Transportation of a Large Object by Mobile Robots Using Hand Trucks

To transport a large object by small mobile robots, it is important to reduce the load on the mobile robots. As a solution for this problem, this research proposes a new methodology for object transportation by mobile robots using hand trucks.

In the proposed method, the object is loaded onto small hand trucks by two mobile robots in the following steps (Fig.1). First, a robot equipped with an end-effecter tilt (robot A) an object to provide the space between the object and ground. Then the other robot (robot B) inserts two hand trucks into the provided space. The robot A moves to the opposite side of the object to tilt it again, and the robot B insert the rest of the hand trucks.

For motion planning of the robots, it is necessary to decide "where to insert the hand trucks" and "where to push by the end-effector to tilt the object" considering the operating procedure of the mobile robots. This problem is formulated as an optimization problem. The stability of the object in the final state in which the object can be transported is used as an evaluation function. The penalty method and multi -start local search method were chosen to acquire the optimization solution.

In the simulation, it was confirmed that the proposed algorithm is applicable to objects of arbitrary shape (Fig.2). And the result shows that mobile robots can transport heavier objects in this method than the conventional method in which robots lift up the object coordinately (Fig.3).

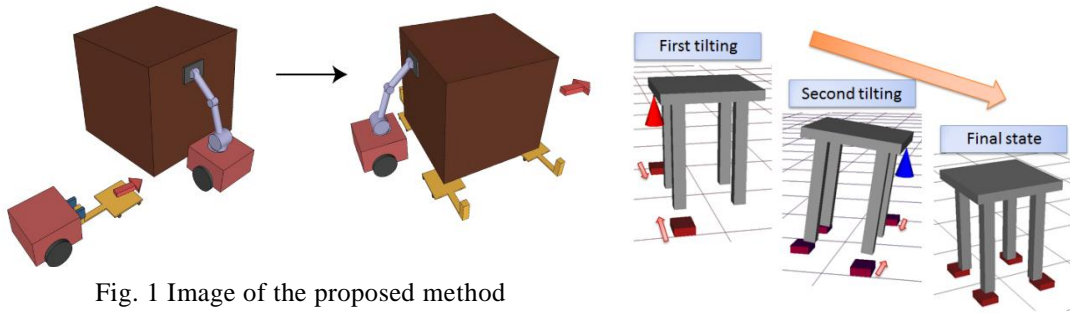*Keywords:* Mobile robot, object transportation, hand truck
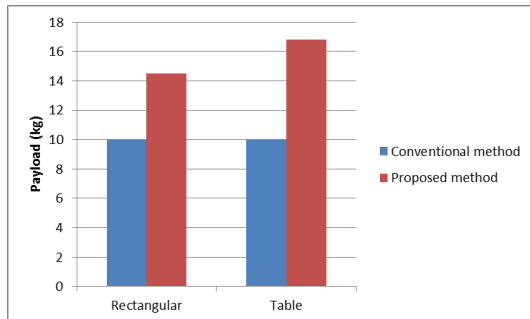

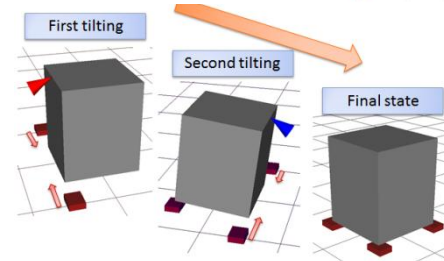Fig. 1 Image of the proposed method

Fig. 3 Comparison of the payload

Fig. 2 Simulation result