Evolving Cutting Horse and Sheepdog Behavior in a Simulated Flock

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The focus of this project is attempting to evolve the behavior of a single agent or small group of agents so that they can effectively direct the movement of a much larger group. This is very similar to the roles cowboys and sheepdogs take to manage their livestock. Emphasis is placed on realistic flocking behavior.

In the course of farming, humans have trained some of the more intelligent creatures to control a herd of livestock or flocks of poultry through planned movement. The sheepdog and the cutting horse are two good examples of this behavior. The sheepdog is used to herd and guard sheep, but the focus of their training is on moving a herd. The cutting horse is used with cattle, to "cut" a single cow off from the herd, allowing farmers to access it. The principal of using a specially instructed single agent, or a small group of agents, to direct the movement of a large group of agents presents an interesting challenge.

This project aims to develop instructions for these specialized agents without explicitly programming it. The nature of different herds varies based on the species of the animals, their condition, and environmental factors. It would be helpful to have a dynamic system for creating this sheepdog behavior, to allow for a later, robotic herding agent to adapt to different conditions. There is also the possibility of discovering new techniques for controlling the movement of the herd, which could be applied to real life.

In addition, it would be interesting to explore methods that a group of coordinated sheepdogs might use to direct a flock more efficiently. From what I have gleamed from my research, sheepdogs might be used together, but the farmer directs each one independently; the dogs do not coordinate. It's possible that cooperation could lead to much more efficient techniques.

Many sources were consulted in the design of this project. Some of the more useful ones are listed below.

Flocks, Herds, and Schools: A Distributed Behavioral Model, Craig Reynolds

Low Stress Methods for Moving and Herding Cattle on Pastures, Paddocks, and large Feedlot Pens, Temple Grandin

There has not been very much research directly in this field. The main focus of past research has been on 'flocking', which is similar to a flock of birds flying at high speed. There has not been almost any simulation of a herd of mostly stable animals. However, I am assuming that they work in similar ways; it seems like a logical assumption.

Flocking behavior has three components to the algorithm They are separation, cohesion and alignment. Seperation is moving to keep a minimum distance away from the nearest flockmate. Cohesion is attempting to move towards distant flockmates. Alignment is changing direction of motion to match the direction of nearby flockmates.

Herding behavior is most likely very similar to flocking behavior. It does not assume constant movement. Separation will be a much stronger force, and alignment will be weakened.

The evolution program, and the herding simulator will be both written in python. TKinter will be the graphical display system used. Screen shots should be available from the herding trials. They will most likely take the form of a birds eye view, two dimensional image.