
CONTENTS

PREFACE

xiii

1 APPLICATIONS OF INTERVAL COMPUTATIONS: AN INTRODUCTION

<i>R. Baker Kearfott and Vladik Kreinovich</i>	1
1 What are Interval Computations?	1
2 International Workshop on Applications of Interval Computations: How This Book Originated	8
3 General Optimization Problems	10
4 General Systems of Equations and Inequalities	14
5 Linear Interval Problems	15
6 Interval Computations Can Also Handle Possible Additional Information About the Input Data	18
7 Software and Hardware Support for Interval Computations	20
REFERENCES	21

2 A REVIEW OF TECHNIQUES IN THE VERIFIED SOLUTION OF CONSTRAINED GLOBAL OPTIMIZATION PROBLEMS

<i>R. Baker Kearfott</i>	23
1 Introduction, Basic Ideas and Literature	23
2 On Constrained Optimization Problems	32
3 On Use of Interval Newton Methods	40
4 Applications	52
5 Summary and Present Work	53
REFERENCES	54

3 THE SHAPE OF THE SYMMETRIC SOLUTION SET

Götz Alefeld, Vladik Kreinovich, and Günter Mayer 61

1 Introduction 61

2 Notation 62

3 Results 63

4 Examples 74

REFERENCES 79

4 LINEAR INTERVAL EQUATIONS: COMPUTING ENCLOSURES WITH BOUNDED RELATIVE OVERESTIMATION IS NP-HARD

Jiří Rohn 81

1 Introduction 81

2 The Result 82

3 The Symmetric Case 86

4 Concluding Remark 87

REFERENCES 88

5 QUALITY IMPROVEMENT VIA OPTIMIZATION OF TOLERANCE INTERVALS DURING THE DESIGN STAGE

Sevgi Hadjihassan, Eric Walter, and Luc Pronzato 91

1 Introduction 91

2 Some Basic Models, and their Origins 97

3 Model of Performance Characteristic is Known Beforehand 101

4 Model Parameters Estimated in Controlled Conditions 111

5 Controlled Conditions are Unavailable 117

6 Temperature Controller 123

7 Conclusions 126

REFERENCES 128

6 APPLICATIONS OF INTERVAL COMPUTATIONS TO REGIONAL ECONOMIC INPUT-OUTPUT MODELS

<i>Max E. Jerrell</i>	133
1 Economic Input-Output Models	133
2 Technical Coefficients are Only Known with Uncertainty	135
3 Statistical Methods are Not Directly Applicable, Hence, Interval Computations May Be Useful	136
4 Computational Algorithms	138
5 An Example	140
REFERENCES	142

7 INTERVAL ARITHMETIC IN QUANTUM MECHANICS

<i>Charles L. Fefferman and Luis A. Seco</i>	145
1 Quantum Mechanics	146
2 Computer-Assisted Set-up	151
3 The Thomas-Fermi Equation	154
4 The Aperiodicity Inequality	160
REFERENCES	164

8 INTERVAL COMPUTATIONS ON THE SPREADSHEET

<i>Eero Hyvönen and Stefano De Pascale</i>	169
1 Limitations of Spreadsheet Computing	169
2 Extended IA on a Spreadsheet	174
3 Global IA on a Spreadsheet	184
4 Interval Constraint Spreadsheets	195
5 Discussion	204
REFERENCES	205

9 SOLVING OPTIMIZATION PROBLEMS WITH HELP OF THE UNICALC SOLVER

<i>Alexander L. Semenov</i>	211
1 Introduction	211
2 The UniCalc Solver	212

3	The Algorithm of Subdefinite Calculations	213
4	Solving Integer Programming Problems	219
5	Real-Valued Optimization	221
6	Future Developments	223
	REFERENCES	224
10	AUTOMATICALLY VERIFIED ARITHMETIC ON PROBABILITY DISTRIBUTIONS AND INTERVALS	
	<i>Daniel Berleant</i>	227
1	Introduction	227
2	Correctly Representing PDFs and Intervals with His- tograms	229
3	Arithmetic Operations	232
	REFERENCES	243
11	NESTED INTERVALS AND SETS: CONCEPTS, RELATIONS TO FUZZY SETS, AND APPLICATIONS	
	<i>Hung T. Nguyen and Vladik Kreinovich</i>	245
1	Introduction	246
2	Nested Intervals and Nested Sets	250
3	Other Problems Where Nested Sets and Nested Intervals Can Be Used: Identification, Optimization, Control, and Decision Making	267
4	Applications of Nested Sets and Nested Intervals	273
	APPENDIX A Proofs	279
	REFERENCES	283
12	FUZZY INTERVAL INFERENCE UTILIZING THE CHECKLIST PARADIGM AND BK-RELATIONAL PRODUCTS	
	<i>Ladislav J. Kohout and Wyllis Bandler</i>	291
1	Introduction	291
2	Many-Valued Logics for Interval Fuzzy Inference Based on the Checklist Paradigm	293
3	Groups of Logic Transformations of Interval Connectives	310

4	Special Types of Compositions of Relations	314
5	An Application: The Basic Knowledge Handling Mechanisms of CLINAID by Means of Relational Inference	321
6	Toward Successful Utilization of Interval Methods in Soft Computing	328
	REFERENCES	329
13	COMPUTING UNCERTAINTY IN INTERVAL BASED SETS	
	<i>Luis Mateus Rocha, Vladik Kreinovich, and R. Baker Kearfott</i>	337
1	Introduction	337
2	Evidence Sets as a Description of Uncertainty	338
3	Different Measures of Uncertainty, and How to Describe them Numerically	355
4	L -Fuzzy Sets, Interval Based L -Fuzzy Sets, and L -Evidence Sets	370
5	3-D Uncertainty Unit Cube	374
	REFERENCES	377
14	SOFTWARE AND HARDWARE TECHNIQUES FOR ACCURATE, SELF-VALIDATING ARITHMETIC	
	<i>Michael J. Schulte and Earl E. Swartzlander, Jr.</i>	381
1	Introduction	381
2	Software Tools	383
3	Hardware Designs	388
4	A Variable-Precision, Interval Arithmetic Coprocessor	391
5	Conclusions and Areas for Future Research	396
	REFERENCES	398
15	STIMULATING HARDWARE AND SOFTWARE SUPPORT FOR INTERVAL ARITHMETIC	
	<i>G. William Walster</i>	405
1	Introduction	405
2	The Participants	406
3	Stable Equilibrium	410

4	The Interval Paradigm Shift	411
5	System Supplier Demand	412
6	End-user Demand	412
7	Action Plan	414
	REFERENCES	415
	INDEX	417