ABSTRACT

Park Jee Hwan MS, Purdue University, August 2020. Grid-based Cyclic Multi-robot Allocation for Object Carrying. Major Professors: Galen King, Byung-Cheol Min.

In this thesis, we are addressing new method of object transportation using multi-robot system. The new method of object transportation is called A grid-based cyclic robot allocation (GCRA) method which consists multiple spherical robots. The object is placed on top of group of spherical robots before the transportation. The rotation of the multiple spherical robots cause the displacement of the object and reach the goal location based on the direction and speed of the rotation of the robots. The GCRA method for spherical robots is proposed along with specific stability criterion, which designs the formation of the multi-robot system. The formation is created based on the customized grid which is to be modified based on the properties of the object. The shape and the center of gravity of the shape define the horizontal gap, g_x and vertical gap, g_y. All the possible locations of spherical robots is the cross points of grid which implies that g_x and g_y defines the distance between the robots and based on the boundary of the robots placed underneath the object, the condition of the stability is defined. It also identifies minimum number of robots required based on the arbitrary shape of an object for stable omni-directional translation of the object on a 2 dimensional space. The desired positions and formation of the robots is identified based goal position of the object. Under centralized system, position control is applied to drive the robots to the desired positions. The position control simultaneously makes the object mobile and maintain the stability of the object. Mathematical proof of the proposed method is shown verifying the stability of the transportation process with the assumptions of no slip between the robots and the object. 2 Dimensional Simulation results of robot allocation using GCRA for several arbitrary shapes certify the proposed method.