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USING PLAN REPAIR METHOD TO COPE WITH PLAN FAILURES IN CHINESE ORBITING MARS MISSION

Abstract

China plans to launch its first Mars probe Mars-1 this year, which is formed of an orbiter, a lander and a rover, with the ambition of achieving the goal of orbiting Mars, landing and patrolling on the Martian surface to carry out global and comprehensive surveys and detailed inspections of special areas through one launch. However, these vehicles may suffer from something unexpected when executing their own mission plans, that is, they encounter plan failures. At this time, it is impractical to perform real-time control directly from the ground due to the significant communication delay, i.e. 3 - 20 minutes for Mars, which will delay the whole project and may lose some scientific opportunity goals, and even worse, the mission fails as a result. Therefore, on-board autonomy is in great need. In order to resume the damage plan aimed at achieving the orbiting Mars mission without human intervention, this paper propose a general reactive rapid autonomous plan repair strategy considering that actions in a plan are durative, concurrent and resource consumption, including both logical and metric elements. When the probe fails to carry on its mission plan, our strategy, firstly analyze the current probe status by comparing it with the state in the mission plan to figure out the cause of the plan failure, in most cases, either unmeet logical preconditions or insufficient resources or both. In the case of logical conditions are not met, a mechanism to convert the mission plan into a state queue in chronological order is presented and based on this, a state evaluation method is provided for selecting the appropriate element as the next subgoal for the probe to achieve to restore the mission execution. As for the insufficient resources, a method is proposed trying as much as possible to search for a course of actions to replenish them by using numeric effects of actions to balance the contradiction between the amount of resources needed at present and the total amount of resources committed in the remaining unexecuted partial plan. The empirical results demonstrate the effectiveness and potential of our approach to cope with plan failures in the orbiting Mars mission.