# Contents


Acknowledgements vi
Abstract vii
List of publications viii
Contents x
List of figures xii
List of tables xvi
1. Introduction 1
2. Optical Imaging 3
2.1 Optical diffuse reflectance (ODR) 3
2.2 Theories 6
2.2.1 Mie scattering 7
2.2.2 Photon-diffusion equation 8
2.2.3 Kubelka Munk model (KMM) 9
2.2.4 Skin 9
2.2.5 Liver 10
2.3 Applications of ODR towards OCT 10
2.4 Optical coherence tomography (OCT) 11
2.4.1 Optical coherence tomography: Mechanism 12
2.4.2 Low coherence interferometery (LCI) with same frequency 14
2.4.3 Fourier domain optical coherence tomography (FD-OCT) 17
2.4.4 Swept source (SS-OCT) 19
2.4.5 Speckle variance OCT 21
2.5 SS-OCT as glucose sensor 24
2.6 Brownian motion 24
2.7 Dynamic light scattering (DLS) 26
2.7.1 Application of DLS to quantify glucose levels using SS-OCT 27
2.8 OCT catheters 20
3.0 Measurements of optical properties (*ex vivo*) with diffuse reflectance 31
3.1 Measurements of optical properties of rat liver and skin 31
3.2 Materials and Methods 31
3.2.1 Signal detection 31
3.2.2 Sample preparation 33
3.2.3 Measurement system 35
3.2.4 Signal processing 38
3.3 Results and discussion 38
3.4 Optical properties of chicken liver 50
3.5 Materials and methods 50

3.5.1 Sample preparation 50
3.5.2 Measurement system 50
3.5.3 Monte Carlo simulation for optical diffuse reflectance 51
3.5.4 Results and discussion 53
4.0 Glucose quantification in non-flowing blood 62
4.1 Glucose levels in blood 62
4.2 Materials and methods 62
4.2.1 Samples preparation 62
4.2.2 Measurement system 65
4.2.3 Signal processing 69
4.3 Results and discussion 79
4.4 Conclusions 86
4.5 Extension of the work 86
5.0 Glucose quantification in non-flowing blood 87
5.1 Flow phantom measurements 87
5.1.1 Samples 88
5.1.2 Measurements and signal processing 89
5.2 Speckle variance OCT: blood vessel images 101
5.2.1 The dorsal skinfold window chamber model 103
5.2.2 M-mode measurements 109
5.3 Results and discussions 110
5.4 Summary 119
5.5 Future extension 120
6.0 Optical coherence tomography probes 121
6.1 OCT probes 121
6.1.5 Multichannel OCT (MOCT) probe 121
6.1.2 Forward view imaging probe 123
6.2 Conclusion 125
7.0 Summary 126
References 129