Motion Analysis using OCS14 Transitions

CS 365: Artificial Intelligence
Project Proposal

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1 Introduction and Motivation

Occlusions are a significant phenomenon in motion analysis in multi-object computer vision. The past studies on the formalization of spatial reasoning (LOS-14 [1] and ROC-20 [2]), have ignored many crucial distinctions to motion analysis, until OCS-14 [3], which considers the following "two distinctions of relevance to visual computation: (a) Whether the occluder is a moving object or part of static background, and (b) Whether the visible part of an object is a connected blob or fragmented."[3] These criteria along with the overlap distinctions modeled in Spatial Reasoning can be formalized into a set of 14 occlusion states, namely OCS-14. The other formalizations are based on binary relations and use the transitive inferences and properties from realtional algebra. However, these relation sets may explode in k-ary situations due to large number of depth layers. On the other hand, in case of state algebra model in OCS-14, maintaining the states of individual objects provides much more compact representation. In cases of interaction among large number of objects, the relational algebra would become extremely large, while state algebra provides relevant distinctions for compact representation. Also it can be shown that these states are representationally complete under the mentioned criteria.

One of the issues reamaining to be addressed for OCS-14 states is the analysis of transitions between these occlusions states i.e. the conceptual neighbourhood of the states. Transitions between these 14 states provide important information about visual activity. Occlusion transitions are important sources of information about the interactions between objects. One may gain useful abstractions and object behaviors from a scene by studying these transitions. e.g. surviellance videos can be queried to obtain events corresponding to some transitions between the states.

2 Objective

We can argue that only a very limited number of transitions out of 14 * 13 transitions are actually possible in real-world motion analysis problems. For example, in Figure 1, the transition from $oc1 \rightarrow ocS0$ (state in which the object is completely isolated to the state in which it is completely hidden behind the tree) has to take place through the transitions $oc1 \rightarrow ocSP$ and $ocSP \rightarrow ocS0$. One may infer that direct transitions from $oc1 \rightarrow ocS0$ is not possible in real world scenes. Similarly, many other such transitions are not possible in real world situations.
In this project, we aim to formalize a transition graph that describes a conceptual map amongst these 14 states. This transition graph will make the OCS-14 formalization more robust and applicable to models of object-tracking etc. This formalization of occlusion phenomenon in computer vision can help in forming a stable conceptualization of the world as it provides crucial information about qualitative depth (ordering).

Figure 1: Result of tracking a person walking accross the tree[3]

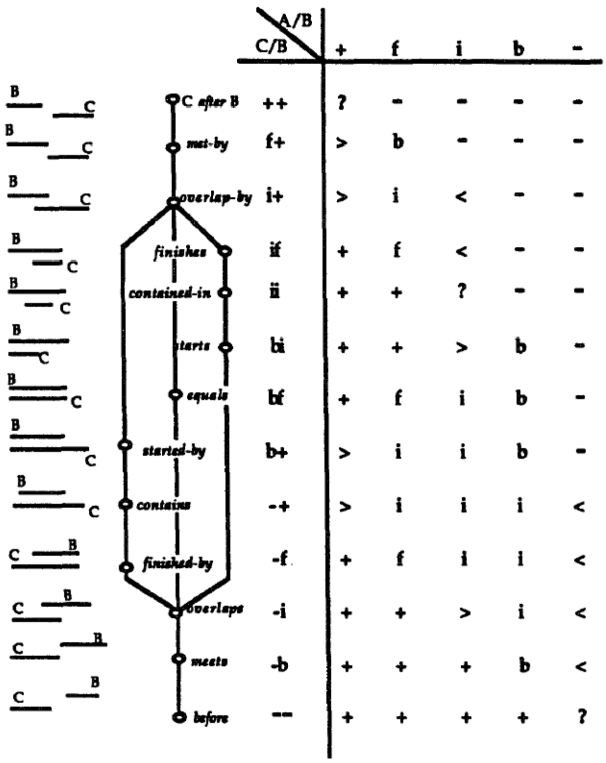

Figure 2: One-dimensional interval relations and the transitive inference table.[4]

3 Approach

Gaining inspiration from the transition graph represented in Figure 2, we can define similar constraints on transition amongst the different states in OCS-14. In figure 2, the diagrams on the left show the relations between the intervals C and B as C moves leftwards from 'after' B to 'before' B. The graph next to it shows the progression of relations during the movement; the three branches in the continuum represent the cases where C is longer than, equal to, or shorter than B.

These constraints from interval logic can motivate the contraints we use to define the constraints for transitions amongst states in OCS-14.

References

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