

Contents

Acknowledgments	iii
1 Introduction	1
1.1 Concrete Results	3
2 Basic Definitions and Notations	7
2.1 The PRAM	7
2.2 Notation	9
2.3 Measures of Efficiency of Parallel Algorithms	10
I Analysis of PRAM Algorithms	11
3 High-Level Analysis: Approximating Shortest Superstrings	13
3.1 Introduction	14
3.2 Preliminaries	16
3.3 Algorithm GREEDY Is Not Parallelizable	17
3.4 Cycle Cover Approach : An \mathcal{RNC} Algorithm with Length Factor 2.83	25
3.4.1 Sequential Algorithm	25
3.4.2 Parallel Algorithm	30
3.5 Cycle Cover Approach : \mathcal{NC} -Approximations with Constant Compression Factor	31
3.5.1 Sequential Approximation of a Maximum Weight Cycle Cover	31
3.5.2 Parallel Approximation of a Maximum Weight Cycle Cover	33
3.5.3 An \mathcal{NC} Algorithm with Constant Compression Factor .	36

3.6	Set Cover Approach : An \mathcal{NC} Algorithm with Logarithmic Length Factor	39
4	Dynamic Programming	41
4.1	Basic Definitions	43
4.1.1	The Convex Least Weight Subsequence Problem	44
4.1.2	Notation Concerning the Triangulation Problem	45
4.1.3	Sequential $\mathcal{O}(n^2)$ Time Algorithm	46
4.2	Outline of the Parallel Algorithm	49
4.3	Computing the Cost of an Optimal Triangulation	50
4.3.1	Computing Values $c(i, i)$	50
4.3.2	Computing Entries $c(i, j)$	54
4.3.3	Computing all Entries of the Array c	55
4.4	Reconstruction of an Optimal Triangulation	55
4.4.1	Finding Ceilings	56
4.4.2	Finding all Candidates Existing in an Optimal Triangulation of the Polygon Below h_i	57
4.4.3	Reconstruction of an Optimal Triangulation	58
4.5	Extensions of the Algorithm	59
4.5.1	The Triangulation of a Monotone Polygon	59
4.5.2	More General Cost Functions	60
5	How to Simulate a Strong Model by a Weaker One: Optimal Algorithms for String Matching	63
5.1	Introduction	64
5.2	Effective Simulations	66
5.2.1	Recursion	66
5.2.2	Sparse Sorting	67
5.2.3	Task Decomposition	67
5.2.4	Simulation of a Ring	67
5.2.5	Monotone Routing	68
5.3	Basic Notation and Definitions	68
5.4	CRCW PRAM Algorithm	70
5.4.1	Text Searching on the CRCW PRAM	70
5.4.2	Preprocessing on the CRCW PRAM	73
5.4.3	General Ideas of Transformations to Weaker Models	74
5.5	Transformation to the CREW PRAM	75
5.6	Transformation to the EREW PRAM	76

5.7	Transformation to the Hypercube and Hypercubic Networks	77
5.7.1	Text Search on the Hypercube	78
5.7.2	Pattern Preprocessing on the Hypercube	79
6	Lower Bound for String Matching	81
6.1	Lower Bound for the ABSTRACT PRAM	82
6.1.1	Parallel Comparison Trees	83
6.1.2	Merging Machine	84
6.1.3	Outline of the Lower Bound for the CRCW PRAM	84
6.1.4	Basic Definitions	85
6.1.5	Simulating PRAM by Merging Machine	86
6.1.6	The Lower Bound	88
6.1.7	Discussion and Extensions	90
6.2	Lower bound for Weaker Models	91
II	PRAM Simulations	93
7	How to Simulate the PRAM	95
7.1	Classes of Hash Functions	95
8	Simulations on C-DMM	99
8.1	Simulations Based on Hashing	100
8.2	Algorithmic Log-Star Techniques	102
8.3	Reduction from CRCW Simulations to EREW Simulations	103
8.4	Distribution of Connected Components	104
8.5	Algorithms for the Random Graph H	109
8.6	Simulations	112
8.6.1	Neighborhood in the Access Graph	113
8.6.2	$\mathcal{O}(\log \log \log n \log^* n)$ -time Simulation	114
8.7	Extensions to Optimal Simulations	116
9	PRAM Simulations on Reconfigurable Networks	119
9.1	$\mathcal{O}(\log^* n)$ -time PRAM Simulation on the R-DMM	121
9.2	Simulation Between Reconfigurable Models	123
9.3	Simulation by the RM-DMM	125
9.3.1	Reduction from CRCW to EREW	125
9.3.2	Real Time Simulation	126

10 Simulating PRAM on Parallel Alternating-Direction Access	
Machine	129
10.1 Preliminaries	131
10.2 Simulating the n -processor CRCW PRAM	132
10.3 Simulating the p -processor CRCW PRAM	135
Bibliography	139
References	139