十年间积淀的经典教材仍有许多值得借鉴之处。因此，引进一批国外优秀计算机教材将对我国计算机教育事业的发展起积极的推动作用，也是与世界接轨、建设真正的世界一流大学的必由之路。

机械工业出版社华章图文信息有限公司较早意识到“出版要为教育服务”。自1998年开始，华章公司就将工作重点放在了遴选、移译国外优秀教材上。经过几年的不懈努力，我们与Prentice Hall，Addison-Wesley，McGraw-Hill，Morgan Kaufmann等世界著名出版公司建立了良好的合作关系，从它们现有的数百种教材中甄选出Tanenbaum，Stroustrup，Kernighan，Jim Gray等大师名家的一批经典作品，以“计算机科学丛书”为总称出版，供读者学习、研究及庋藏。大理石纹理的封面，也正体现了这套丛书的品位和格调。

“计算机科学丛书”的出版工作得到了国内外学者的鼎力襄助，国内的专家不仅提供了中肯的选题指导，还不辞劳苦地担任了翻译和审校的工作；而原书的作者也相当关注其作品在中国的传播，有的还专诚为其书的中译本作序。迄今，“计算机科学丛书”已经出版了近百个品种，这些书籍在读者中树立了良好的口碑，并被许多高校采用为正式教材和参考书籍，为进一步推广与发展打下了坚实的基础。

随着学科建设的初步完善和教材改革的逐渐深化，教育界对国外计算机教材的需求和应用都步入一个新的阶段。为此，华章公司将加大引进教材的力度，在“华章教育”的总规划之下出版三个系列的计算机教材：除“计算机科学丛书”之外，对影印版的教材，则单独开辟出“经典原版书库”；同时，引进全美通行的教学辅导书“Schaum's Outlines”系列组成“全美经典学习指导系列”。为了保证这三套丛书的权威性，同时也为了更好地为学校和老师们服务，华章公司聘请了中国科学院、北京大学、清华大学、国防科技大学、复旦大学、上海交通大学、南京大学、浙江大学、中国科技大学、哈尔滨工业大学、西安交通大学、中国人民大学、北京航空航天大学、北京邮电大学、中山大学、解放军理工大学、郑州大学、湖北工学院、中国国

家信息安全测评认证中心等国内重点大学和科研机构在计算机的各个领域的著名学者组成“专家指导委员会”，为我们提供选题意见和出版监督。

这三套丛书是响应教育部提出的使用外版教材的号召，为国内高校的计算机及相关专业的教学度身订造的。其中许多教材均已为M. I. T.，Stanford，U.C. Berkeley，C. M. U. 等世界名牌大学所采用。不仅涵盖了程序设计、数据结构、操作系统、计算机体系结构、数据库、编译原理、软件工程、图形学、通信与网络、离散数学等国内大学计算机专业普遍开设的核心课程，而且各具特色——有的出自语言设计者之手、有的历经三十年而不衰、有的已被全世界的几百所高校采用。在这些圆熟通博的名师大作的指引之下，读者必将在计算机科学的宫殿中由登堂而入室。

权威的作者、经典的教材、一流的译者、严格的审校、精细的编辑，这些因素使我们的图书有了质量的保证，但我们的目标是尽善尽美，而反馈的意见正是我们达到这一终极目标的重要帮助。教材的出版只是我们的后续服务的起点。华章公司欢迎老师和读者对我们的工作提出建议或给予指正，我们的联系方法如下：

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To Graham and Robert
WES

To my parents and Feiyi
HQ

To the instructor

This textbook covers both fundamentals and advanced topics in computer-based recognition of objects in scenes. It is intended to be both a text and a reference. Almost every chapter has a "Fundamentals" section which is pedagogically structured as a textbook, and a "Topics" section which includes extensive references to the current literature and can be used as a reference. The text is directed toward graduate students and advanced undergraduates in electrical and computer engineering, computer science, or mathematics.

Chapters 4 through 17 cover topics including edge detection, shape characterization, diffusion, adaptive contours, parametric transforms, matching, and consistent labeling. Syntactic and statistical pattern recognition and clustering are introduced. Two recurrent themes are used throughout these chapters: Consistency (a principal philosophical construct for solving machine vision problems) and optimization (the mathematical tool used to implement those methods). These two topics are so pervasive that we conclude each chapter by discussing how they have been reflected in the text. Chapter 18 uses one application area, automatic target recognition, to show how all the topics presented in the previous chapters can be integrated to solve real-world problems.

This text assumes a solid graduate or advanced-undergraduate background including linear algebra and advanced calculus. The student who successfully completes this course can design a wide variety of industrial, medical, and military machine vision systems. A CDROM is included with software tools developed by the authors and images to support the homework assignments and projects. The software will run on PCs running Windows or Linux, Macintosh computers running OS-X, and SUN computers running SOLARIS. Software includes ability to process images whose pixels are of any data type on any computer and to convert to and from "standard" image formats such as JPEG.

Although it can be used in a variety of ways, we designed the book primarily as a graduate textbook in machine vision, and as a reference in machine vision. If used as a text, the students would be expected to read the basic topics section of each chapter used in the course (there is more material in this book than can be covered in a single semester). For use in a first course at the graduate level, we present a sample syllabus in the following table.

Sample syllabus.

Lecture	Topics	Assignment (weeks)	Reading assignment
1	Introduction, terminology, operations on images, pattern classification and computer vision, image formation, resolution, dynamic range, pixels	2.2–2.5 and 2.9 (1)	Read Chapter 2. Convince yourself that you have the background for this course
2	The image as a function. Image degradation. Point spread function. Restoration	3.1 (1)	Chapters 1 and 3
3	Properties of an image, isophotes, ridges, connectivity	3.2, 4.1 (2)	Sections 4.1–4.5
4	Kernel operators: Application of kernels to estimate edge locations	4.A1, 4.A2 (1)	Sections 5.1 and 5.2
5	Fitting a function (a biquadratic) to an image. Taking derivatives of vectors to minimize a function	5.1, 5.2 (1)	Sections 5.3–5.4 (skip hexagonal pixels)
6	Vector representations of images, image basis functions. Edge detection, Gaussian blur, second and higher derivatives	5.4, 5.5 (2) and 5.7, 5.8, 5.9 (1)	Sections 5.5 and 5.6 (skip section 5.7)
7	Introduction to scale space. Discussion of homeworks	5.10, 5.11 (1)	Section 5.8 (skip section 5.9)
8	Relaxation and annealing	6.1, 6.3 (1)	Sections 6.1–6.3
9	Diffusion	6.2 (2)	Sections 6A.2
10	Equivalence of MFA and diffusion	6.7 and 6.8 (1)	Section 6A.4
11	Image morphology	7.5–7.7 (1)	Section 7.1
12	Morphology, continued. Gray-scale morphology. Distance transform	7.10 (2)	Sections 7.2, 7.3
13	Closing gaps in edges, connectivity	7.4 (1)	Section 7A.4
14	Segmentation by optimal thresholding		Sections 8.1, 8.2
15	Connected component labeling	8.2 (1)	Section 8.3
16	2D geometry, transformations	9.3 (1)	Sections 9.1, 9.2
17	2D shape features, invariant moments, Fourier descriptors, medial axis	9.2, 9.4, 9.10 (1)	Sections 9.3–9.7
18	Segmentation using snakes and balloons		Sections 8.5, 8.5.1
19	PDE representations and level sets		Section 8.5.2
20	Shape-from-X and structured illumination	9.10 (1)	Sections 9A.2.2, 9A.2.3
21	Graph-theoretic image representations: Graphs, region adjacency graphs. Subgraph isomorphism		Chapter 12
22	Consistent and relaxation labeling	10.1 (1)	Chapter 10
23	Hough transform, parametric transforms	11.1 (2)	Sections 11.1, 11.2, 11.3.3
24	Generalized Hough transform, Gauss map, application to finding holes in circuit boards		Section 11A.3
25	Iconic matching, springs and templates, association graphs	13.2 and 13.3 (1)	Sections 13.1–13.3
26	The role of statistical pattern recognition		

The assignments are projects which must include a formal report. Since there is usually programming involved, we allow more time to accomplish these assignments–suggested times are in parentheses in column 3. It is also possible, by careful selection of the students and the topics, to use this book in an advanced undergraduate course.

For advanced students, the "Topics" sections of this book should serve as a collection of pointers to the literature. Be sure to emphasize to your students (as we do in the text) that no textbook can provide the details available in the literature, and any "real" (that is, for a paying customer) machine vision project will require the development engineer to go to the published journal and conference literature. As stated above, the two recurrent themes throughout this book are consistency and optimization. The concept of consistency occurs throughout the discipline as a principal philosophical construct for solving machine vision problems. When confronted with a machine vision application, the engineer should seek to find ways to determine sources of information which are consistent. Optimization is the principal mathematical tool for solving machine vision problems, including determining consistency. At the end of each chapter which introduces techniques, we remind the student where consistency fits into the problems of that chapter, as well as where and which optimization methods are used.

Contents