- Friday, March 3, 1995
  Why is There Attention in the Visual System

1.0 It was a pleasure to welcome John Tsotsos from Uof T Dept. of Computer Science

1.1 The next meeting will be on the first Friday of April (7th April 1995) and will be given by Josee Rivest from the Glendon Campus. Usual place, usual time: 061 BSB, 10am.

2.0 The broad question under discussion was: Why is there attention in the visual system? And the suggested answer was as a mechanism for optimizing a search. The problem of what it was you might be looking for, of course, remains.

2.1 several groups of theories for stimulus selection were described, all imply that there is a MAXIMUM to be detected

i selective routing hypotheses:

based on the theories of Koch and Ullman and the concept of salience-weighting in which more important events or phenomena are given greater weighting - ie. a higher firing rate

problems:

1 need some provision to route the information to higher centres

2 need some provision to delete the result of the first search so you can find the next item

3 predicts a reaction time dependent on the log of the retinal distance between one feature and the next

4 needs too many connections because of the high resolution of the retina

ii oscillation tagging

in which a marker is tied on the most important feature and you can then look for the marker (a 40Hz oscillation)

iii connection theories (linked to learning and not discussed further)

iv selective tuning model (the Tsotsos model)

In this model, the problem of detecting a maximal response on a large grid with multiple connections between the elements, is solved by having a series of layers, each with fewer connections, and a pyramidal or cone-like connection pattern between the layers. Thus the calculations can be done on one layer (with a manageable number of connections) and the results passed down to the input layer. Having detected the maximum member of the set, this can then be inhibited (by a series of gates, so that the original maxmium doesn't get selected again) and the search repeated to find the next-biggest and so on.

The addition of a parallel series of connections carrying BIAS information from the higher levels out to the input layer allows PRESELECTION of certain features or areas. Examples of implementation were found in which the algorithm found the fixed, repeatable sequence of brightest patches across an image of a boat, the sequence of lengths of edges across an image of a hand, and the best-fit class of visual movement for each patch in a visual flow field. An

intriguing feature of the last example, is that the algorithm can also provide the second best fit and so on allowing the assessment of multiple components at the same spatial location.

Advantages:

1 fits the connection constraint for realism

2 doesn't require an increase in processing times for features separated on the retina

3 fits with the observation that things on the edge are not so significant (the boundary effect)

Disadvantages:

1 doesn't address the issue of what dimension to look at at any one time

2 will always produce the SAME scan path

3 will not look at the same thing twice (unlike human scanning), at least until the block imposed in response to that site's initial selection has decayed.

4.0 Look forward to seeing you all next time!

John Tsotsos
Computer Science, University of Toronto