

Toward Bootstrap Learning of the Foundations of Commonsense Knowledge*

Benjamin Kuipers

University of Michigan
Computer Science and Engineering
2260 Hayward Street
Ann Arbor, Michigan 48109
kuipers@umich.edu

Abstract

Our goal is for an autonomous learning agent to acquire the knowledge that serves as the foundations of common sense from its own experience without outside guidance. This requires the agent to (1) learn the structure of its own sensors and effectors; (2) learn a model of space around itself; (3) learn to move effectively in that space; (4) identify and describe objects, as distinct from the static environment; (5) learn and represent actions for affecting those objects, including preconditions and postconditions, and so on. We will provide examples of progress we have made, and the roadmap we envision for future research.

For further information, see (Pierce and Kuipers 1997; Kuipers and Beeson 2002; Kuipers et al. 2006; Provost, Kuipers, and Miikkulainen 2006; Modayil and Kuipers 2008; Kuipers 2008; Stober and Kuipers 2008; Mugan and Kuipers 2009).

Biographical Sketch

Benjamin Kuipers joined the University of Michigan in January 2009 as Professor of Computer Science and Engineering. Prior to that, he held an endowed Professorship in Computer Sciences at the University of Texas at Austin. He received his B.A. from Swarthmore College, and his Ph.D. from MIT. He investigates the representation of commonsense and expert knowledge, with particular emphasis on the effective use of incomplete knowledge. His research accomplishments include developing the TOUR model of spatial knowledge in the cognitive map, the QSIM algorithm for qualitative simulation, the Algernon system for knowledge representation, and the Spatial Semantic Hierarchy model of knowledge for robot exploration and mapping. He has served as Department Chair at UT Austin, and is a Fellow of AAAI and IEEE.

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References

- Kuipers, B., and Beeson, P. 2002. Bootstrap learning for place recognition. In *Proc. 18th National Conf. on Artificial Intelligence (AAAI-02)*, 174–180. AAAI/MIT Press.
- Kuipers, B.; Beeson, P.; Modayil, J.; and Provost, J. 2006. Bootstrap learning of foundational representations. *Connection Science* 18(2):145–158.
- Kuipers, B. 2008. Drinking from the firehose of experience. *Artificial Intelligence in Medicine* 44:155–170. doi:10.1016/j.artmed.2008.07.010.
- Modayil, J., and Kuipers, B. 2008. The initial development of object knowledge by a learning robot. *Robotics and Autonomous Systems* 56:879–890.
- Mugan, J., and Kuipers, B. 2009. Autonomously learning an action hierarchy using a learned qualitative state representation. In *International Joint Conference on Artificial Intelligence (IJCAI)*.
- Pierce, D. M., and Kuipers, B. J. 1997. Map learning with uninterpreted sensors and effectors. *Artificial Intelligence* 92:169–227.
- Provost, J.; Kuipers, B. J.; and Miikkulainen, R. 2006. Developing navigation behavior through self-organizing distinctive-state abstraction. *Connection Science* 18(2):159–172.
- Stober, J., and Kuipers, B. 2008. From pixels to policies: a bootstrapping agent. In *Int. Conf. on Development and Learning (ICDL)*.