

# List of Figures

1.1	Movement Pattern: A Hierarchical Perspective . . . . .	4
2.1	Cone Based and Projection Based Orientation . . . . .	15
2.2	Star Calculus: Renz and Mitra . . . . .	15
2.3	Direction of An Oriented Point . . . . .	16
2.4	Orientation Relation Between Two Points . . . . .	17
2.5	lrrr Relation Between Two Dipoles . . . . .	18
2.6	Twenty Four Atomic Relations of Coarse Dipole Calculus . . . . .	18
2.7	Rectangle Algebra and Direction Relation Matrix . . . . .	19
2.8	Rectangular Cardinal Directions . . . . .	19
2.9	Allen's Interval Algebra Relations . . . . .	21
2.10	Conceptual Neighbourhood Graph: Allen's Interval Algebra . . .	23
2.11	Movement Parameters (as defined in [1]) . . . . .	26
2.12	Classification of Movement Parameters (as defined in [1]) . . . . .	27
2.13	Colocation in Space (taken from [1]) . . . . .	28
2.14	Concentration (taken from [1]) . . . . .	29
2.15	Concurrence (taken from [1]) . . . . .	29
2.16	Opposition (taken from [1]) . . . . .	30
2.17	Dispersion (taken from [1]) . . . . .	30
2.18	Constancy of Direction and Constancy of Speed (taken from [1]) .	30
2.19	Sequence (taken from [1]) . . . . .	31
2.20	Periodicity (taken from [1]) . . . . .	31

## *List of Figures*

2.21 Meet (taken from [1]) . . . . .	32
2.22 Moving Cluster (taken from [1]) . . . . .	33
2.23 Synchronization in Time (taken from [1]) . . . . .	33
2.24 Isolated Moving Point Object (taken from [1]) . . . . .	34
2.25 Symmetry (taken from [1]) . . . . .	34
2.26 Repetition (taken from [1]) . . . . .	34
2.27 Propagation (taken from [1]) . . . . .	35
2.28 Convergence and Divergence (taken from [1]) . . . . .	35
2.29 Encounter and Breakup (taken from [1]) . . . . .	36
2.30 Trend and Fluctuation (taken from [1]) . . . . .	37
2.31 Trendsetting Pattern (taken from [1]) . . . . .	37
3.1 Objects and Their Direction . . . . .	50
3.2 Direction Relations . . . . .	50
3.3 The Direction Relations . . . . .	53
3.4 Direction Relations: One Level Refined . . . . .	54
3.5 Conceptual Dependency of Base Relations . . . . .	55
3.6 Effect of Egocentric Direction . . . . .	56
3.7 Spatial Orientation Regions For Rectangles . . . . .	57
3.8 Spatial Orientation Model . . . . .	57
3.9 Spatial Orientation: One Region Span . . . . .	58
3.10 Spatial Orientation: Two Region Span . . . . .	58
3.11 Spatial Orientation: Three Region Span . . . . .	59
3.12 Spatial Orientation: Four Region Span . . . . .	59
3.13 Inclusion of The Primary Inside the Reference . . . . .	61
3.14 Conceptual Dependency of Spatial Orientation Relations . . . . .	63
3.15 Illustration of Conceptual Dependency Transitions 1 . . . . .	65
3.16 Illustration of Conceptual Dependency Transitions 2 . . . . .	66

## *List of Figures*

4.1	Training Examples for Overtake Pattern . . . . .	75
4.2	Data Structures for Error Handling During Learning . . . . .	83
4.3	Conceptual Dependency of Distance Relations . . . . .	83
4.4	Allen's Interval Algebra: In terms of Endpoint Relations . . . . .	89
4.5	Hierarchical Organization of Motion Pattern . . . . .	91
4.6	Representation of bmop using FSA . . . . .	101
5.1	An Orientation Model for Point Objects . . . . .	114
5.2	Execution Phases of QDL . . . . .	116
6.1	Elements of Movement Patterns(taken from [1]) . . . . .	122
6.2	First Instance of Follow Pattern . . . . .	151
6.3	Second Instance of Follow Pattern . . . . .	152
6.4	Computation of Spatial Orientation Relation . . . . .	153
6.5	Computation of Direction Relation . . . . .	153
6.6	The Route Network in GIS Data Collection . . . . .	160
6.7	User Interface for Two Object Data Collection . . . . .	168
6.8	User Interface for Four Object Data Collection . . . . .	168
6.9	Overtake on Left 1 . . . . .	171
6.10	Overtake on Left 2 . . . . .	171
6.11	Overtake on Right 1 . . . . .	172
6.12	Overtake on Right 2 . . . . .	172
6.13	Rectangular Cardinal Directions (taken from [2] ) . . . . .	173
A.1	Follow Pattern: Tracked Persons in First Instance (same as Figure in section 6.2) . . . . .	183
A.2	Follow Pattern: Tracked Persons in Second Instance (same as Fig- ure in section 6.2) . . . . .	184
B.1	Recognised Patterns . . . . .	200
B.2	UTM Coordinates for Route 1 . . . . .	201

*List of Figures*

B.3 UTM Coordinates for Route 2 . . . . .	202
B.4 UTM Coordinates for Route 3 . . . . .	203
B.5 UTM Coordinates for Route 4 . . . . .	204
B.6 UTM Coordinates for Route 5 . . . . .	205
B.7 UTM Coordinates for Route 6 . . . . .	206
B.8 UTM Coordinates for Route 7 . . . . .	207
B.9 UTM Coordinates for Route 8 . . . . .	208
B.10 UTM Coordinates for Route 9 . . . . .	209
B.11 UTM Coordinates for Route 10 . . . . .	210
B.12 UTM Coordinates for Route 11 . . . . .	211
B.13 UTM Coordinates for Route 12 . . . . .	212
B.14 UTM Coordinates for Route 13 . . . . .	213
B.15 UTM Coordinates for Route 14 . . . . .	214
B.16 Temporal Characteristics of Routes . . . . .	215
B.17 Temporal Characteristics of Routes . . . . .	216
B.18 Temporal Characteristics of Routes . . . . .	216
E.1 User Interface for Cognitive Input . . . . .	336