Contents

1 Fast Methods for Shape Extraction in Medical and Biomedical Imaging 1
R. Malladi, J. A. Sethian
1.1 Introduction 1
1.2 The Fast Marching Method 3
1.3 Shape Recovery from Medical Images 6
1.4 Results 10
References 13

2 A Geometric Model for Image Analysis in Cytology 19
C. Ortiz de Solorzano, R. Malladi,, S. J. Lockett
2.1 Introduction 19
2.2 Geometric Model for Image Analysis 20
2.3 Segmentation of Nuclei 22
2.4 Segmentation of Nuclei and Cells Using Membrane-Related Protein Markers 31
2.5 Conclusions 37
References 38

3 Level Set Models for Analysis of $2D$ and $3D$ Echocardiographic Data 43
A. Sarti, C. Lamberti, R. Malladi
3.1 Introduction 43
3.2 The Geometric Evolution Equation 45
3.3 The Shock-Type Filtering 46
3.4 Shape Extraction 49
3.5 $2D$ Echocardiography 52
3.6 $2D + time$ Echocardiography 53
3.7 $3D$ Echocardiography 56
3.8 $3D + time$ Echocardiography 58
3.9 Conclusions 59
References 61

4 Active Contour and Segmentation Models using Geometric PDE's for Medical Imaging 63
T. F. Chan, L. A. Vese
4.1 Introduction 63
4.2 Description of the Models 64
4.3 Applications to Bio-Medical Images 68
4.4 Concluding Remarks 68
References 70

5 Spherical Flattening of the Cortex Surface 77
A. Elad (Elbaz), R. Kimmel
5.1 Introduction 77
5.2 Fast Marching Method on Triangulated Domains 80
5.3 Multi-Dimensional Scaling 80
5.4 Cortex Unfolding 84
5.5 Conclusions 86
References 86

6 Grouping Connected Components using Minimal Path Techniques 91
T. Deschamps, L. D. Cohen
6.1 Introduction 91
6.2 Minimal Paths in 2D and 3D 93
6.3 Finding Contours from a Set of Connected Components R_k 96
6.4 Finding a Set of Paths in a 3D Image 102
6.5 Conclusion 103
References 104

7 Nonlinear Multiscale Analysis Models for Filtering of 3D + Time Biomedical Images 107
A. Sarti, K. Mikula, F. Sgallari, C. Lamberti
7.1 Introduction 107
7.2 Nonlinear Diffusion Equations for Processing of 2D and 3D Still Images 109
7.3 Space-Time Filtering Nonlinear Diffusion Equations 115
7.4 Numerical Algorithm 117
7.5 Discussion on Numerical Experiments 120
7.6 Preconditioning and Solving of Linear Systems 122
References 126

Appendix. Color Plates 129