Patch Sorting: Multi-object Clustering using Minimalist Robots

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Abstract. This study shows that a task as complicated as patch sorting can be accomplished with a 'minimalist' solution employing four simple rules. The solution is an extension of the object clustering research of Beckers *et al.* [1] and the object sorting research of Melhuish *et al.* [2]. Beckers *et al.* [1] used a very simple mechanism and achieved puck clustering in an arena with simple robots. Melhuish *et al.* [2] extended this technique to sort two objects, again using simple robots and a simple mechanism. The new mechanism reported in this paper, explores the sorting of any number of different objects into separate clusters. The method works by comparing two objects: the object the robot is carrying and, using a special antenna, the object with which the robot has collided. The results in this paper provide a demonstration of the success of this n-colour mechanism.

1 Introduction

Deneubourg *et al.* [3] began research into the idea of sorting objects using minimal rules. They present a simulation which demonstrates a simple mechanism that is sufficient to generate separate clusters of two different objects. The mechanism modulates the probability of dropping objects as a function of the local density of objects near the robot. Lumer and Faieta [4] claim to have extended the algorithm to sort objects, which are all different, into clusters of similarity. The possibility therefore exists to extend the method to sort any different number of discrete object types into separate clusters. However, this algorithm, while successful in simulation, has the major drawback that the agents need to be able to sense the local densities of the different types of objects. While this information is easily made available to simulated robots, it is difficult to transfer to real robots operating with minimum sensing capability.

A simpler mechanism was used by Beckers *et al.* [1] and was successfully implemented on a group of real robots. This mechanism was later modified and tested by Melhuish *et al.* [2]. It involves robots moving in straight lines within an arena. Whenever their scoop is depressed, the robots reverse and turn though a random