## CONTENTS

Title Page	i			
Certificate of Approval				
Certificate				
Declaration				
Acknowledgements	V			
Abstract	vi			
List of Symbols and Abbreviations	viii			
List of Figures	X			
List of Tables	xiii			
Chapter 1: Introduction1				
1.1 Photoplethysmography and its applicability in Preventive Cardiology	3			
1.2 Research Objectives				
1.3 Summary of the work				
1.4 Contributions in the thesis	7			
1.5 Organization of the thesis	8			
Chapter 2: Human Cardiovascular System – anatomy, pathophysiology and	1			
noninvasive assessment9				
2.1 Relevance of Preventive Cardiology in Public Healthcare	10			
2.2 Human Cardiovascular System- A Brief Introduction	11			
2.3 Pulse Wave Propagation and Wave Reflection	17			
2.4 Alterations in Vascular Pathophysiology with Age and Disease	21			
2.4.1 Atherosclerosis	22			
2.4.2 Roles of Pharmacological Agents in Normalizing the Effect	s of			
Hypertension and Diabetes	28			
2.5 Noninvasive Measurements for Cardiovascular System	30			
2.6 The Photoplethysmograph Signal	33			
2.7 Applicability of PPG Signal Analysis in Preventive Cardiac Care	38			
2.8 Summary	41			

Chapter 3: A Two-Pulse-Synthesis Model and a Measurement Setup for PPG
Signal Acquisition and Modeling43
3.1 A Brief Account on Evolution of Arterial models44
3.2 Recent Work on PPG Signal Analysis47
3.3 Description of a New Two-Pulse-Synthesis Model51
3.4 A Setup for Non-Invasive Measurement of Multiple Biomedical Signals63
3.5 Relevance and Utility of the TPS Model70
3.6 New Parameters of Clinical Relevance Based on TPS Model71
3.7 Limitations of TPS Model75
3.8 Summary
Chapter 4: Measurement of Signals and Application of TPS Model for
Hypertension77
4.1 Data Collection Methodology
4.2 Parameters of PPG Signals Obtained by Conventional Methods83
4.2.1 PPG Data of normal subjects obtained by conventional measurement85
4.2.2 Age-Group wise PPG data for diseased subjects by conventional
measurement89
4.2.3 Finger PPG signals in hypertensive subjects obtained by conventional
measurement93
4.3 Basic Parameters of Healthy Subjects Obtained from TPS Model96
4.4 Determination of Threshold values for Foot to Foot Delay, DPS and SDR for
Healthy subjects99
4.5 Summary of TPS Model Parameters for all Diseased Subjects100
4.6 TPS Model Parameters for Hypertensive Subjects
4.7 A Brief Discussion on Therapeutics
4.8 Summary110
Chapter 5: Applicability of TPS Model for Diabetes and Coronary Artery
Diseases
5.1 Studies on Subjects with Only Diabetes Mellitus
5.2 TPS Model Parameters for Diabetic Subjects with Hypertension118
5.3 Studies on Subjects with Coronary Artery Diseases

		5.3.1	Validation of TPS model for CAD against coronary	angiography		
				122		
		5.3.2	Study on post-intervention CAD subjects under treatm	nent132		
	5.4	Carotic	I Intima Media Thickness Study	135		
	5.5	Principal Component Analysis towards TPS Model Application1				
	5.6 Summary					
Chapte	er 6: R	Robustn	ess of TPS Model and its Applicability in Public Ca	ırdiac		
		Care		147		
	6.1	Applic	cability of TPS Model on Toe PPG	147		
	6.2	Suitab	ility of TPS Model for Brachial PPG	153		
	6.3	TPS M	Model on PPG Signals from Red LED	155		
	6.4	Studie	s Involving combination of Lead-2 ECG and Finger PP	G157		
	6.4	4.1 Stud	ies on Pulse Transit Time	157		
			n-invasive measurement of Pulse Wave Velocity and			
	Pe	riod usi	ng multiple PPG-ECG	159		
	6.5	PPG S	Signal Analysis in Public Cardiac Care Program	161		
	6.6	An Ind	icative Longitudinal Study Based on TPS Model Param	neters165		
	6.7	Summa	ary	170		
Cha	apter '	7: Conc	lusions	. 173		
	Apper	ndix				
	Refer	ences				
	Autho	or's con	nmunications			
	Bioda	ta				