

Contents

Preface	xiii
1. Introduction	1
1.1. Medical Imaging: A Collaborative Paradigm / 2	
1.2. Medical Imaging Modalities / 3	
1.3. Medical Imaging: From Physiology to Information Processing / 6	
1.4. General Performance Measures / 8	
1.5. Biomedical Image Processing and Analysis / 11	
1.6. Exercises / 14	
1.7. References / 16	
1.8. Definitions / 16	
2. Image Formation	19
2.1. Image Coordinate System / 21	
2.2. Linear Systems and Impulse Response / 22	
2.3. Principle of Image Formation / 22	
2.4. Pin-Hole Imaging / 26	
2.5. Fourier Transform / 27	
2.6. Radon Transform / 30	
2.7. Sampling / 32	
2.8. Discrete Fourier Transform / 37	
2.9. Exercises / 37	
2.10. References / 38	
3. Interaction of Electromagnetic Radiation with Matter in Medical Imaging	41
3.1. Electromagnetic (EM) Radiation / 42	
3.2. EM Radiation for Image Formation / 43	

3.3.	Radiation Interaction with Matter / 43	
3.4.	Linear Attenuation Coefficient / 46	
3.5.	Radiation Detection / 47	
3.6.	Exercises / 51	
3.7.	References / 51	
4.	Medical Imaging Modalities	53
4.1.	X-Ray Imaging / 54	
4.2.	Magnetic Resonance Imaging / 62	
4.3.	Nuclear Medicine Imaging Modalities / 91	
4.4.	Ultrasound Imaging / 99	
4.5.	Exercises / 107	
4.6.	References / 108	
5.	Image Reconstruction	111
5.1.	Mathematical Preliminaries and Basic Reconstruction Methods / 112	
5.2.	Image Reconstruction in Medical Imaging Modalities / 125	
5.3.	Exercises / 133	
5.4.	References / 134	
6.	Image Enhancement	139
6.1.	Spatial Domain Methods / 140	
6.2.	Frequency Domain Filtering / 153	
6.3.	Wavelet Transform for Image Processing / 162	
6.4.	Exercises / 170	
6.5.	References / 172	
7.	Image Segmentation	175
7.1.	Edge-Based Image Segmentation / 176	
7.2.	Pixel-Based Direct Classification Methods / 181	
7.3.	Region-Based Segmentation / 189	
7.4.	Recent Advances in Segmentation / 193	
7.5.	Exercises / 207	
7.6.	References / 208	
8.	Image Representation and Analysis	211
8.1.	Feature Extraction and Representation / 214	
8.2.	Feature and Image Classification / 233	
8.3.	Image Analysis Example: Analysis of Difficult-to-Diagnose Mammographic Microcalcifications / 242	
8.4.	Exercises / 246	
8.5.	References / 248	

