Preface

A picture says more than a thousand words. This is something that we all know to be true. Imaging has been important since the early days of medicine and biology, as seen in the anatomical studies of Leonardo Da Vinci or Andreas Vesalius. More than 100 years ago, the first noninvasive imaging technologies, such as Konrad Roentgen's X-ray technology, were applied to the medical field—and while still crude—revolutionized medical diagnosis. Today, every patient will be exposed to some kind of advanced imaging technology such as medical resonance imaging, computed tomography or four-dimensional ultrasound during their lifetime. Many diseases, such as brain tumors, are initially diagnosed solely by imaging, and most of the surgical planning relies on the patient imagery. 4D ultrasound is available to expecting parents who wish to create unique early memories of the new baby, and it may soon be used for the morphometric diagnosis of malformations that may one day be treatable—*in utero*!

Light and electron microscopy are unequal brethren, which have contributed to most of our knowledge about the existence and organization of cells, tissues and microorganisms. Every student of biology or medicine is introduced to the fascinating images of the microcosm. New advances have converted these imaging technologies, which were considered by many to be antiquated, into powerful tools for research in systems biology and related fields. The development of laser technology and advances in the development of computer systems have been instrumental in the improvement of imaging technologies, which will be utilized for many generations to gain new insight into complex biological and medical phenomena.

With the completion of the human genome, hopes were high that we would now be able to read the "blueprint" of life and understand how the human body works. Unfortunately, as is quite common in science, the complete genome has triggered more questions than it has helped to answer at this point. A simple approach to understanding how the body functions by reading the "blueprint" is not possible, as almost all of the bodily functions are spatiotemporal in nature. In addition, a protein modification which causes curled wings in *Drosophila melanogaster* will naturally have a completely different function in humans, and so a 1:1 transposition of knowledge from one organism to another is impossible. Genome researchers are now forced to conduct additional large-scale experiments, including gene expression, proteomic and metabolomic studies. Integrating the data from these complex experiments is an extremely difficult task, and displaying the results requires new approaches to imaging in order to allow a wide audience to make sense of the facts. Imaging technologies will be especially useful for the creation of spatiotemporal models, which can be used for the integration of “omics” data.

As we can see from the above three paragraphs, advanced imaging in medicine and biology is a very wide field. When we started to plan this book, we were unable to find a publication that provided a broad sampling of this rapidly expanding field. We hope that our readers will appreciate and benefit from the diversity of topics presented here.

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