

## Contents

Foreword

Introduction

Part I : A formalism and a computation method for the synthesis of algorithms 8

Chapter 1 : Instructions and models of algorithm implementation 8

1.1. The basic formalism 8

1.2. The Glushkov model and the parallel program schema 12

1.3. Formalisation of the Glushkov model 14

1.4. Formalisation of the parallel program schema 15

1.5. A particular type of schema : the parallel flowchart 18

Chapter 2 : The synthesis of algorithms 20

2.1. High-level instructions 20

2.2. The interpretation of high-level instructions 24

2.3. Low-level instructions 28

2.4. The synthesis and the optimization problems 28

2.5. Example 1 29

Chapter 3 : The formulation of algorithm synthesis in terms of P-functions 32

3.1. P-functions associated to algorithms 32

3.2. Transformations associated to high-level instructions 33

3.3. Transformations associated to low-level instructions 37

3.4. The synthesis of matrix-instructions 40

Chapter 4 : The synthesis of (or)-interpreted matrix-instructions with disjoint-columns 42

4.1. General theory 42

4.2. Example 1 (continued) 44

4.3. An algorithm for generating optimal syntheses of matrix-instructions 50

4.4. Hardware implementations of matrix-instructions and an hardware description language 55

Chapter 5. The synthesis of (or)-interpreted matrix-instructions 65

5.1. General theory 65

5.2. Partially indeterminate instructions 67

5.3. Example 2 : A routing problem 68

5.4. The particularities of the implementation of matrix-instructions with non disjoint columns 77

Chapter 6 : The synthesis of (and)-interpreted matrix-instructions	81
6.1. General theory	81
6.2. A dual system of P-functions	83
6.3. Example 2 (continued)	87
6.4. Implementations of (and)-interpreted matrix-instructions and of their transpose	89
Chapter 7 : A summary and the conclusions of part I	92
7.1. A synthesis procedure for the realization of matrix-instructions	92
7.2. Example 2 (continued)	95
7.3. Conclusions of part I	99
Part II : Implementation of algorithms	100
Chapter 8 : Representation of instructions by means of parallel flowcharts or of Petri nets	100
8.1. Representation of instructions and of algorithms	100
8.2. Representation of low-level and of high-level instructions	103
8.3. Vector addition systems	107
8.4. A comparison between the fields of application of parallel flowcharts and of the P-function technique	113
Chapter 9 : Synchronous and asynchronous implementation of instructions	116
9.1. The use of (and)-interpreted instructions in asynchronous design	116
9.2. The use of feedback-instructions in concurrent processing of data	119
9.3. A general scheme for asynchronous implementation of matrix-instructions	122
9.4. Example 2 (continued)	125
Chapter 10 : Programmed implementation of instructions	129
10.1. Characterization of safe programs	130
10.2. Realization of safe programs	133
10.3. Computation of safe programs by means of P-functions	144
10.4. Example 2 (Continued)	148
10.5 A general type of architecture for safe program implementation	152
Chapter 11 : Microprogrammed implementation of instructions	156
11.1. Introduction to microprogrammed implementation	156
11.2. Microprogrammed implementation of safe programs	160
Chapter 12 : A summary and the conclusions of part II	163
Part III : The algebra of P-functions	165
Chapter 13 : Laws acting on P-functions	165

13.1. P-functions associated with Boolean functions ; composition laws	166
13.2. Synthesis of binary instructions by means of P-functions and of composition laws	172
13.3. P-functions associated with Boolean functions ; decomposition laws	177
13.4. Lattices of P-functions and logical design	183
13.5. Boolean and pseudo-Boolean notations for P-functions	184
13.6. P-functions associated with incompletely specified Boolean functions	185
 Chapter 14 : The multivalued extension of P-functions and of their laws	 188
14.1. General theory	189
14.2. Example and interpretations	194
 Chapter 15 : The vectorial extension of P-functions and of their laws	 199
15.1. The vectorial extension of the domain function	199
15.2. The vectorial extension of the codomain function	204
15.3. The vectorial extension of the domain and of the codomain functions	208
15.4. Generalized transformations on P-functions and their interpretation	214
 Chapter 16 : Finite automata, matrix-instructions and speech recognition	 217
16.1. Introduction to speech recognition	217
16.2. Recognition of letter strings without repetition or omission	218
16.3. Recognition of letters using a relative distance measure	224
16.4. Recognition of isolated words with repetition of letters	227
 Acknowledgement	 233
Bibliography	234
Index	241
List of symbols	247