

# Model-Based Reflection and Self-Adaptation

Ashok K. Goel

Artificial Intelligence Laboratory  
College of Computing, Georgia Institute of Technology  
Atlanta, Georgia 30332, USA  
[goel@cc.gatech.edu](mailto:goel@cc.gatech.edu)

**Abstract:** Autonomous agents operate in complex and dynamic environments. Therefore, an intelligent agent must be able to learn new capabilities throughout its lifetime or it risks becoming obsolete and useless. Ideally an intelligent agent would be capable of both retrospective and proactive self-adaptation. Retrospective adaptation occurs when an agent fails in its assigned task, and proactive adaptation occurs when an agent is presented with a task different from the task(s) for which it was originally designed. In this talk, I will describe research in my group on retrospective and proactive self-adaptation in autonomous agents. We endow the autonomous agent with a teleological model of its reasoning process. The model enables the agent to introspect/reflect on its reasoning and to localize the needed modifications. I will present experimental results from the domains of reactive control, route planning, and device assembly. I will also describe an integration of model-based reflection with reinforcement learning which appears quite promising.

## References

- 1 Goel, A.K., Stroulia, E., Chen, Z., & Rowland, P. (1998) Model-Based Reconfiguration of Schema-Based Reactive Control Architectures. In *Proc. AAAI Fall Symposium on Model-Based Autonomous Systems*.
- 2 Murdock, J.W. & Goel, A.K. (2001a). Learning about Constraints by Reflection. In *Proc. Fourteenth Canadian Conference on Artificial Intelligence* (pp. 131-140). Ottawa, Ontario, Canada: Springer.
- 3 Murdock, J.W. & Goel, A.K. (2001b). Meta-Case-Based Reasoning: Using Functional Models to Adapt Case-Based Agents. In *Proc. Fourth. International Conference on Case-Based Reasoning* (pp. 407-421). Vancouver, Canada: Springer.
- 4 Murdock, J.W. & Goel, A.K. (2003). Localizing Planning with Functional Process Models. In *Proc. Thirteenth International Conference on Automated Planning and Scheduling*. Trento, Italy.
- 5 Stroulia, E. & Goel, A.K. (1995) Functional Representation and Reasoning in Reflective Systems, *Applied Intelligence*, Special Issue on Functional Reasoning, 9(1): 101-124, 1995.
- 6 Stroulia, E. & Goel, A.K. (1999) Evaluating Problem-Solving Methods in Evolutionary Design: The Autognostic Experiments, *International Journal of Human-Computer Studies*, Special Issue on Evaluation Methodologies, 51, 825-847.