## CONTENTS

### CHAPTER 1  Introduction

1.1 Scope of the work 1  
1.2 Synopsis of the thesis 4

### CHAPTER 2  Some Topics Related To Electrocardiography

2.1 Electrocardiogram 7  
2.2 The electrocardiograph 8  
2.3 The heart and its activity 8  
2.4 The conduction system 9  
2.5 Nomenclature and location of the electrode leads 10  
2.6 ECG complexes and intervals 14  
2.7 Data acquisition system 23  
2.8 Preprocessing of ECG signal 25  
2.9 Electrical axis of the heart 26  
2.10 Concluding remarks 28

### CHAPTER 3  Syntactic Pattern Recognition and Formal Language Theory

3.1 Basics 29  
3.2 String grammars and language 31  
3.3 Chomsky hierarchy 36  
3.4 Equivalent context-free grammars 40  
3.5 Cycle free grammars 40  
3.6 Grammars with no useless symbols or productions 42  
3.7 Chomsky normal form 43  
3.8 Parsing 45  
3.9 The Cocke-Younger-Kasami (CYK) parsing algorithm 47  
3.10 Concluding remarks 50

### CHAPTER 4  Expert Systems and Turbo Prolog

4.1 Artificial intelligence 51  
4.2 Expert systems 52  
4.3 The knowledge engineer 53  
4.4 Knowledge representation 54  
4.5 The production system 54  
4.6 Certainty factor 57  
4.7 Using Prolog to design rule based systems 59  
4.8 Turbo Prolog 61  
4.9 Concluding remarks 77

### CHAPTER 5  ECG Analysis - A Review

5.1 Data reduction 79  
5.2 Feature extraction 86  
5.3 Classification 93
CHAPTER 6 Recognition And Extraction of ECG Features - A Syntactic Approach

6.1 Feature selection 99
6.2 Baseline detection 100
6.3 Selection of pattern primitives 101
6.4 String generation 104
6.5 String compression 107
6.6 QRS detection 112
6.7 P and T wave detection 115
6.8 Identification of wave types 118
6.9 Development of a QRS grammar 120
6.10 Development of P wave grammar 122
6.11 Development of T wave grammar 125
6.12 ECG feature measurement 126
6.13 Heart-rate measurement 131
6.14 Measurement of the electrical axis 132
6.15 Concluding remarks 134

CHAPTER 7 Diagnosis Of Cardiac Diseases Using Dynamic Database and Turbo Prolog

7.1 Introduction 136
7.2 Selection of diseases 137
7.3 Bundle branch block 139
7.4 Left ventricular hypertrophy 141
7.5 Left anterior hemiblock 142
7.6 Left atrial hypertrophy 144
7.7 Diagnostic criteria 145
7.8 The reply_file / PAT.DAT 147
7.9 The knowledge base 148
7.10 Ordering of rules 149
7.11 Inexact reasoning 150
7.12 The program 152
7.13 Concluding remarks 158

CHAPTER 8 Results And Discussion

8.1 An illustration 159
8.2 Concluding remarks 160

Detailed computer outputs

Appendix - Computer programs

Bibliography

Publications of the author