

DWARF & COOPERATION

Cooperative Transportation by Multiple Mobile Robots with Tools

In this research, we proposed a motion planning method when multiple mobile robots transport a large object cooperatively in a 3D environment. The robots must select a short path and avoid obstacles (A. path planning). They must manipulate a large object dexterously (B. manipulation planning). And precise positioning method is also needed (C. observation planning).

As to A, we reduce computation time by reducing the dimension of configuration space and the paths of the object and the robots are searched by using potential function to avoid obstacles. The motion of robots is generated by taking costs of the manipulating the object into consideration. Feasible paths can be found quickly by heuristic search (Fig.1). As to B, the robots use the sticks as tools to accomplish this task flexibly. We build the manipulation technique suitable for mobile robots by position-control. We propose the manipulation method without using sensor information considering the motion error of mobile robots and the indefinite element of environment from the planning stage (Fig.2). As to C, a visual feedback method is adopted. We plan the sensing direction of the robots for precise positioning of the object (Fig.3). The effectiveness of proposed method was verified by experiments on omnidirectional mobile robots ZEN (Fig.4).

Keywords: Multiple Mobile Robots, Motion Planning, Cooperation, Transportation, Tool

References

- 1) Atsushi YAMASHITA, Jun SASAKI, Jun OTA and Tamio ARAI: "Cooperative Manipulation of Objects by Multiple Mobile Robots with Tools", Proc. 4th Japan-France/2nd Asia-Europe Congress on Mechatronics, pp.310-315, 1998.
- 2) Atsushi YAMASHITA, Kou KAWANO, Jun OTA, Tamio ARAI, Masaki FUKUCHI, Jun SASAKI and Yasumichi AIYAMA: "Planning Method for Cooperative Manipulation by Multiple Mobile Robots using Tools with Motion Errors", Proc. 1999 IEEE/RSJ Int. Conf. on Intelligent Robots and Systems, pp.978-983, 1999.
- 3) Atsushi YAMASHITA, Masaki FUKUCHI, Jun OTA, Tamio ARAI and Hajime ASAMA: "Motion Planning for Cooperative Transportation of a Large Object by Multiple Mobile Robots in a 3D Environment", Proc. 2000 IEEE Int. Conf. on Robotics and Automation, pp.3144-3151, 2000.

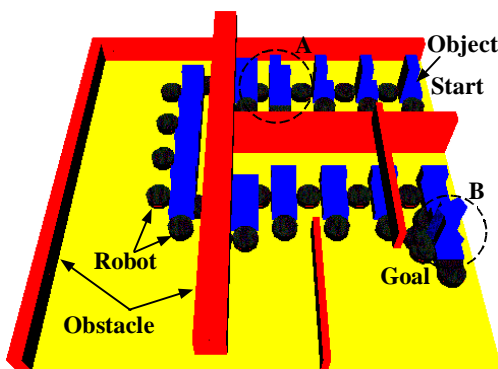


Fig.1 Result of path planning

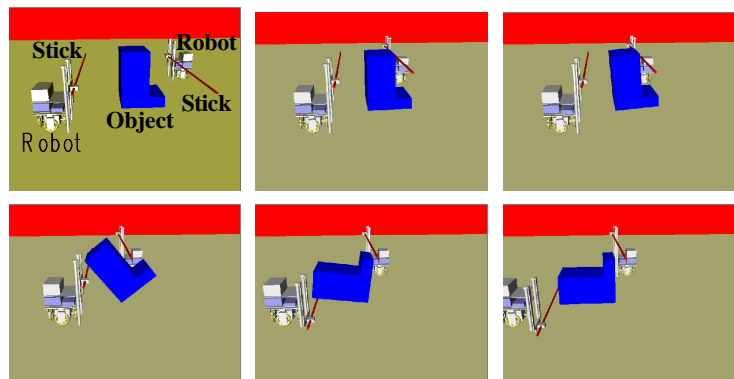


Fig.2 Result of manipulation planning

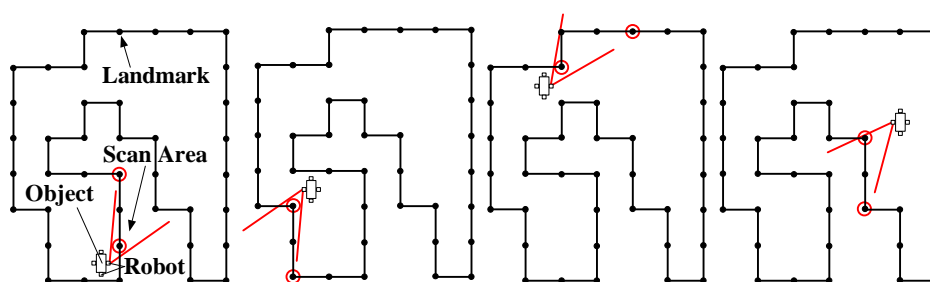


Fig.3 Result of observation planning

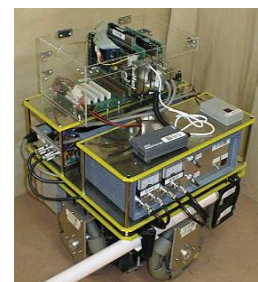


Fig.4 Mobile robot