Fast and flexible optimal motion planning algorithm using unreliable human demonstration data

Demonstration-based learning has achieved great success in the area of robot motion planning. In this process, a human demonstrator shows ideal motions in the target task using some demonstration techniques, such as kinesthetic teaching, in which human operators directly contact and move the robot end-effector [1], or teleoperation, in which human operators indirectly move the robot through the controller and some other devices [2]. By using the human demonstration data, the robot can solve the difficult motion planning problem fast. However, the problem of existing studies is the dependency on the accuracy of the original demonstration data. If the accuracy of the demonstration data decreases, the performance of the existing demonstration-based planner also decreases. Although our previous work [3] partially solved this problem, it does not ensure the optimal motion to minimalize the path cost in the configuration space (C-space).

Based on the above background, this study developed new motion planning algorithm that can solve the optimal motion planning problem using the unreliable human demonstration data collected by a single RGB camera [3]. Figure 1 shows the overview of the proposed method. The algorithm first divides the demonstrated trajectory into several micro-pass, and flexibly explores the search tree in C-space. After finding an initial solution, it tries to reduce the path cost by rewiring the connection between previous sampling nodes. Through these processes, it can find an optimal path using unreliable human demonstration data.

To verify the effectiveness of the proposed algorithm, we conducted the experiment shown in the Figure 2. In the experiment, the motion of the human in two different tasks were collected by a single RGB camera, and used as the demonstration data. The experimental results showed that the proposed method can solve the difficult motion planning problems that cannot be solved by the standard motion planner more than 90 %, and reduce the path cost about 50%. Based on these experimental results, we will add further improvements on the proposed algorithm.

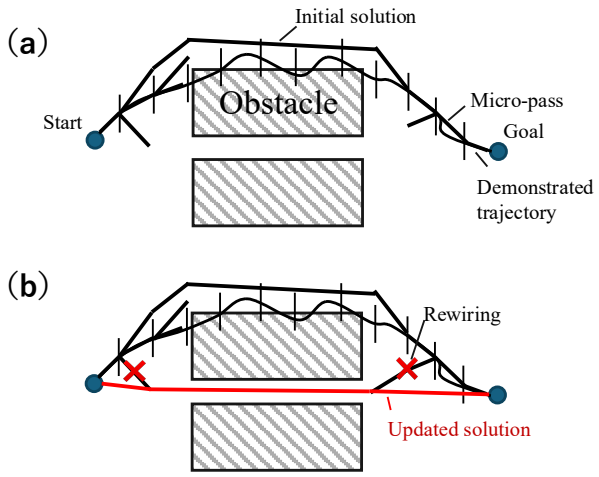

Figure 1. Overview of the proposed method. (a) flexible tree exploring using micro-pass (b) reducing path cost by rewiring.

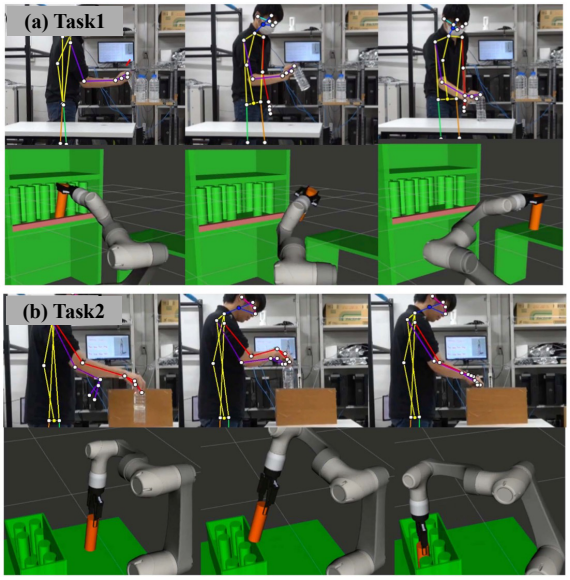

Figure 2. The experiment tasks, (a) pick-up objects from the shelf, (b) placing the bottle into the box.

Keywords: Learning from Demonstration (LfD), Optimal Motion Planning, Skeleton Recognition

References

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