

Contents

Contents.....	v
1. Introduction	1
2. Sources of medical images and their general characteristics.....	7
2.1. X-ray images	7
2.2. CT images	15
2.3. NMR images	21
2.4. Nuclear imaging	29
2.5. PET imaging	34
2.6. USG images	38
3. Compressing medical images and storing them in medical databases.....	47
3.1. Systems for archiving and distributing medical images	47
3.2. Standards for medical images treated as computer data files	49
3.3. Why medical images need to be compressed	51
3.4. General remarks about image compression methods	52
3.5. Lossless compression methods	54
3.6. Compression standards	57
3.7. Comparison of compression methods.....	58
3.8. Video sequence compression.....	61
3.9. The problem of assessing the quality of images subjected to compressing	63
4. Preprocessing medical images and their overall enhancement	65
4.1. One point based transformations	66
4.2. Subtractive angiography and other methods of image enrichment using multi-image transformations	70
4.3. Simple low pass and high pass filtering of images	74
4.3.1. General definition.....	74
4.3.2. Low pass filters	77
4.3.3. High pass filters.....	80

4.4. Nonlinear filtering and mathematical morphology algorithms for medical image cleaning and improvement	83
4.5. Binarization of medical images.....	91
4.5.1. General remarks	91
4.5.2. Binarization by simple thresholding	93
4.5.3. Binarization by detecting edges	93
4.5.4. Binarization by region growing.....	94
4.5.5. Binarization with the use of neuron networks.....	94
4.6. Hough transform in medical applications	94
5. Algorithms and methods for the goal-oriented processing of medical images	99
5.1. Segmentation of medical images	99
5.2. Segmentation based on the image texture.....	102
5.3. Separating gallbladders from USG images.....	104
5.4. Segmenting ERCP images	107
5.5. Thinning and skeletonizing objects in images	109
5.6. An example of a special type of medical image processing: the straightening transform	111
6. Pattern recognition, clustering and classification applied to selected medical images.....	117
6.1. Introduction	117
6.2. A general model of medical image recognition.....	120
6.3. Clustering as a symmetrical problem for classification and pattern recognition.....	122
6.4. Simple pattern recognition methods (e.g. the k-neighbors algorithm and similar metrics-based methods) in medical applications	125
6.5. Pattern recognition methods based on approximating regions in feature space	128
6.5.1. Linear approximation of boundaries between regions	129
6.5.2. SVM: a simple and effective method of pattern recognition	130
6.5.3. Nonlinear methods and nonlinear transformations in region modeling.....	132
6.6. Neural networks for medical image recognition.....	134
6.6.1. Kohonen network	136
6.6.2. Hopfield net.....	137
6.6.3. Multi-layer perceptron.....	139
6.7. Bayesian and other probabilistic methods of pattern recognition in medical applications.....	140
6.7.1. Bayes method	141
6.7.2. An example of using Bayes classification to recognize tumors.....	143
6.7.3. Maximum entropy criterion.....	144
6.7.4. Non-parametric estimation methods	145
6.7.5. Histogram method	145
6.7.6. Parzen windows	146

6.7.7. Application of probabilistic methods.....	147
6.8. Syntactic and other structural methods in medical image recognition.....	148
7. Automatic understanding of medical images as a new paradigm for advanced computer aiding of medical investigations	153
7.1. A general overview of the image understanding concept.....	154
7.2. Two-way data flow when solving image understanding problems	161
7.3. Language description of the image as a key to understanding procedures	163
7.4. Types of languages used in the syntactic approach to image description problems	166
8. Image understanding methods applied to medical diagnostics	171
8.1. Graph image language techniques supporting cognitive interpretations of radiological hand images.....	172
8.1.1. Characteristics of the analyzed data.....	174
8.1.2. A syntactic description of wrist radiographs	179
8.1.3. The graph language describing the wrist structure	181
8.1.4. Selected results.....	183
8.1.5. Conclusions concerning semantic analysis methods for wrist bones.....	184
8.2. Picture grammars for classifying 3D coronary vessel visualizations	185
8.2.1. The classification problem.....	187
8.2.2. Functional characteristics of coronary arteries	190
8.2.3. Graph-based formalisms in the semantic description of coronary vessels	192
8.2.3.1. Characteristics of the image data.....	192
8.2.3.2. A graph-based description of coronary arteries	193
8.2.3.3. A semantic analysis of the coronary structure	197
8.2.4. Selected results.....	198
8.2.5. Conclusions concerning the semantic analysis of coronary artery images	200
8.3. Concluding remarks	200
References	203
Index	207

Modern Computational Intelligence Methods for the
Interpretation of Medical Images

Tadeusiewicz, R.

2008, VII, 209 p., Hardcover

ISBN: 978-3-540-75399-5