
Contents

Notations and Abbreviations	ix
Introduction	xiii
Chapter 1. General Presentation of Vehicle Routing Problems	1
1.1. Logistics management and combinatorial optimization	1
1.1.1. History of logistics	2
1.1.2. Logistics as a science	5
1.1.3. Combinatorial optimization	5
1.2. Vehicle routing problems	6
1.2.1. Problems in transportation optimization	6
1.2.2. Vehicle routing problems in other contexts	7
1.2.3. Characteristics of vehicle routing problems	7
1.2.4. The capacitated vehicle routing problem	11
1.3. Conclusion	13
Chapter 2. Simple Heuristics and Local Search Procedures	15
2.1. Simple heuristics	16
2.1.1. Constructive heuristics	16
2.1.2. Two-phase methods	19
2.1.3. Best-of approach and randomization	22
2.2. Local search	23
2.2.1. Principle	23
2.2.2. Classical moves	24
2.2.3. Feasibility tests	25
2.2.4. General approach from Vidal <i>et al.</i>	28
2.2.5. Multiple neighborhoods	30
2.2.6. Very constrained problems	33

2.2.7. Acceleration techniques	33
2.2.8. Complex moves	36
2.3. Conclusion	37
Chapter 3. Metaheuristics Generating a Sequence of Solutions	39
3.1. Simulated annealing (SA)	39
3.1.1. Principle	39
3.1.2. Simulated annealing in vehicle routing problems	40
3.2. Greedy randomized adaptive search procedure: GRASP	41
3.2.1. Principle	41
3.2.2. GRASP in vehicle routing problems	43
3.3. Tabu search	44
3.3.1. Principle	44
3.3.2. Tabu search in vehicle routing problems	45
3.4. Variable neighborhood search	47
3.4.1. Principle	47
3.4.2. Variable neighborhood search in vehicle routing problems	49
3.5. Iterated local search	50
3.5.1. Principle	50
3.5.2. Iterated local search in vehicle routing problems	52
3.6. Guided local search	54
3.6.1. Principle	54
3.6.2. Guided local search in vehicle routing problems	55
3.7. Large neighborhood search	56
3.7.1. Principle	56
3.7.2. Large neighborhood search in vehicle routing problems	58
3.8. Transitional forms	59
3.8.1. Evolutionary local search principle	59
3.8.2. Application to vehicle routing problems	60
3.9. Selected examples	61
3.9.1. GRASP for the location-routing problem	61
3.9.2. Granular tabu search for the CVRP	65
3.9.3. Adaptive large neighborhood search for the pickup and delivery problem with time windows	69
3.10. Conclusion	74
Chapter 4. Metaheuristics Based on a Set of Solutions	77
4.1. Genetic algorithm and its variants	77
4.1.1. Genetic algorithm	77
4.1.2. Memetic algorithm	79
4.1.3. Memetic algorithm with population management	79
4.1.4. Genetic algorithm and its variants in vehicle routing problems	80

4.2. Scatter search	82
4.2.1. Scatter search principle	82
4.2.2. Scatter search in vehicle routing problems	83
4.3. Path relinking	83
4.3.1. Principle	84
4.3.2. Path relinking in vehicle routing problems	85
4.4. Ant colony optimization	86
4.4.1. Principle	86
4.4.2. ACO in vehicle routing problems	89
4.5. Particle swarm optimization	89
4.5.1. Principle	89
4.5.2. PSO in vehicle routing problems	90
4.6. Other approaches and their use in vehicle routing problems	91
4.7. Selected examples	92
4.7.1. Scatter search for the periodic capacitated arc routing problem	92
4.7.2. PR for the multi-depot periodic VRP	97
4.7.3. Unified genetic algorithm for a wide class of vehicle routing problems	101
4.8. Conclusion	106
Chapter 5. Metaheuristics Hybridizing Various Components	109
5.1. Hybridizing metaheuristics	109
5.1.1. Principle	110
5.1.2. Application to vehicle routing problems	111
5.1.3. Selected examples	112
5.2. Metaheuristics	122
5.2.1. Principle	123
5.2.2. Application to vehicle routing problems	124
5.2.3. Selected examples	128
5.3. Conclusion	144
Conclusion	145
Bibliography	149
Index	167