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Evolving swarm of UAVs

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Abstract. This paper reports on an ongoing study investigating the feasibility of using an evolutionary method to develop the rules governing Self-Organised (SO) systems for use in swarms of unmanned aerial vehicles. In general, it is difficult to design swarm systems that follow explicit global behaviour. Unlike optimising a predefined objective function, the solution to the problem is the emergent behaviour in the SO systems which results from simultaneous interactions among agents and between agents and their environment. In this study, evolutionary algorithms are used to investigate their control and effectiveness in synthesising the weighting of different rules on SO emergent behaviour. Both homogeneous swarms and heterogeneous swarms were considered though the results provided are for a case study investigating the simplest problem a homogeneous swarm without mutation. Though simple this study does indicate the potential of the approach.

Keywords: evolution; multi-agent; self-organising swarms; search and rescue

1. Introduction

Swarms of aerial vehicles have advantages over single vehicles in a number of situations that exploit their unique characteristics. They are able to distribute their sensors more widely, require less sophistication and are robust in that the failure of one element leads to the degradation of the unmanned aerial system rather than complete failure. When significant autonomy is transferred to the individual vehicles further advantages appear in the reduction in data transfer and computing required.

The design of cooperative controllers by means of Self-Organisation can be found in literature (Ergnac 2007, Gazi 2005, Hauret *et al.* 2009 and Nowak 2008). The applications include: persistent coverage, wide area search, communication relay, formation control, and target sets engagement. The previous research that applies swarm methodology was limited to relative simple scenarios which lack complex task constraints. The reasons for the lack of successful applications in relative complex scenarios are as follows: First, the swarm intelligent systems are hard to develop. As opposed to the centralised algorithm, the path to the problem solving is not the

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