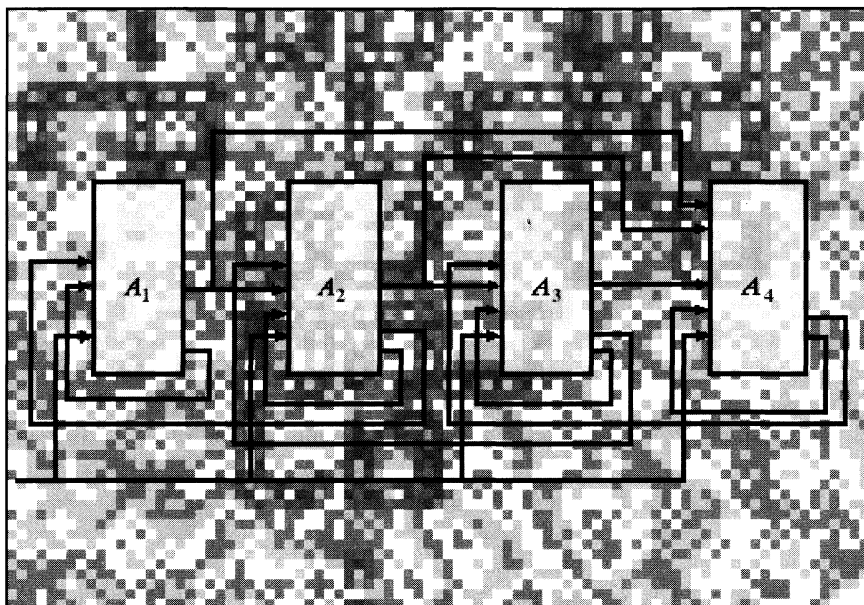


ALGEBRAIC THEORY OF AUTOMATA NETWORKS

AN INTRODUCTION



PÁL DÖMÖSI

University of Debrecen
Debrecen, Hungary

CHRISTOPHER L. NEHANIV

University of Hertfordshire
Hatfield, United Kingdom

siam

Society for Industrial and Applied Mathematics
Philadelphia

Contents

Preface and Overview	ix
1 Preliminaries	1
1.1 Basic Notation and Notions	1
1.2 Semigroups, Monoids, and Groups	4
1.3 Transformation Semigroups, Division, and Wreath Products	8
1.4 Bibliographical Remarks	21
2 Directed Graphs, Automata, and Automata Networks	23
2.1 Digraph Completeness	23
2.2 Automata and Automaton Mappings	44
2.3 Automata and Semigroups	50
2.4 Automata Networks and Products of Automata	58
2.5 Bibliographical Remarks	71
3 Krohn–Rhodes Theory and Complete Classes	73
3.1 Krohn–Rhodes and Holonomy Decomposition Theorems	73
3.2 Some Results Related to the Krohn–Rhodes Decomposition Theorem	82
3.3 Homomorphically Complete Classes Under the Quasi-Direct Product	101
3.4 Homomorphically Complete Classes Under the Cascade Product	104
3.5 Bibliographical Remarks	108
4 Without Letichevsky’s Criterion	111
4.1 Semi-Leticevsky Criterion	111
4.2 Without Any Leticevsky Criteria	121
4.3 Networks of Automata Without Any Leticevsky Criteria	131
4.4 Product Hierarchies of Automata	142
4.5 Bibliographical Remarks	145
5 Leticevsky’s Criterion	147
5.1 Homomorphic Simulation and the ν_2 -Product	147
5.2 Automata with Control Words	152
5.3 The Beauty of Leticevsky’s Criterion	157
5.4 Bibliographical Remarks	162

6	Primitive Products and Temporal Products	163
6.1	Primitive Products	164
6.2	Primitive Products and Letichevsky's Criterion	166
6.3	Homomorphic Completeness Under the Primitive Product	176
6.4	Temporal Products	183
6.5	Bibliographical Remarks	197
7	Finite State-Homogeneous Automata Networks and Asynchronous Automata Networks	199
7.1	State-Homogeneous Networks and Some Technical Lemmas	200
7.2	Network Completeness for Digraphs Having All Loop Edges	207
7.3	Complete Finite Automata Network Graphs with Minimal Number of Edges	211
7.4	Completeness and Computation	216
7.5	Asynchronous Automata Networks	219
7.6	Bibliographical Remarks	235
	Bibliography	237
	Index	253