Convoying: Using Chorusing to Form Travelling Groups of Minimal Agents

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Abstract

We have previously used a biologically-inspired chorusing mechanism to control group size in an environment containing many simulated minimal agents. We now modify the technique to produce travelling groups of a particular size (convoys). An agent in a group of the desired size enters a primed state, emits a signal after a delay, and at the end of the signal moves off to the next destination; other agents in the neighbourhood which are in the primed state and detect the signal also move off at the same time, forming a group. Several such travelling groups in succession can be produced.

KEYWORDS: MINIMAL AGENTS; BIOLOGICAL INSPIRATION; TRAVELLING GROUPS; CHORUSING MECHANISM

Introduction

This paper is the most recent in a series dealing with the generation of useful behaviour from minimal mobile agents using biological strategies. The use of minimal agents is intended to shed light on the use and usefulness of robots with severely constrained sensory, motor, computational, and communication abilities, such as micro- or nano-robots. Biological strategies adapted from bacteria and insects, especially social insects, have been found to be suitable for deployment on simple agents. Previous work covered the use of minimal sensing and locomotion to approach a source of stimulation in a noisy environment [7], minimal communication to improve swarm integrity when following a moving source [8], and synchronised chorusing to control swarm size [9, 10]. This paper reviews the operation of the chorusing mechanism for the control of group size, and shows how it can be extended to produce from a large number of minimal agents a succession of small groups which each move away as a group from the site of their formation.

The control of group size in collective robotics has received relatively little attention. It may be required for a number of reasons. For example, if a localised resource is sufficient for only a limited number of agents, there is little point in attracting extra agents to the resource. Again, it has been established by at least two sets of robot experiments [2, 5] that there may be an optimum number of robots for carrying out a given task under certain circumstances; in such cases, the control of the size of the group undertaking the task may be critical to achieving the task quickly or