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LEVEL SET SEGMENTATION OF MR IMAGES FOR EXTRACTION OF FEMUR BONE AND TISSUES

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by

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To my Parents, Brother

and Grandmother

for

everything...

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List of Abbreviations

1-D	One-dimensional
2-D	Two-dimensional
3-D	Three-dimensional
ANN	Artificial Neural Network
ASM	Active Shape Models
CAD	Computer-Aided Design
CT	Computed Tomography
DWT	Discrete Wavelet Transform
EM	Expectation-maximization
FCM	Fuzzy *c*-Means
MDM	Magnetic Dipole Moment
mm	millimeter
mm^3	millimeter cube
MOD	Magneto-Optical Disk
MR	Magnetic Resonance
MRF	Markov Random Field
MRI	Magnetic Resonance Imaging
NMR	Nuclear Magnetic Resonance
NN	Neural Network
PDE	Partial Differential Equations
PET	Positron Emission Tomography
RF	Radio Frequency

RGB	Red, Green and Blue
ROI	Region Of Interest
SOM	Self-Organizing Map
SPECT	Single Photon Emission Computed Tomography
T	Tesla
TE	Time to Echo
TR	Time to Repeat
WT	Wavelet Transform

FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY UNIVERSITY OF MALAYA

Degree	: Master of Computer Science
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Abstract

This research explores a potentially useful segmentation algorithm, known as the level set method. It is suitable for images obtained from the Magnetic Resonance Imaging (MRI) modality, despite the fact that MR images have low contrast between bone and tissue. The level set method is a numerical technique designed to track the evolution of an interface. The fast marching version of the method is implemented for two-dimensional (2-D) and three-dimensional (3-D) segmentation in this research. Femur segmentation is the main thrust of this thesis, however brain and heart images are also presented.

Pre-processing steps are first performed for the 2-D images. The 2-D segmentation method begins when the user selects the seed point by clicking on the region of interest, on the image. An interface starts propagating outwards, towards the boundary of the region being segmented. An energy-based function controls the evolving interface by using image gradient information and a control parameter defined by the user. The user is able to visually control accuracy.

The 3-D volume is built by concatenating and interpolating the 2-D slices. The 3-D method is an extension of the 2-D method, with differences in implementation. 3-D segmentation begins when a slice chosen by the user is displayed, and the seed point is selected. The current slice being segmented within the volume is displayed to allow the user to view the segmentation process. The segmented 3-D volume is then isosurface rendered and displayed as a 3-D model