Motion analysis using OCS-14 transitions

Abhishek Maheshwari (10028)
Ashudeep Singh (10162)

Occlusions

- Images–a projection of the 3D scene on a 2D plane.

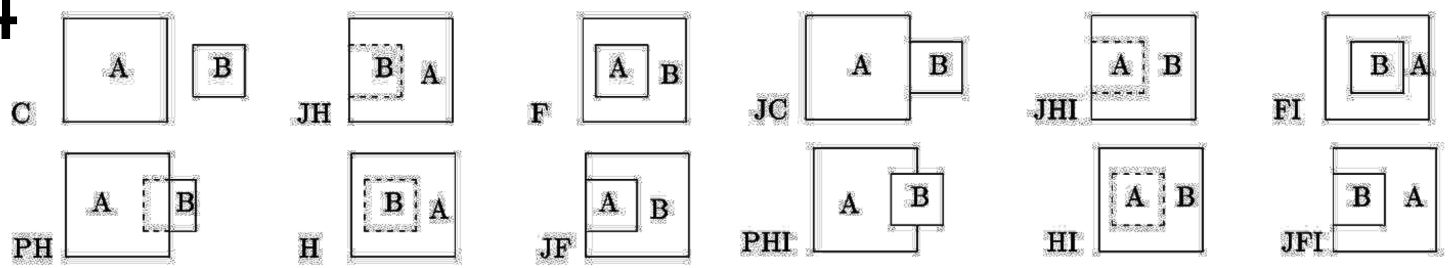
- **Occlusion** – the concept that two objects that are spatially separated in the 3D world interfere with each other in the projected 2D image plane.

Occlusions

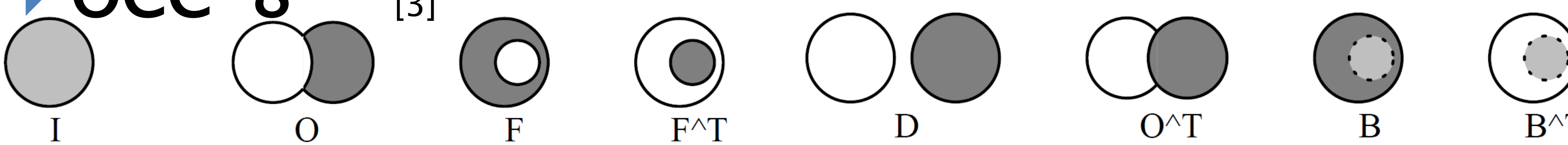
- Occlusions carry information about relative depth ordering which is important for:
  - Multi-object tracking
  - Activity modelling
  - In human cognition, occlusion is crucial in forming concepts such as object persistence, containment and support, amongst infants. (Baillargeon et al. 2002)
- So, in spatial reasoning literature, there have been formal analyses to study occlusions. E.g. LOS-14, ROC-20, OCC-8 etc.

Previous Work

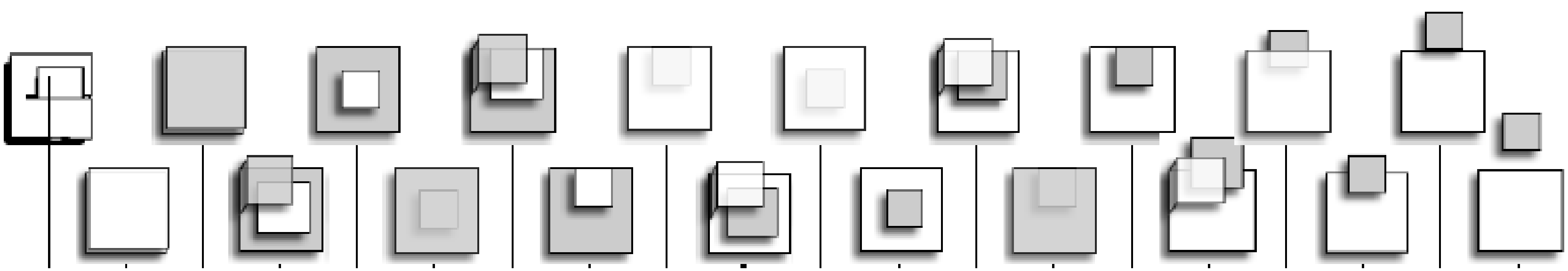
- **LOS-14**
  [2]



- **OCC-8** [3]



- **ROC-20** [4]

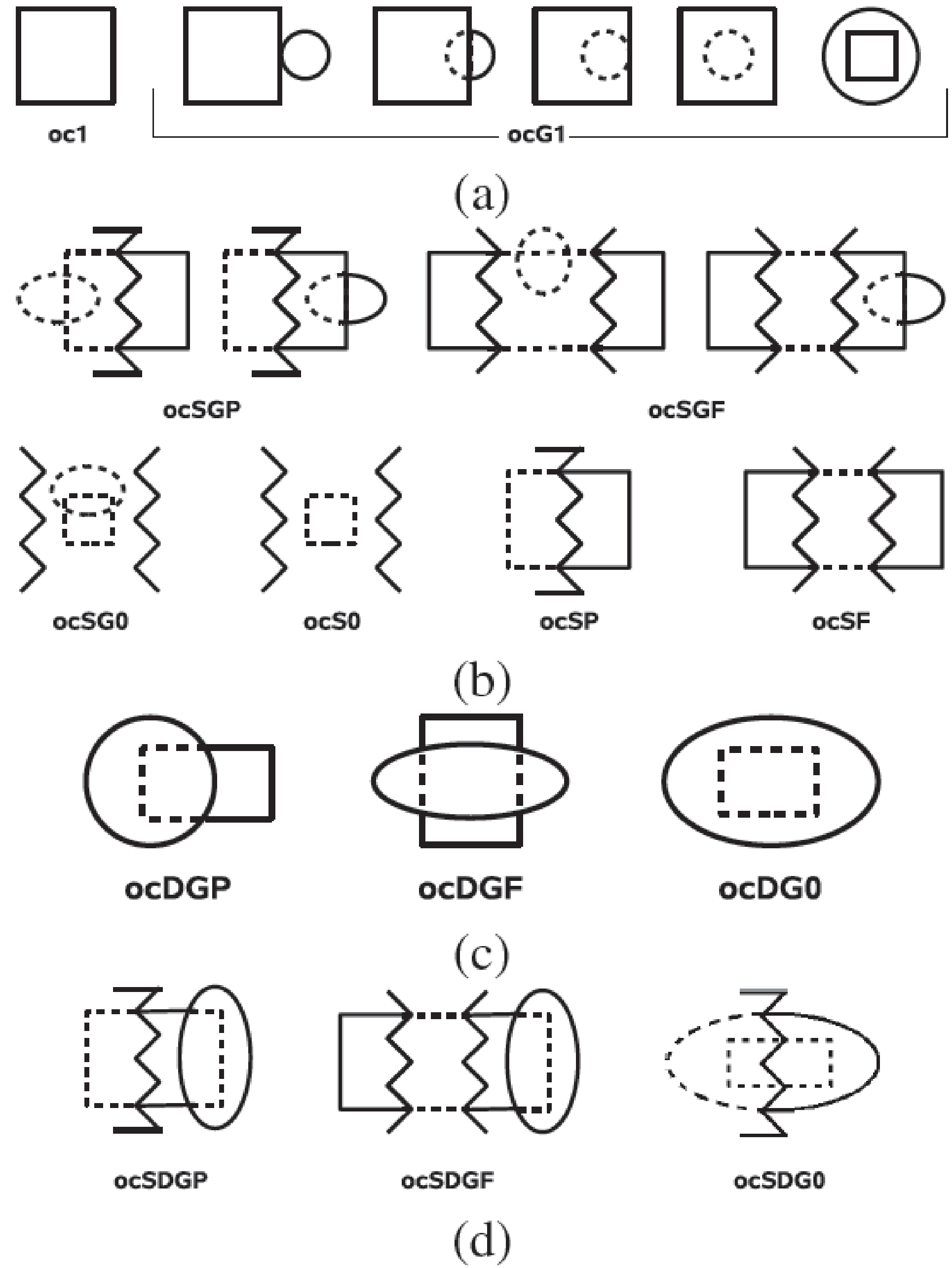


Drawbacks

- Ignore crucial criteria such as:
  - Whether visible parts are connected or not
  - Whether occluder is moving or static
- Some aspects of spatial reasoning (like precise tangency situations) are less relevant in vision, since they can't be easily detected.
- All these formalizations are based on relational algebra.
  So, OCS-14 considers state algebra based formalization of occlusion states.

OCS-14

- State algebra- maintains just the states of each object
- Compact representation
- Considers 3 characteristics-
    - nature of occluder
    - visibility
    - isolation/grouping
- It can be shown that these states are representationally complete.



[1]-Guha, Mukerjee, Venkatesh:2011

OCS-14 Transitions

- Only a limited number of transitions out of 14 x 13 are possible in real world situations.
- There is a need to formalize a transition graph amongst these states.
- This will make *OCS-14* formalization more robust and applicable to real world motion analysis problems.

OCS-14 Transitions

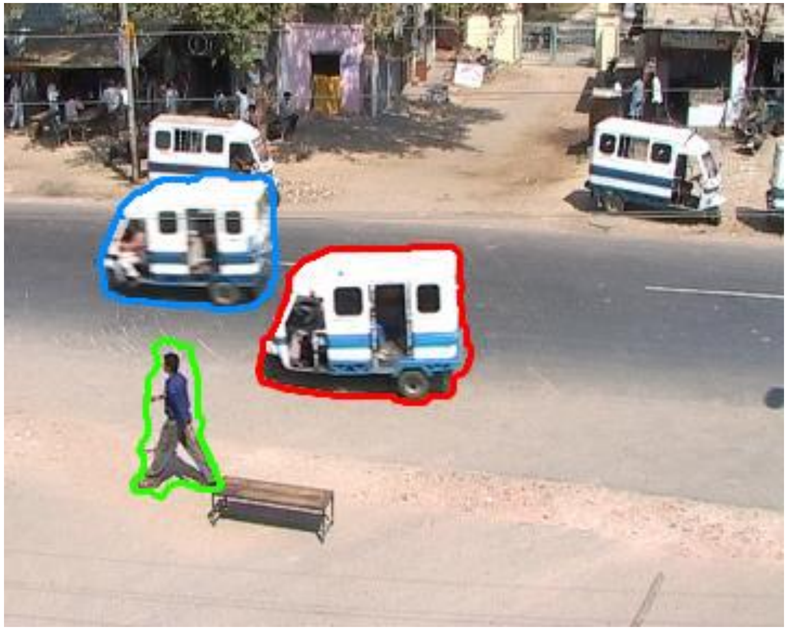
- For example

[1]

- Here the person(object) moves from state oc1 to ocS0 through transitions oc1→ocSP and ocSP→ocS0.
- Direct transition from oc1→ocS0 is not possible in real world scenes.

Example: IITK Traffic Video Dataset

A vehicle overtaking another vehicle

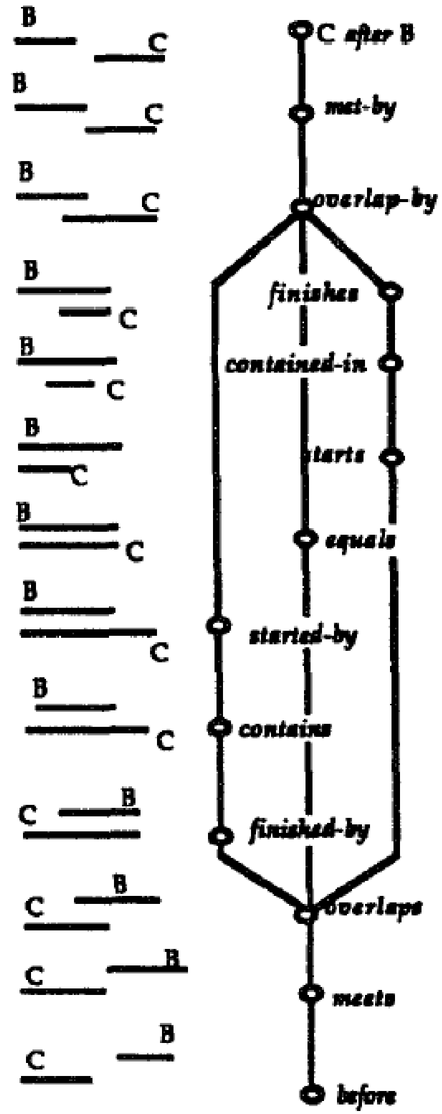


Object	State 1	State 2
1	ocDGP	oc1
2	ocG1	oc1
3	ocSP	oc1

Interval Logic Model

“We treat the system of such relations in a way that is analogous to the treatment of temporal intervals by (Allen 1984) and (Freksa 1992a), and of spatial regions by (Randell, Cui & Cohn 1992).”

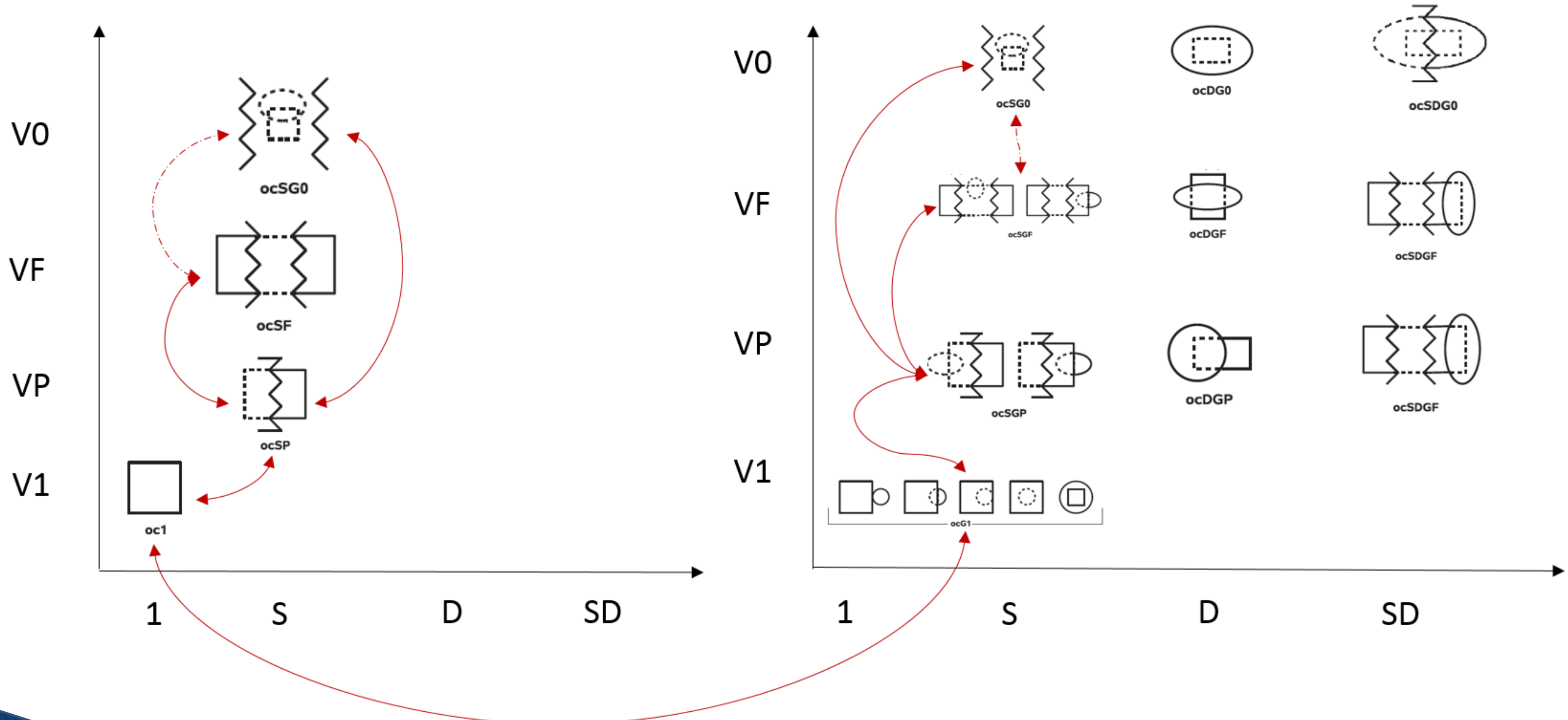
[LOS-14]



	C/B \ A/B	+	f	i	b	-
C after B	++	?	-	-	-	-
met-by	f+	>	b	-	-	-
overlap-by	i+	>	i	<	-	-
finishes	if	+	f	<	-	-
contained-in	ii	+	+	?	-	-
starts	bi	+	+	>	b	-
equals	bf	+	f	i	b	-
started-by	b+	>	i	i	b	-
contains	-+	>	i	i	i	<
finished-by	-f	+	f	i	i	<
overlaps	-i	+	+	>	i	<
meets	-b	+	+	+	b	<
before	--	+	+	+	+	?

[Mukerjee, A., & Joe, G.: 1990]

OCS-14 Transitions



References

[1] Prithwijit Guha, Amitabha Mukerjee, and K. S. Venkatesh. **OCS-14: you can get occluded in fourteen ways.** Proceedings of the Twenty-Second international joint conference on Artificial Intelligence-Volume Volume Two. AAAI Press, 2011.

[2] Galton, Antony. **Lines of sight.** AI and Cognitive science 94 (1994).

[3] Köhler, Christian. **The occlusion calculus.** Cognitive Vision Workshop. 2002.

[4] Randell, David, Mark Witkowski, and Murray Shanahan**. From images to bodies: Modelling and exploiting spatial occlusion and motion parallax.** International Joint Conference on Artificial Intelligence. Vol. 17, 2001.

[5] Mukerjee, A., & Joe, G. **A qualitative model for space**. Texas A & M University, Computer Science Department, 1990.

[6] Westphal, Matthias, et al. **Guiding the generation of manipulation plans by qualitative spatial reasoning.** Spatial Cognition & Computation 11.1 (2011)

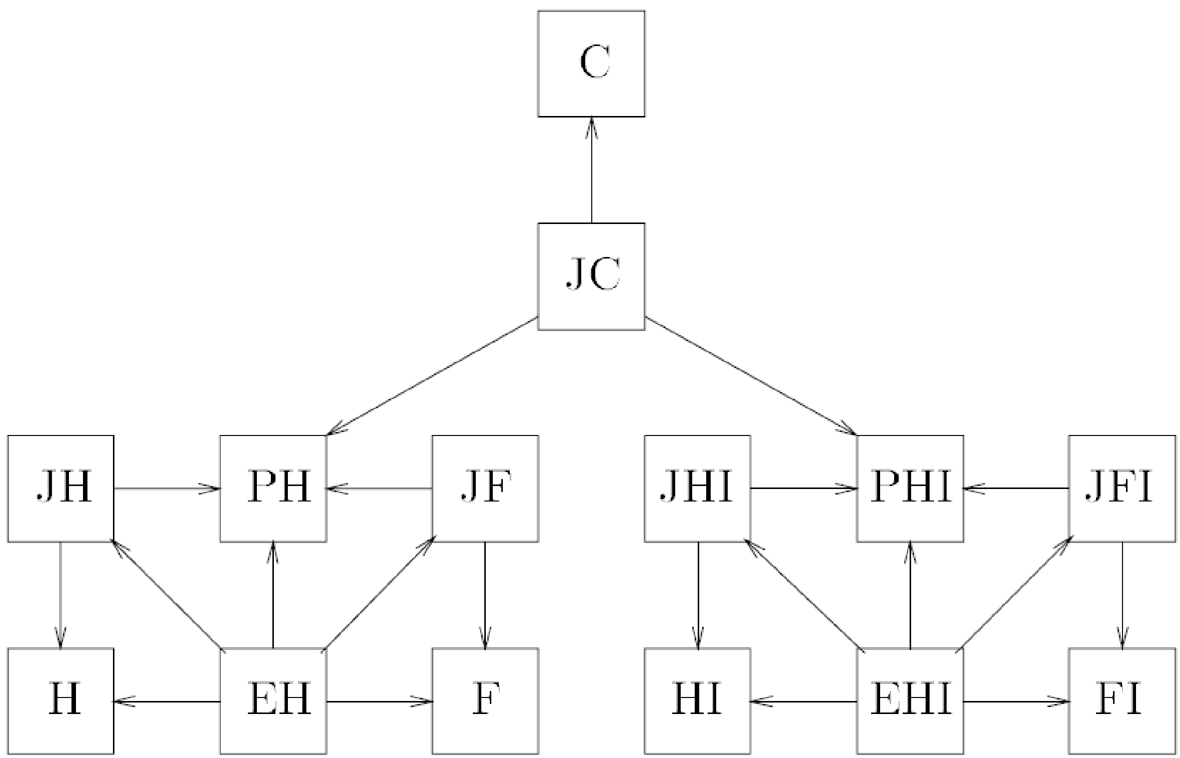
Thank You!!!

Questions?
Suggestions!

Binary relations corresponding to OCS-14 states

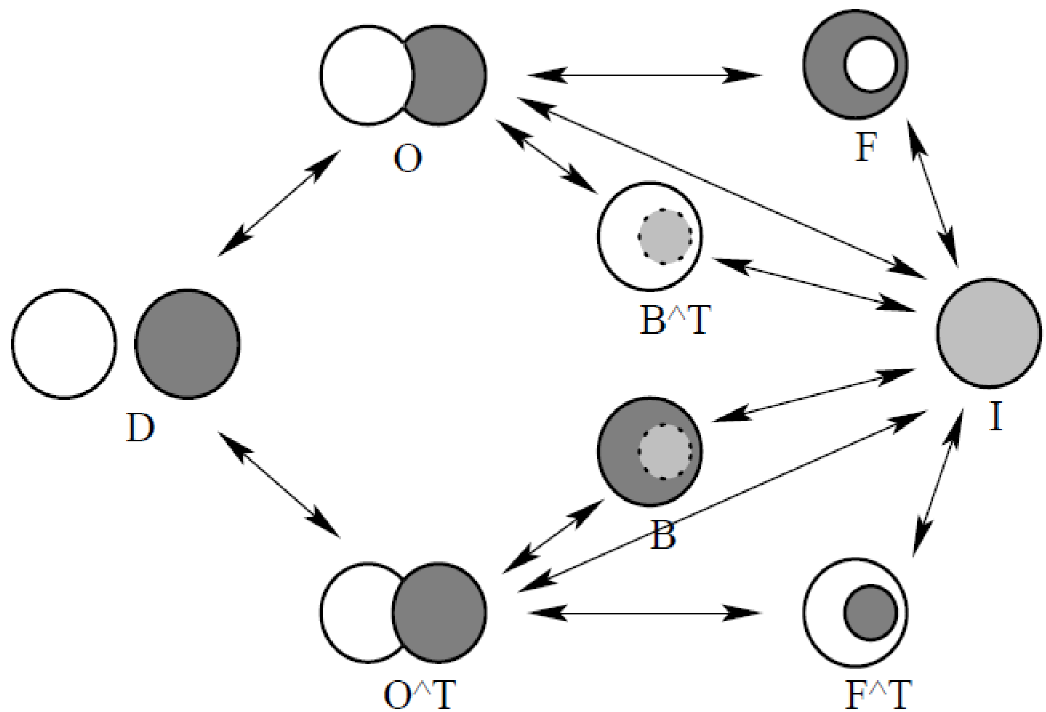
	ocG1	ocDGP	ocDGF	ocDG0
ocG1	JC	PH, JF, F	PH	H, JH, EH
ocDGP	PHi, JFi, Fi	MuOccPO	MuOccPO	×
ocDGF	PHi	MuOccPO	MuOccPO	×
ocDG0	Hi, JHi, EHi	×	×	×

[1]



[2]

OCC-8 Neighborhood Graph



[3]