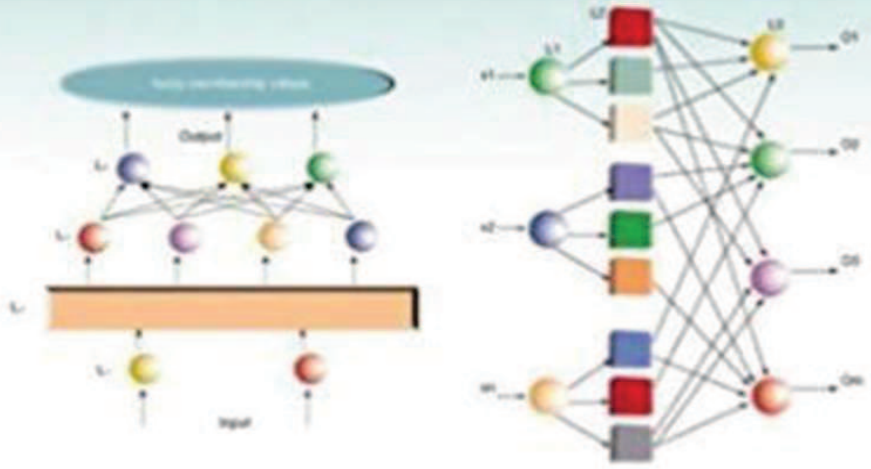
Computer Vision and Fuzzy-Neural Systems



ARUN D. KULKARNI

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ARUN D. KULKARNI

mplete guide to applying fuzzy-neural systems in computer vision

in neural networks and fuzzy logic are trans-
. of computer vision, making it possible for
applications to learn and make decisions, and
visual data far more effectively. Now, Dr. Arun
gs together the latest research and applications,
eld's first comprehensive tutorial and reference.

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work models. Coverage includes:

techniques such as radiometric or geometric

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vision applications: remote sensing, medical
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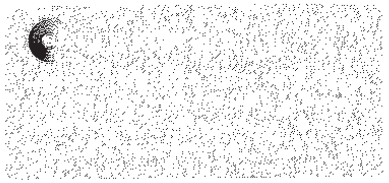

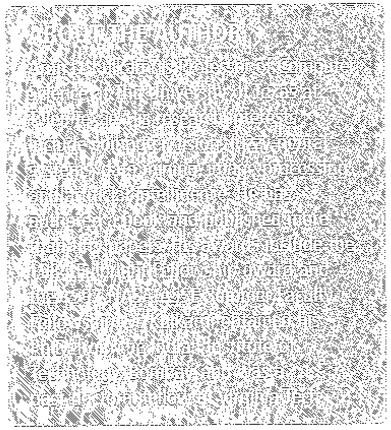

on and Fuzzy-Neural Systems illuminates state-of-the-art technology through hands-on exercises,
mples, and proven algorithms. It is an essential resource for every engineer, scientist, and programmer
puter vision and a wide range of related fields. It can also be used as a textbook for undergraduate- or
ourses in computer vision.

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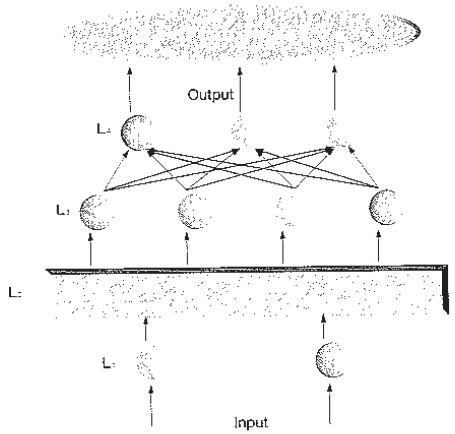

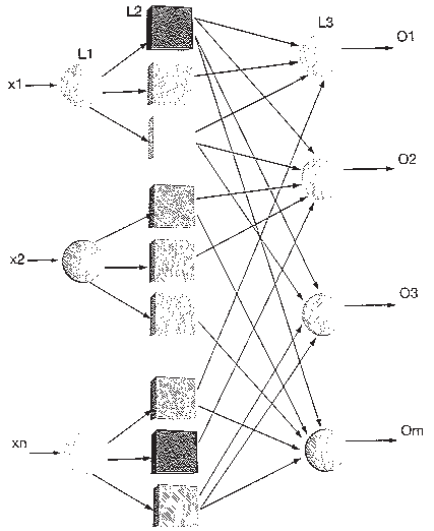

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This book is dedicated to the memory of my parents

CONTENTS

PREFACE

Computer vision deals with extracting meaningful descriptions of physical objects from images. Computer vision has many practical applications such as remote sensing, medical image processing, robot vision, military reconnaissance, mineral exploration, cartography, forestry, etc. Recent developments in neural networks and fuzzy logic have changed the computer vision field dramatically. During the past few years there has been a large and energetic upswing in research efforts aimed at synthesizing fuzzy logic with neural networks. Neural networks provide algorithms for learning and are modeled after the physical architecture of the brain. Fuzzy logic deals with issues such as reasoning at the semantic or linguistic level and is based on the way brain deals with inexact information. Consequently, the two technologies complement each other. A variety of fuzzy-neural network models have been used in computer vision. This book deals with the topic of fuzzy-neural systems as applied to computer vision. The book provides exercises at the end of each chapter, and it can be used as a textbook for a course in computer vision at senior undergraduate or master degree level. The book also provides engineers, scientists, researchers, and students involved in computer vision a comprehensive, well-organized, up-to-date overview of recent techniques used in computer vision. The book is the outgrowth of my lecture notes in various classes that I taught at The University of Texas at Tyler. The material in the book is well tested in the classroom. It also has been published as journal articles and has been presented at various professional meetings.

Every effort has been made to produce a book that is easy to understand without oversimplification of the material. The mathematical level is well within grasp of a first-year graduate in a technical discipline such as engineering, computer science, or technology requiring preparation in classical set theory, discrete mathematics, matrix algebra, and computer programming. The textbook presents several worked-out examples along with MATLAB examples. All chapters contain exercises.

AUDIENCE

This book is intended for use as a textbook for courses in computer vision, pattern recognition, or image processing at either the senior undergraduate level or first year graduate level. It is also suitable for use as a self-study guide by researchers, professionals, or engineers who want to learn about recent advances in computer vision and fuzzy-neural systems. Many techniques described in the book are also useful in data mining.

ORGANIZATION

The book consists of ten chapters. Chapter 1 provides the overview of the book. Chapter 2 describes the fundamentals of computer vision. It describes various stages of a computer vision system. These stages can be implemented with conventional statistical techniques, neural networks, fuzzy inference systems, or fuzzy-neural network models. Chapter 3 and Chapter 4 describe fuzzy logic and neural network models, respectively. Chapter 5 describes pre-processing techniques such as radiometric or geometric corrections. Chapter 6 deals with feature extraction. Chapter 7 and Chapter 8 deal with supervised and unsupervised classification. Chapter 9 concerns with associative memories, and Chapter 10 presents various applications of computer vision. Topics such as remote sensing, medical image processing, data compression, data mining, character recognition, and stereovision are discussed in Chapter 10. The dependency chart for the chapters is shown in Figure P.1. The book covers material for two semesters in computer vision. Chapters 1 through 5 can be covered in the first semester and Chapters 6 through 10 can be covered during the second semester. For a one-semester course Chapters 1, 2, 3, 4, 5, 7, and 10 can be covered.

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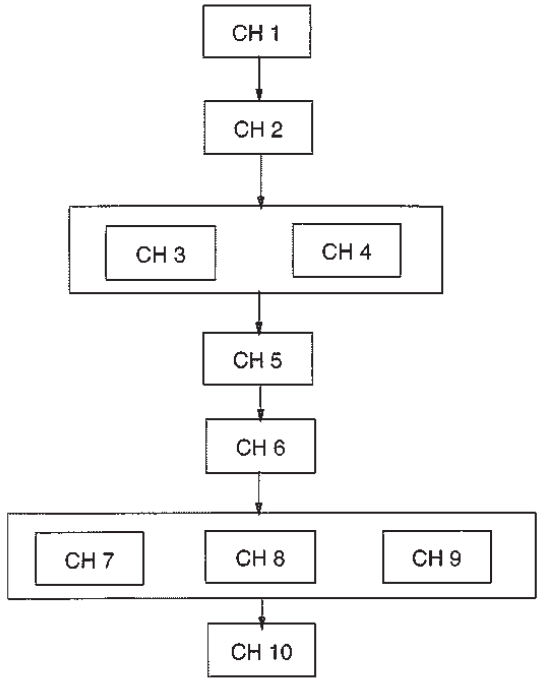

Figure P.1 Chapter dependency diagram

His research interests include computer vision, fuzzy-neural systems, data mining, image processing, and artificial intelligence. He has authored a book and published more than 50 referred papers. His awards include the 1984 Fulbright Fellowship award and the 1997 NASA/ASSE Summer Faculty Fellowship. Dr. Kulkarni obtained his Ph.D. from the Indian Institute of Technology, Bombay, and was a post-doctoral fellow at Virginia Tech. AUTHORS. Arun D. Kulkarni. No contact information provided yet. Daxwanger, W. A. and Schmidt, G.: Neural and fuzzy approaches to vision-based parking control, Control Engrg. Practice 4(11) (1996), 1607-1614.Google Scholar. 3. Kuo, R. J.: A robotic die polishing system through fuzzy neural networks, Comput. Industry 32(3) (1997), 273-280.Google Scholar. 4.Â Zadeh, L. A.: Roles of soft computing and fuzzy logic in the conception, design and deployment of information/intelligent systems, in: O. Kaynak, L. A. Zadeh, B. Turksen, and I. J. Rudas (eds), Computational Intelligence: Soft Computing and Fuzzy-Neuro Integration with Applications, NATO ASI Series F: Computer and Systems Sciences, Vol. 162, 1998, pp. 1-9.Google Scholar.