Investigating the Impact of AI Techniques on Inter-Flock Dynamics

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2019-02-17

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1 Abstract

1.1 Context

Artificial intelligence is a rapidly expanding field, there is a clear useful context in their use in Flocking Techniques.

1.2 Aim

Investigate the impact of AI techniques on the dynamic interaction of flocks with each other to see if this has a beneficial effect in comparision to regular flocking algorithms.

1.3 Method - description here needs updating!

Using an application that models flocking behaviour (developed by the author), observe and compare AI flocking strategies to those of regular flocking algorithms. This will be developed using the AI techniques found to be most likely to produce viable intelligent flocking behaviour.

1.4 Results

The analysis of the effectiveness of strategies that the AI come up with in their interactions with other flocks, with contrast and comparison to the behaviour of standard flocking algorithms.

1.5 Conclusion

This project will display the flocking strategies that emerge in their interactions with other flocks, and conclude on their effectiveness in relation to other strategies and flock type. This will demonstrate the impact the AI techniques have on this kind of flocking interaction.

2 Introduction

2.1 General Introduction and Background Information

Flocking is a behaviour in which all social organisms engage; it is the common movement of organisms guided by both social and environmental pressures. These flocks of organisms can be found interacting with other flocks in nature, and the way they interact is as varied as it is interesting.

Producing flocking behavior that recreates those found in nature is an endeavor already undertaken and in constant update. The field, taking off in 1987 with Craig Reynolds' influential paper (Reynolds 1987), shows how realistic flocking behaviour can already be achieved by applying 3 simple rules to each boid ('boid' as coined in the prior paper, this is essentially an agent) in regard to its neighbours: Cohesion, movement toward the average position; Alignment, movement toward the average direction; and Separation, movement to avoid collision.

Since then, the original flocking algorithm has been extended in various ways, with communication techniques, mathematical models for how leadership arises in the flock, as well as models for how consensus is made in a flock. These expansions allow for more complex behaviours and reactions to the enviornment and surroundings.

Learning behaviours have also been added. The behaviour and strategies flocks produce are patterns. This means if a flock can learn and understand those patterns it has a significant advantage over that other flock – an interesting example would be a group of honey hunters and smoke; bees flee the nest if they think there is a fire, the first warning sign to this is smoke, as a group (or flock) they take advantage of this by releasing smoke into the hive. The bees evacuate the nest; they get honey.

This dissemination of new knowledge, either through behaviour or communication is interesting because it can increase the complexity of the reactions the flock has to a given situation. This added complexity may lead to new behaviours that may not have been easily predicted or thought of as something a flock could produce.

2.2 Aim

To investigate the impact of a genetic algorithm on the dynamic interaction of flocks with each other to see if this has a beneficial effect in comparison to regular flocking algorithms.

2.3 Objectives

- To research and evaluate AI techniques, studying their relevance and potential for further development in applying them to flocking algorithms, with particular focus on artificial life techniques.

- To produce an application that models flocking behaviour, and allows the observation and comparison of AI flocking strategies to regular flocking algorithms. This will be developed using the prior identified AI techniques most likely to produce viable flocking behaviours.
- To analyse the effectiveness of strategies that the AI come up with in their interactions with other flocks, comparing and contrasting that to the behavior of standard flocking algorithms.

2.4 Research Question

What impact can a genetic algorithm have on the dynamic interaction of flocks with each other in comparison to that of regular flocking techniques?

3 Literature Review

3.1 Flocking in Nature - Swarm Behaviour

Flocking algorithms draw a lot of their inspiration from the behaviour of flocks in the natural world (Flake 1998). As there are many examples of this behaviour in organisms across the planet (**?**), there is a lot of information and insight that can be gleaned on how to design these algorithms.

Leadership and Consensus The way leadership in a flock emerges is varied. The two main ways

An interesting look at this can be found in the behaviour of pigeons. A study conducted into the behaviour of these birds in a flock (Jorge & Marques 2012)

3.2 Flocking Algorithm

3.3 Genetic Algorithm

3.4 The Effect of AI on Flocking Algorithms

References

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