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Computer Vision for Biomedical Image Applications

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Preface

With the rapid increase in the variety and quantity of biomedical images in recent years, we see a steadily growing number of computer vision technologies applied to biomedical applications. The time is ripe for us to take a closer look at the accomplishments and experiences gained in this research subdomain, and to strategically plan the directions of our future research. The scientific goal of our workshop, "Computer Vision for Biomedical Image Applications: Current Techniques and Future Trends" (CVBIA), is to examine the diverse applications of computer vision to biomedical image applications, considering both current methods and promising new trends. An additional goal is to provide the opportunity for direct interactions between (1) prominent senior researchers and young scientists, including students, postdoctoral associates and junior faculty; (2) local researchers and international leaders in biomedical image analysis; and (3) computer scientists and medical practitioners. Our CVBIA workshop had two novel characteristics: each contributed paper was authored primarily by a young scientist, and the workshop attracted an unusually large number of well-respected invited speakers (and their papers). We had the good fortune of having Dr. Ayache of INRIA, France to talk about "Computational Anatomy and Computational Physiology," Prof. Grimson of MIT to discuss "Analyzing Anatomical Structures: Leveraging Multiple Sources of Knowledge," Dr. Jiang of the Chinese Academy of Sciences to present their work on "Computational Neuroanatomy and Brain Connectivity," Prof. Kanade of CMU to reveal their recent work on "Tracking of Migrating and Proliferating Cells in Phase-Contrast Microscopy Imagery for Tissue Engineering," Prof. Noble of Oxford to answer the question: "Cardiology Meets Image Analysis: Just an Application or Can Image Analysis Usefully Impact Cardiology Practice?," and Prof. Stewart of RPI to summarize "Computer Vision Algorithms for Retina Images."

We received an overwhelming response from the computer vision community to our call for papers. A total of 82 full papers were received from 12 countries. Through careful reviews of each paper by at least three members of our Program Committee, 50 contributed papers were accepted for this volume of the LNCS book series. This large number of paper acceptances reflects the high quality of the submissions.

We received generous support from our sponsors: National Science Foundation of China, Chinese Association for Artificial Intelligence, Siemens Research, Intel Research, and Dr. Enming Song.

A workshop of this size would not be possible without the hard work of many people. In particular, we would like to thank each member of the Program Committee for their prompt and critical reviews, which ensured high standards for this workshop. We would like to express our sincere gratitude to our administrative coordinator, Ms. Janice Brochetti of Carnegie Mellon University, for her dedicated, tireless effort; to Dr. Zhongbao Kou of Tsinghua University for his effective plans; and to Ms. Fang Qian of the National Lab of Pattern Recognition for her care and attention to detail.

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Last, but not least, we would like to thank the Advisory Committee and Prof. Stewart. Without their insightful guidance, we would not have made.

We hope our readers will benefit from this timely collection of excellent papers in CVBIA research as much as we enjoyed putting the volume together.

August 2005

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Computational Anatomy and Computational Physiology for Medical Image Analysis

Nicholas Ayache

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Medical image analysis brings about a revolution to the medicine of the 21st century, introducing a collection of powerful new tools designed to better assist the clinical diagnosis and to model, simulate, and guide more efficiently the patient's therapy. A new discipline has emerged in computer science, closely related to others like computer vision, computer graphics, artificial intelligence and robotics.

In this talk, I will describe the increasing role of computational models of anatomy and physiology to guide the interpretation of complex series of medical images, and illustrate my presentation with three applications: the modeling and analysis of 1) brain variability from a large database of cerebral images, 2) tumor growth in the brain and 3) heart function from a combined exploitation of cardiac images and electrophysiology.

I will conclude with a presentation of some promising trends, including the analysis of *in vivo* microscopic images.

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