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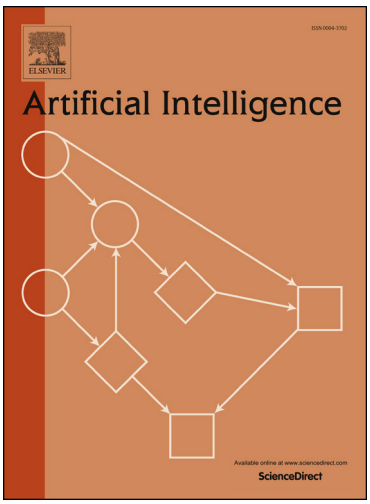

Strong Temporal Planning with Uncontrollable Durations

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Strong Temporal Planning with Uncontrollable Durations[☆]

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Abstract

Planning in real world domains often involves modeling and reasoning about the duration of actions. Temporal planning allows such modeling and reasoning by looking for plans that specify start and end time points for each action. In many practical cases, however, the duration of actions may be uncertain and not under the full control of the executor. For example, a navigation task may take more or less time, depending on external conditions such as terrain or weather.

In this paper, we tackle the problem of strong temporal planning with uncontrollable action durations (STPUD). For actions with uncontrollable durations, the planner is only allowed to choose the start of the actions, while the end is chosen, within known bounds, by the environment. A solution plan must be robust with respect to all uncontrollable action durations, and must achieve the goal on all executions, despite the choices of the environment.

We propose two complementary techniques. First, we discuss a dedicated planning method, that generalizes the state-space temporal planning framework, leveraging SMT-based techniques for temporal networks under uncertainty. Second, we present a compilation-based method, that reduces any STPUD problem to an ordinary temporal planning problem. Moreover, we investigate a set of sufficient conditions to simplify domains by removing some of the uncontrollability.

We implemented both our approaches, and we experimentally evaluated our techniques on a large number of instances. Our results demonstrate the practical applicability of the two techniques, which show complementary behavior.

Keywords: Strong Temporal Planning, Strong Controllability, Temporal Planning, Uncontrollable Durations, Forward State Space Planning, PDDL,

[☆] This paper is an extended version of [1] and [2], published at AAAI 2015 and at IJCAI 2015 respectively.

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