Demo Derby

St. Louis Booze Final Project

Problem Statement

To design a multiagent system that simulates a demolition derby where cars attempt to maximize their individual rewards by damaging/destroying other cars, while avoiding being damaged as well. The agents will attempt to maximize the rewards they personally gain from the competition (Local Decisions) while developing global patterns of behavior, including general aggression levels, types of risks taken, and cars being targeted (Global Coherence). The goal of the derby will be to gauge how the agents' behavior is altered based upon a changing reward system.

Agent Design

- Demo Derby Car
  - Durability
  - Weight/Mass *f*(durability)
  - Max speed *f(*durability)
  - Field of Vision
  - Rewards

Agent Design Cont.

Derby Cars will consider the following when making decisions

- How well other cars are performing in the race.
  - If a car has inflicted a high amount of damage, and also has a high amount of durability left, other cars may avoid that car.
- How well the car is performing.
  - If the car itself is performing well, it may be likely to take more risks.
- How dropping out will affect its reward.
  - In a real life demolition derby, some drivers may choose to “surrender” the race in order

Desired Emergent Behavior

Local Behavior

Cars will behave in a ways that demonstrates their ability to weigh the risks and potential rewards of available actions, taking actions that will maximize the agent's individual reward. Because we will be testing various reward functions, we expect the emergent behavior to change based on the current reward system

Desired Emergent Behavior

Global Behavior

The global patterns we expect to see will be a result of these individual behaviors that result from the rewards system. If cars are being more aggressive, we expect to see shorter derbies. If the reward system doesn't punish being knocked out of the race, we expect to see no withdrawals, and every car continuing the derby until it is completely eliminated. A reward system that encourages conservatism may result in several cars avoiding each other, never trying to finish the derby. In each case, the changes in individual behaviors lead to derby-wide behavioral patterns.

Hypothesis

Hypothesis 1:

If we alter the reward system to give the most rewards to the sole winner of the derby, then the agents will behave in measurably different ways.

Particularly, we would expect the number of collisions to be lower in these simulations as agents will behave cautiously to avoid taking any sort of damage.

Hypothesis 2:

If we change the reward system to reward cars for dealing damage, then different car attributes (particularly durability) will be positively correlated with the amount of rewards a car receives.

Hypothesis Cont.

Hypothesis 3:

If we change the reward system to reward cars for knocking other cars out of the competition, then different car attributes (in this case, speed) will be positively correlated with the amount of rewards a car receives.

Hypothesis 4:

If a car is performing well (i.e. - low damage taken, current high rewards), it will be avoided or hit at a lesser rate than other cars.

Hypothesis Cont.

Hypothesis 5:

We hypothesize that if a car is more aggressive (more likely to inflict hits), then it will not last as long in the derby (either via dropout or knockout) compared to other cars.

Experiments

- Run each configuration 100 times
  - Keep log Used to determine behaviors
- Setup
  - 12 cars
  - Oval area
  - Normal distribution of durabilities
- 3 Different Reward Systems