Reasoning about Perception, Space and Motion: a Cognitive Robotics Perspective[1]

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(Extended Abstract)

Endowing robots with higher-level cognitive functions that involve reasoning about, for example, goals, actions, perception, and collaborative tasks, is a primary goal of cognitive robotics. It is one that has seen the popular use of logics both as representational languages, but also as the basis of implementing programs that enable such reasoning to be automated. The current focus of research adopted by our *Cognitive Robotics* research group is directed toward modelling and reasoning about space and visual perception, and implementing programs on real-world as opposed to software simulated robots.

Abductive inference using the *Event Calculus* forms the overall theoretical and implementational framework whereby hypotheses generated from interpreted sensor data is back-fitted to explicit models, and then tested in a hypothetico-deductive framework. Notable examples of this include the use of abduction to, and prediction from an explicit domain model to explain often incomplete or noisy vision sensor data in an *active vision* context [Shanahan, 2002, Shanahan and Randell, 2004]. Other formalisms and methods investigated by the group include a viewer-centred region-based calculus for modelling of occlusion events [Randell *et al*, 2001] which builds on the spatial logic *RCC8* [Randell et al 1992]; and a generic framework for coupling together conceptually related but distinct spatial logics [Randell and Witkowski, 2002].

In this paper, a brief introduction to Cognitive Robotics and the experimental platforms used by our group will be given. This will be followed by a retrospective discussion about bespoke logics and research methodologies that have been investigated by the group to tackle what may be arguably seen as one of the grand goals of AI.

Many of the group's other publications can be obtained from the Web by following the link at: http://www.ee.ic.ac.uk/research/neural/iis/research.htm#Cognitive

References

[Randell, *et al.*, 1992] Randell, D. A., Cui, Z and Cohn A. G., A Spatial Logic Based on Regions and Connection, *Proc. 3rd Int. Conf. on Knowledge Representation and Reasoning (KR-92)*, Morgan Kaufmann, San Mateo, pp. 165-176.

[Randell *et al*, 2001], Randell, D., Witkowski, M., and Shanahan, M., From Images to Bodies: Modelling Spatial Occlusion and Motion Parallax, *Proc 17th Int. Joint Conf. On Artificial Intelligence*, Morgan Kaufmann, Seattle, pp. 57-63.

[Randell and Witkowski, 2002], Randell, D.A. and Witkowski, M., Building Large Composition Tables via Axiomatic Theories, in *Proc. KR 2002*, pp. 26-36.

[Shanahan, 2002], Shanahan, M.P, A Logical Account of Perception Incorporating Feedback and Expectation, *Proceedings KR 2002*, pages 3-13.

[Shanahan and Randell, 2004] Shanahan, M. P. and Randell, D.A, A Logic-Based Formulation of Active Visual Perception, *Proceedings KR 2004*, to appear.

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