

Extending Case Based Planning

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Over the last several years, a group in the Advanced Systems Laboratory at Loral Librascope has been working on the problems of command and control planning. Most of this work has focused on developing a series of prototype self-defense planners in the domain of naval operations, including both submarines and surface ships. The approach taken has evolved into a case-based planner employing hierarchical refinement of abstract plan templates.

It was clear from the outset classical planning was not sufficient for typical command and control problems due to the pervasive "fog of war." These uncertainties affect both knowledge of the situation and the effect of actions. Situation uncertainty includes incomplete knowledge of the current situation, and the tendency of the situation to change in unpredictable ways. Uncertainty regarding actions extends to whether an action can be successfully executed at all. We adopted the viewpoint of plans as heuristics, which may or may not succeed in achieving their objectives. A heuristic planning process has to be ongoing, monitoring the situation for plan failures, and situation changes that create new objectives.

We have addressed the difficulty in making projections of situations and the effects of plans in two ways. First, we use constraint based descriptions of plan objects which enables us to delay choosing specific values for future actions until later in plan execution. Second, we embed conditionals in plans to anticipate likely variations in situation evolution.

Our experience in the submarine and surface ship planning domains, and likely in command and control planning in general, is that these techniques are not sufficient for planning under uncertainty. It has also become clear that handling multiple objectives - often on many strategic and temporal scales - is more important than originally realized. The difficulties we have encountered in reconciling conflicts in objectives, or relating objectives on different scales to planning has revealed the importance of establishing a consistent model of objectives.

The structure provided by Decision Theory appears to offer the best framework for addressing these issues. We are currently extending the planning system we have developed to apply insights from Decision Theory and the practice of decision analysis.

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