TABLE OF CONTENTS

Declaration I
Certificate II
Abstract III
Acknowledgements VI
Table of Contents VII
List of Tables XII
List of Figures & Graphs XVI
List of Abbreviations XXIII

CHAPTER 1
INTRODUCTION
1.1 Introduction 2
1.2 Digital Image Processing 2
  1.2.1 Image 2
  1.2.2 Image Sampling and Quantization 3
  1.2.3 Fundamental steps in digital image processing 3
1.3 Image Enhancement and Filtering in Spatial Domain 4
  1.3.1 Spatial domain method 4
  1.3.2 Filters 5
1.4 Image Enhancement and Filtering in Frequency Domain 7
  1.4.1 Fourier transform and the frequency domain 7
  1.4.2 Filters 8
1.5 Wavelet Transform 10
  1.5.1 Continuous wavelet transform 10
  1.5.2 Multiresolution and scaling function 11
1.5.3 Discrete wavelet transform

1.6 Noise Models
  1.6.1 Gaussian noise
  1.6.2 Impulse (salt and pepper) noise
  1.6.3 Poisson noise (photon noise)
  1.6.4 Speckle noise
  1.6.5 Uniform noise
  1.6.6 Erlang (gamma) noise

1.7 Fundamentals of Microscopy
  1.7.1 Microscope
  1.7.2 Parts of microscopes
  1.7.3 Types of microscopes
  1.7.4 Terms associated with microscopes

1.8 Microscopic Images

1.9 Motivation

1.10 Objectives

1.11 Organization of the Thesis

CHAPTER 2
  REVIEW OF LITERATURE
  2.1 Introduction
  2.2 Review of Basic Image Processing
  2.3 Review of Enhancement Techniques
  2.4 Review of Noise Removal Techniques
  2.5 Review of Wavelet Based Techniques
  2.6 Review of Image Processing of Microscopic Images
  2.7 Review of Computational Complexity
CHAPTER 3
RESEARCH DESIGN
3.1 Introduction
3.2 Research Design
  3.2.1 Problem base and theory Base
  3.2.2 Analysis
  3.2.3 Data collection
  3.2.4 Methods/Procedure Used
  3.2.5 Coding (execution)
  3.2.6 Observation and validation
CHAPTER 4
NOISE REMOVAL WITH SHARPENING
4.1 Introduction
4.2 Noise Sources in Microscopy and Microscopic Images
  4.2.1 Photon noise
  4.2.2 Dark noise
  4.2.3 Read noise
4.3 Proposed Model
  4.3.1 Design
  4.3.2 Microscopic image database
  4.3.3 Preprocessing
  4.3.4 Noise suppressing methods
  4.3.5 Image sharpening
4.4 Algorithm for First Approach
4.5 Assessment Parameter used for analyzing the output of the Algorithm
  4.5.1 Mean square error
CHAPTER 5
DIRECTIONAL NEIGHBOURHOOD DENOISING
5.1 Introduction 103
5.2 Image Noise 103
  5.2.1 Image impulse noise 103
  5.2.2 Median filter 104
  5.2.3 Adaptive median 105
5.3 Proposed Model 106
  5.3.1 Design 106
  5.3.2 Database 108
  5.3.3 Preprocessing 109
  5.3.4 Algorithm for second approach 109
5.4 Assessment Parameter used for analyzing 113
the output of the Algorithm
  5.4.1 Mean square error 114
  5.4.2 Peak signal to noise ratio 114
  5.4.3 Computational complexity 114
5.5 Performance Analysis 114
5.6 Summary 129

CHAPTER 6
DIRECTIONAL NEIGHBOURHOOD WITH WAVELETS
6.1 Introduction 131
6.2 Wavelet Theory 133
  6.2.1 Fourier transform vs. wavelet transform 133