# The Automated Mapping of Plans for Plan Recognition*

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To coordinate with other agents in its an environment, an agent needs models of what the other agents are trying to do. When communication is impossible or expensive, this information must be acquired indirectly via plan recognition. Typical approaches to plan recognition start with specification of the possible plans the other agents may be following and develop special techniques for discriminating among the possibilities. These structures are not the direct nor derived output of a planning system. Prior work has not yet addressed the problem of how the plan recognition structures are (or could be) derived from executable plans as generated by planning systems. Furthermore, concerns about building models of agents' actions in all possible worlds lead to a desire for dynamically constructing belief network models for situation-specific plan recognition activities. As a step in this direction, we have developed and implemented methods that take plans, as generated by a planning system, and creates a belief network model in support of the plan recognition task.

We start from a language designed for plan specification, PRS (Ingrand, Georgeff, & Rao 1992).[1] From a PRS plan, we generate a belief network model that directly serves plan recognition by relating potential observations to the candidate plans. Our methods handle a large variety of plan structures such as conditional branching, subgoaling, and alternative goals. Furthermore, our application domain is coordinated autonomous robotic teams, where sensor-based observations are inherently uncertain. The methodology we have developed handles this uncertainty through explicit modeling, something not necessary in other plan recognition domains (Charniak & Goldman 1993; Goodman & Litman 1990) where observations are certain. An example of a belief network generated by the mapping methods from a set of simple plans for performing a "bounding-overwatch" surveillance task can be seen in Figure 1. Results from early experiments have shown the dynamically constructed belief

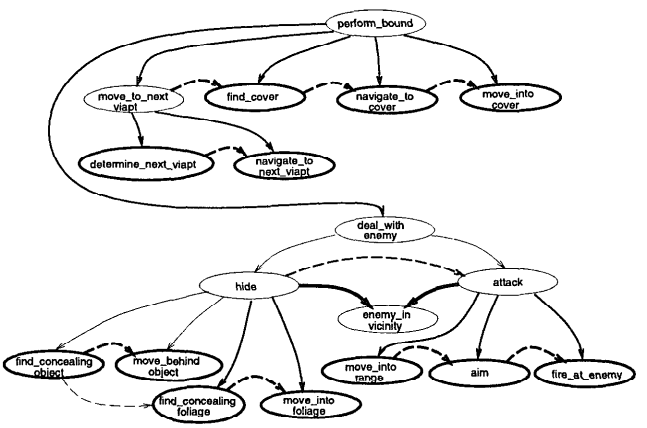


Figure 1: Belief network representation.

network to be a useful mechanism for inferring the observed agent's plans based solely upon observations of its actions.

This research is novel in that the plan recognition model is derived *directly* from a plan as represented by a planning system, instead of being built from a specially constructed database. Our explicit modeling of the uncertainty associated with observations is also unique. Our future research includes extending the methodolgy to incorporate iteration and recursion and in more extensive evaluation of the utility of using plan recognition for coordination of multiple robotic agents.

## References

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[1] Although any plan language would serve as well.