

List of Figures

1-1	<i>Handshaking</i> from the UT-Interaction Dataset	3
2-1	Overview of an HAR system	12
2-2	The JEPD relations of RCC8	18
2-3	Cardinal Directions of a region	19
2-4	Qualitative distance for a spherical object	19
2-5	The RoI and 9 cores of CORE9	21
2-6	Inaccurate relations for single axis-aligned bounding box	23
2-7	Conceptual Neighbourhood Graphs of RCC, CDC, and QD	25
2-8	Subsumption Hierarchy of RCC	26
2-9	Subsumption Hierarchy of Cardinal Direction Relations	26
2-10	Variations of Graph	29
2-11	A simple temporal graph	29
3-1	Two configurations that would be indistinguishable to CORE9 _w	44
3-2	The three possible cases for core boundaries parallel to the X-axis	47
3-3	The four possible configurations between a pair of extended objects	49
3-4	Illustrative example of Extended CORE9	53
3-5	Illustrative example of Extended CORE9 - Recursion tree	54
3-6	Comparison of F1-scores on UT Interaction Dataset	58
3-7	Comparison of F1-scores on SBU Kinect Interaction Dataset	59
3-8	Comparison of F1-scores on Mind's Eye Dataset	59
4-1	A Temporal Activity Graph	68
4-2	TAG for the sequence of four frames in Figure 1-1	76
4-3	Set of label sequences describing the TAG shown in Figure 4-2	77
5-1	TAG and the corresponding sequence of insubTAGs	85
5-2	Block Diagram of the steps in Learning and Recognition of videos using TAG Grammars	100

5-3	Comparison of F1-scores on UT Interaction Dataset	102
5-4	Comparison of F1-scores on SBU Kinect Interaction Dataset	102
5-5	Comparison of F1-scores on Mind’s Eye Dataset	104
6-1	Extended object based abstraction of firewall rules	109
6-2	Abstraction and Representation of a Fall activity from the UR Fall Detection dataset	112
A-1	Screenshot of a keyframe from the Kick activity of the Mind’s Eye dataset during the manual tracking.	120
A-2	Coordinate matrix of the keyframe shown in Figure A-1	121
B-1	Subgraph of a TAG (topological + directional + distance) con- structed for the keyframe of the Kick activity shown in Figure A-1 .	125
B-2	Reduced Adjacency Matrix representation for the keyframe shown in Figure A-1. Each entry is of the form <i>top</i> – <i>dir</i> – <i>dis</i> , where <i>top</i> is the topological relation, <i>dir</i> is the qualitative direction relation, and <i>dis</i> is the qualitative distance relation computed using Extended CORE9. Entries of the form <i>X</i> – <i>X</i> – <i>X</i> correspond to unavailable data for missing or occluded components.	125

List of Tables

3.1	Inference of Cardinal Directional Relation for components a_i and b_j	50
3.2	Inference of Distance Relation for components a_i and b_j	51
3.3	Computing whole relation for the distance relations	52
3.4	Results for Extended CORE9 on UT Interaction dataset	58
3.5	Results for Extended CORE9 on Mind’s Eye dataset	60
3.6	Results for Extended CORE9 on SBU Kinect Interaction dataset	60
3.7	Comparison of classification accuracies on three datasets	60
3.8	Comparison of classification accuracies with literature	60
4.1	Results for TAG Kernel on Mind’s Eye dataset	79
4.2	Results for TAG Kernel on UT Interaction	79
4.3	Results for TAG Kernel on SBU Kinect Interaction dataset	80
4.4	Comparison of classification accuracies for the three datasets	80
4.5	Comparison of classification accuracies with literature	80
5.1	Results for TAG Grammar on Mind’s Eye dataset	101
5.2	Results for TAG Grammar on UT Interaction Dataset	103
5.3	Results for TAG Grammar on SBU Kinect Interaction dataset	103
5.4	Comparison of classification accuracies on the three datasets	103
5.5	Comparison of classification accuracies with literature	104
6.1	A sample set of firewall rules	109
6.2	Confusion matrix for classification of Fall activities in UR Fall De- tection Dataset	114

List of Symbols

σ	Extended state information of a pair of extended objects
σ_{xy}	Extended state information of $core_{xy}$
\mathcal{T}	Time function that determines whether a component appears at a given time point
ε	Edge label that is three-tuple of topological, direction and distance relation
$ls_{i,j}^{u:t}$	Label sequence between i^{th} component of the first entity and the j^{th} component of the second entity from time point u to t
\mathcal{G}	The set of all temporal activity graphs
κ	Temporal activity graph kernel
κ_{ls}	Label sequence similarity function
κ_{edge}	Edge label similarity function
\mathcal{C}^Q	Conceptual Neighbourhood graph of the Qualitative Relational Calculus Q
$\mathcal{N}_s^{\mathcal{C}}$	Neighbourhood based similarity given the conceptual neighbourhood graph \mathcal{C}
Σ	Set of terminals for some grammar
Δ	Set of non-terminals for some grammar
Γ	Set of activities represented as TAGs
\mathbb{G}_C	TAG grammar for the activity class C

