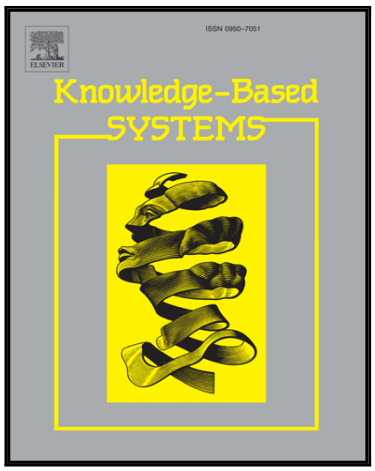

Improving hierarchical task network planning performance by the use of domain-independent heuristic search

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Improving hierarchical task network planning performance by the use of domain-independent heuristic search

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Abstract: Heuristics serve as a powerful tool in classical planning. However, due to some incompatibilities between classical planning and hierarchical planning, heuristics from classical planning cannot be easily adapted to work in the hierarchical task network (HTN) setting. In order to improve HTN planning performance by the use of heuristics from classical planning, a new HTN planning named SHOP-h planning algorithm is established. Based on simple hierarchical ordered planner (SHOP), SHOP-h implemented with Python is called Pyhop-h. It can heuristically select the best decomposition method by using domain independent state-based heuristics. The experimental benchmark problem shows that the Pyhop-h outperforms the existed Pyhop in plan length and time. It can be concluded that Pyhop-h can leverage domain independent heuristics and other techniques both to reduce the domain engineering burden and to solve more and larger problems rapidly especially for problems with a deep hierarchy of tasks.

Keywords: hybrid planning; ordered task decomposition; hierarchical task network; domain independent state-based heuristics; simple hierarchical ordered planner; python

1. Introduction

As the most prominent automated planning techniques, classical planning and hierarchical task network (HTN) planning have been widely used in many practical planning problems[1][2][3] such as evacuation planning, controlling multiple unmanned aerial vehicle (UAVs), automated composition of web services and so on. Classical planning algorithms make use of sophisticated domain-independent heuristics and other reasoning techniques to decide how to choose and organize these actions suitably in order to achieve the given goal. However, due to their inability to model and exploit any additional domain-specific strategies, they often do not scale well.

HTN planning algorithms are designed by decomposing compound tasks to concrete course of actions (COA) hierarchically and take, in addition to the classical planning action models, additional domain-specific knowledge as input. But HTN planners are often completely reliant on the user provided knowledge in providing the necessary guidance, thus further increasing the burden on the user[4][5].

As HTN-based planners, simple hierarchical ordered planner (SHOP) and its successor SHOP2[6] use ordered task decomposition (OTD) algorithm to generate the steps of each plan in the same order that they will later be executed. Because they know the current state at each step of the planning process, it shows efficient performance on complex problems and make the biggest

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