

Foreword

Within computer science, computer graphics and computer vision emerged as identifiable disciplines in the early 1960s and thereafter spawned largely independent research communities, this despite the fact that the two fields are closely related by their common focus on digital images and videos. As a researcher whose work since the mid 1980s has taken a unified perspective spanning both vision and graphics, this book is an intellectual delight for me. A passion of mine has been to bridge graphics and vision through mathematical modeling, based on the natural notion that graphics is the *forward problem* of *synthesizing* images and video from mathematical models of objects while, conversely, vision is the *inverse problem* of *analyzing* images and video to infer such mathematical models. In my opinion, the most exciting research in computer vision and computer graphics today cuts across the traditional boundaries of these fields.

Zicheng Liu and Zhengyou Zhang, who respectively are Senior and Principal Researchers at Microsoft Research with enviable records of technical achievement, have produced a unique volume whose content spans graphics and vision and which contributes into a variety of applications of relevance to practitioners and researchers in industry and academia alike. I find their treatise especially stimulating because its subject matter is the modeling of humans, specifically the human face, a topic that has attracted my research interest for some two dozen years. Although either the model-based synthesis or analysis of facial images and videos has been the topic of existing monographs, this book by Liu and Zhang is the first to cover both aspects in depth.

The human face has fascinated people since time immemorial. Many scientists would agree that, aside from the brain itself, the face situated to the front of it is the most intriguing part of the human body. Attempting to emulate its form, appearance, and function by computer has been an extremely challenging problem because people are very sensitive to even the slightest flaws and shortcomings in digital models of the human face. Liu and Zhang boldly tackle the difficult challenge of modeling the form and appearance of the face. The value of their book is enhanced tremendously by the fact that it not only presents and discusses the details of their own work, but that it also reviews the technical details of a plethora of related methodologies and algorithms that have been contributed by other researchers.

In Part I of this book, the authors consider a variety of digital representations of the human face, including shape models and appearance models.

In Part II, after discussing face modeling approaches based on active sens-

ing, such as laser scanners and structured light systems, Liu and Zhang consider image-based face modeling techniques and they present their innovative system that captures facial models in a highly automated manner using an ordinary video camera connected to a conventional computer. They show how this system exploits computer vision techniques such as feature extraction and matching, structure from motion estimation, 3D reconstruction, and geometric model fitting. The authors then consider the topics of appearance modeling through reflectometry, the reconstruction of irradiance environment maps, and illumination recovery from specular reflection. Finally, they discuss the combined shape and appearance modeling of faces through shape from shading and the construction of morphable models of the face. Among the many uses of the appearance modeling methods that are covered by the authors, one of the most potentially significant from a commercial standpoint is automatic face recognition.

Part III of the book demonstrates that the photorealistic models of the face produced using the aforementioned techniques are suitable for a variety of applications in computer graphics and vision. These include facial animation, facial appearance editing and relighting, and the construction and use of facial avatars in computer graphics. For computer vision, Liu and Zhang discuss model-based facial tracking for video conferencing and other applications. Finally, they consider the development of conversational agents using their photorealistic facial models, plus the application of these animated agents to human-computer interaction, an important area which stands to benefit tremendously from such a confluence of vision and graphics.

It is my pleasure to recommend Zicheng Liu and Zhengyou Zhang's 300-page magnum opus to anyone interested in graphics and vision in general and the human face in particular. Let's face it, for researchers and practitioners like us, this book is an essential read.

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March 2011