

# Medical Image Analysis

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*Medical Image Analysis* covers the fundamentals of medical imaging, as well as image reconstruction, processing, and analysis, and briefly describes recent developments in these areas. The book is organized into 11 chapters, with more than 160 figures, and proceeds logically from how medical images are obtained to how they are processed and analyzed. The intended audiences are graduate and undergraduate students, medical physicists, and biomedical engineers who have a sound mathematic background and are interested in medical image acquisition, formation, processing, and analysis.

The book begins with an overview of imaging modalities and their role in diagnostic radiology and medicine. The next 3 chapters lay down the mathematic foundations and basic physical principles behind electromagnetic radiation detection and image acquisition and formation and briefly describe the imaging modalities used in diagnostic radiography, mammography, CT, nuclear medicine (SPECT and PET), MRI, and ultrasound. Chapter 5 is devoted to 2- and 3-dimensional image reconstruction techniques. The chapter starts with the mathematic foundations for basic image reconstruction, such as the central-slice theorem and the inverse radon transform, and then briefly describes reconstruction methods such as backprojection, iterative algebra, estimation, and Fourier transformation. Their use in imaging is also covered. The remaining chapters focus on image processing, particularly image enhancement, which is covered in chapter 6. This chapter is divided into 2 parts. The first discusses spatial domain methods such as histogram modifications, neighborhood operations, and image addition and subtraction, whereas the second discusses frequency domain filtering techniques. Wavelet transforms are also discussed as a technique for image enhancement. Chapter 7 presents image segmentation methods and classifies them into 3 broad categories. The first is edge-based methods such as boundary tracking and the Hough transform, the second is pixel-based direct classification methods such as global thresholding and clustering, and the third is region-based methods such as region-growing and -splitting techniques. In addition, this chapter includes recent advances in image segmentation such as adaptive techniques and neural networks. Image representation and analysis are covered in

Chapter 8. In particular, this chapter describes feature-extraction methods for region representation and classification methods for object identification and understanding, with a specific image analysis example of mammographic microcalcification. Chapter 9 describes image registration techniques, with emphasis on model-based and interactive approaches for registering multidimensional, multimodality images. Rigid-body, principal-axis, and iterative principal-axis techniques are covered. The chapter also covers the similarity transformation used for point-based registration, weighted features-based registration, and elastic deformation-based registration. Chapter 10 briefly covers current image visualization techniques such as stereovision and semi-3-dimensional display, surface and volume rendering, and interactive virtual reality visualization. The final chapter discusses current and future trends in medical imaging and image analysis.

Each chapter is neatly organized and accompanied by exercises and references. The exercises are well thought out and help the reader understand the presented material. Although they require the reader to have a working knowledge of the MATLAB software package (The MathWorks, Inc.), they increase in complexity as the reader advances through the book, thus helping students build skills in MATLAB. The references are generally current and appropriate.

In summary, this book is a good reference on medical image analysis. It is well organized and well written and covers topics ranging from electromagnetic radiation detection to medical image processing and analysis. While reading the book, I found an orderly and logical development of topics. However, each was covered relatively briefly, suggesting that the reader should have prior knowledge of the material. Moreover, few examples were provided. Furthermore, many figures were poorly reproduced, and none were in color—sometimes obscuring the point being made in the text. Still, I found the book useful as a quick reference on medical image analysis, and I recommend it.

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