Motion Analysis using OCS-14 transitions

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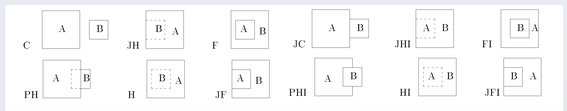
Motivation

- **Occlusion** - interference of projections of spatially separated objects in 3-d space on a 2-d image plane.
- Occlusions carry information about relative depth ordering of objects, that are important for: Multi-Object Tracking, Activity Modelling and studying concepts like object persistence and support amongst infants in human cognition.
- In Spatial Reasoning literature, there have been formal analyses to study occlusions- LOS 14, ROC 20, OCC 8 etc.
- These formalizations had major drawbacks due to which they were not widely used in computer vision applications.
- OCS-14, a state-algebra based formalization, addresses these drawbacks

Prior Work

- LOS-14



- OCC-8

- ROC-20

DRAWBACKS

- Ignore crucial criteria-
  1. Whether visible parts are connected or fragmented
  2. Whether occluder is dynamic or static
- Many unnecessary states, which can't be easily distinguished nor they can be easily detected. e.g. precise tangency situations.
- Based on relational algebra. Relations have to be maintained for each pair of objects under consideration. So, quite expensive.

OCS-14

- State Algebra based formalization- We need to maintain just the states of each object in a scene.
- Compact Representation
- Considers three characteristics-
  - Nature of Occluder – Static or Dynamic
  - Visibility of Object – Visible, Partial, Fragmented, Invisible
  - Isolation/Grouping of Objects
- These three characteristics make OCS-14 representationally complete.

State Transitions

- Limited transitions out of 14 x 13 possible transitions valid in real world scenes.
- Need to formalize a transition graph for these states.
- A transition diagram will make OCS-14 formalization more robust and make it applicable to real world motion analysis problems.

Transition Diagram

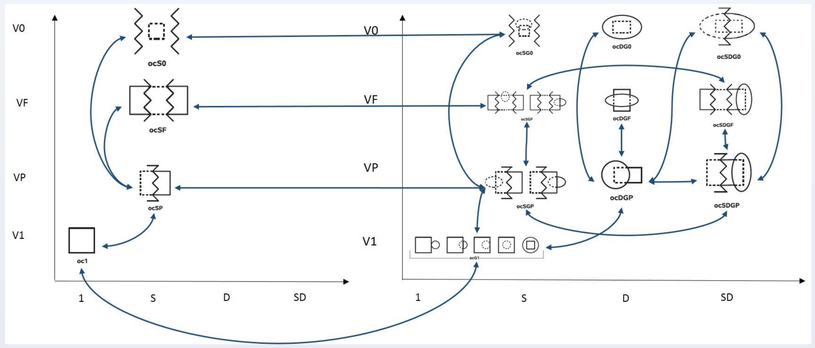


Fig 1. Transitions states (with no assumptions)

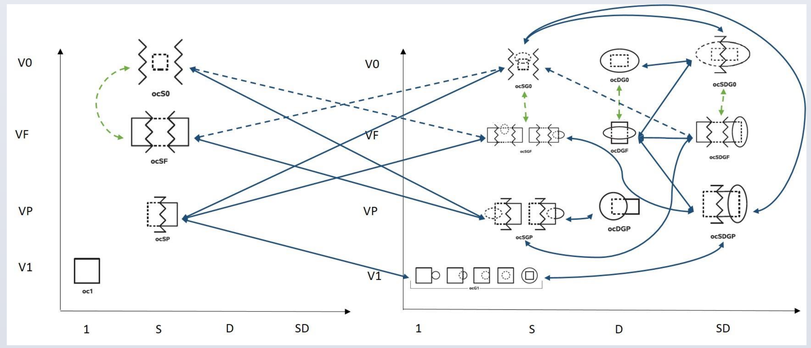


Fig 2. Transitions states (with assumptions)

- The left half (4 states) of the state diagram contains states in which occluders are static i.e. parts of the static background.
- The right half (10 states) of the diagram shows the states in which the object is occluded by both static and dynamic occluders.
- Figure 1 shows transitions that take place which requires one or more (dynamic) objects to move without any constraint.
- Figure 2 shows the transitions when certain special movements like shrinking (moving far), expanding (moving close) and special simultaneous motions are required.
- Transitions of figure-2 have a very low probability of occurrence in real world visual scenes.
- ---- Objects are allowed to shrink (move far), expand (move close) and also the two fragmented portions disappear together.
- ---- Objects are allowed to shrink (move far), expand (move close) while allowing another dynamic object to come in contact with it in the projection (grouping).
- ── These transitions occur under the assumption that object move simultaneously so as to reach another state from one state.

OC1

OCSP

OCSF

OCSF

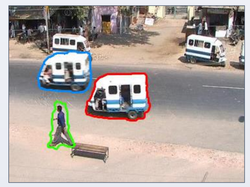
OCS0

OCDGP

OCDGF

OCS-14 Transitions as Signatures

- Occlusion Transitions are important visual signatures of interaction between objects.
- Through OCS 14 formulation, it is possible to mine out transitions from a scene and hence gain useful abstraction and object behavior.



The event of "An Auto Rickshaw overtaking another one is accompalished by a transition from ocDGP → oc1 for the overtaking auto rickshaw and from ocG1→oc1 for the auto rickshaw overtaken.

References

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