Proposal of a Task Assignment and Movement Planning Algorithm Considering Dynamic Characteristics of AGVs

The use of Automated Guided Vehicles (AGVs) is expanding against the backdrop of the automation of logistics warehouses and the increasing flexibility of manufacturing lines. To operate a system consisting of multiple AGVs, it is necessary to solve two types of problems: the problem of assigning a material transfer request (hereinafter referred to as "task") to each AGV, and the problem of motion planning from the initial position of each AGV to its destination. It is important to complete each task as quickly as possible while avoiding collisions between AGVs. In general, AGVs run with a constant acceleration/deceleration pattern, and it is necessary to consider such AGV dynamic characteristics to avoid collisions between AGVs operating in the real world and to derive the optimal route. However, previous studies in this field have not optimized AGVs to reflect their dynamic characteristics. Therefore, the objective of this study is to design an algorithm for task assignment and motion planning that takes into account the dynamic characteristics of multiple AGVs.

Conflict-Based Search with optimal Task Assignment (CBS-TA) [1] by Hönig et al. with optimality and completeness is known as an algorithm for solving the task assignment and motion planning problems. In this study, we propose an algorithm based on the CBS-TA framework that performs task assignment and motion planning using multiple search trees. The proposed algorithm has the following features: 1.

(1) Optimization is performed based on the movement cost considering the dynamic characteristics of AGVs.

(2) Consistent optimization from task assignment to the completion of goods transportation.

The above is achieved by using a heuristic function that reflects the dynamic characteristics of the AGV to calculate the estimated cost in the search process, and by sequentially performing motion planning for picking up supplies and motion planning for transporting them. To verify the effectiveness of the proposed method, we solved the problem shown in Fig.1 using both the conventional and proposed methods and obtained the results shown in Table 1. By performing the optimization consistently, a solution that takes into account the effects of standby movements and turning was obtained over the entire time the AGV is in operation. In the future, we will investigate algorithms that can handle problems in which tasks are repeated or disturbances occur along the way.

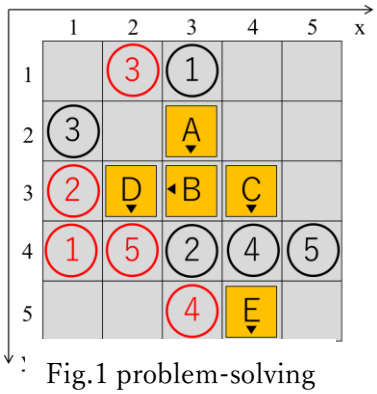

Fig.1 problem-solving

Table 1 Results

アルゴリズム	割り付け結果	全AGVの総移動時間 [s]	計算時間 [s]
CBS-TA + CBS	タスク1:A タスク2:B タスク3:D タスク4:C タスク5:E	197.20	1.53×10^{-1}
提案手法	タスク1:B タスク2:D タスク3:A タスク4:C タスク5:E	188.54	2.37×10^{-1}

[1] Hönig, W., Kiesel, S., Tinka, A., Durham, J.W., Ayanian, N.: Conflict-Based Search with Optimal Task Assignment. In Proceedings of the 17th International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS). International Foundation for Autonomous Agents and Multiagent Systems, 757765 (2018)

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