Experiments with Steering Behaviours in Processing

Experiment 1.1

Method

We tested each case with 3 values, 1, 13 and 25. These values were chosen as they were evenly distributed across the range while not creating too many tests.

Results

Mass	Force	Speed	Result
1	1	1	Moves slowly towards the point, then oscillates on top of the target
1	1	13	Moves quickly, then oscillates a large distance across an axis quickly
1	1	25	Moves very quickly then oscillates a huge distance quickly
1	13	1	Moves slowly, then oscillates. No discernable difference from (1,1,1)
1	13	13	Moves quickly, then oscillates a small distance incredibly fast
1	13	25	Moves very quickly, then oscillates a medium distance incredibly fast
1	25	1	Moves slowly, then oscillates on. No discernable difference from (1,1,1)
1	25	13	Moves quickly, then oscillates a small distance incredibly fast
1	25	25	Moves quickly, then oscillates a small distance ridiculously fast
13	1	1	Moves slowly, then oscillates a small distance slowly
13	1	13	Moves at an average speed, then oscillates a huge distance at the same speed. The oscillation distance seems to only be limited by the screen borders when enough momentum is gained.
13	1	25	Indiscernable from (13,1,13)
13	13	1	Moves slowly then oscillates on top of the point slowly
13	13	13	Moves quickly then oscillates quickly. The oscillation distance reduces from quite large to on top of the point within a few oscillations.
13	13	25	Similar to (13,13,13) but reduces only reduces the oscillation distance to a medium amount
13	25	1	Moves very slowly and oscillates on the point very slowly.
13	25	13	Moves quickly then oscillates, reducing the oscillation distance very quickly and slowing down, sometimes almost halting.
13	25	25	Similar to (13, 25, 13) except the oscillation speed on the point remains high.
25	1	1	Moves slowly then oscillates a small distance slowly
25	1	13	Moves slowly then oscillates a large distance slowly
25	1	25	Moves slowly then oscillates a huge distance slowly
25	13	1	Moves slowly then oscillates on the point slowly.

25	13	13	Moves quickly then oscillates quickly, honing the oscillation distance quickly
25	13	25	Moves quickly then oscillates a huge distance quickly
25	25	1	Moves slowly then oscillates on the point slowly
25	25	13	Moves slowly then oscillates quickly, honing in the oscillation distance quickly
25	25	25	Similar to (25,25,13) but moving even faster

Conclusions

An agent with low force and high speed will quickly move towards the target and then overshoot a large distance. Increasing the force results in the agent overshooting less and staying closer to the target. When the mass and force are higher the agent will still overshoot at high speeds but reduce the distance on each oscillation.

Experiment 1.2

Method

Starting values of (5,5,5, 50) for mass, force, speed and stopping distance were chosen, then the values were varied to try and find interesting results. This approach was chosen as there were too many variables to test every permutation, and the default values produced the intended results, of moving onto the centre of the target and stopping.

Results

With the starting values, the agent moves towards the target, then slows down as it approaches and stops on top of it. If the stopping distance is reduced then the agent will keep going and stop off-centre, and if it is reduced even further it will overshoot the target slightly and have to go back onto the target before stopping. Large values had the opposite effect. The agent would slow down a long time before reaching the target, then stop before reaching the centre.

Increasing the mass would cause the agent to overshoot and turn around, though also increasing the stopping distance mitigates this. Reducing the mass has the opposite affect and causes the agent to move very quickly to the target and stop early, even with a stopping distance of 1.

Increasing the force seems to have no affect as the agent is already stopping centrally on the target, though decreasing it to 1 causes the agent to overshoot and turn around.

Increasing the speed causes wide oscillations but even with very high speed values the agent stops on the centre of the target within a few oscillations. Reducing the speed only causes the agent to move slowly towards the target and stop before reaching the centre. This can be fixed by reducing the stopping distance as well.

Conclusion

Introducing the stopping distance largely fixes the oscillation problem with seek. Even with a very high mass, speed and low force, one of the worst cases for seek, the agent will only oscillate a few times before reducing speed enough to stop on the target.

Experiment 2

Method

Default values of 5, 5 and 1 were used for the mass, force and speed. Speed was set lower than in previous experiments as it was easier to observe. For the jitter, circle radius and wander distance the default values used were 2, 20 and 50, as this produced a nice smooth path that varied but usually continued in one direction.

Results

When the jitter was increased too much the path taken became more erratic and changed sharply, sometimes turning more than 90 degrees in less than a second. This looks unnatural and is precisely the type of random steering that the wander steering seeks to avoid. When decreased too much the steering became not random enough and would only slightly deviate from the original straight path.

Values under 1 usually didn't deviate enough.
Values between 1-2 produced a path that was usually in one direction but would take a winding route in that direction.
Values between 2-3 produced a meandering path which changed directions regularly. These values usually produced the most interesting paths to watch.
Values above 3 often caused the agent to shudder and caused sudden direction changes that looked unnatural.

Increasing the circle radius caused the direction to change less as the jitter was moving relatively less around the circumference of the circle. Similarly decreasing the circle radius caused the jitter to move further around the circle radius and the agent to smoothly change direction too frequently. An extremely small circle radius will cause the jitter to make such a small difference that the agent continues in a straight line.

Values under 10 caused the path to deviate too much.
Values from 10-30 produced interesting paths that didn't change too much.
Values above 30 caused the path to not deviate very much from the original direction.

Varying the wander distance did not seem to have a very dramatic affect. We expected it to have a similar affect to changing the radius, the direction should have changed less as the distance was increased and increased as the distance was decreased, but it was difficult to observe much difference due to the randomness inherent in the system.

Conclusion

Varying the wander circle radius had a more dramatic effect than increasing the wander distance but both caused fluid wandering movements. Increasing the jitter too much caused an unstable path but not enough caused the path to not change.

Experiment 3

Method

Default values of 10 and 5 were used for mass and force. The hunting agent's speed was set to 5.5 and the fleeing agent's speed was set to 5.0.

We tested each combination of Seek/Pursue and Flee/Evade 10 times with random starting positions, taking the average.

Results

Chaser behaviour	Flee behaviour	Results (ms)	Average (ms)
Seek	Flee	25238 1681 16534 29727 24062 15441 8612 31179 11294 7532	17130
Seek	Evade	14623 22403 2350 11748 6772 17028 23789 4995 4853 15818	12493
Pursue	Flee	12585 1924 13780 14897 8710 14600 21914 8726 12190 15610	12437

Pursue	Evade	16742 25687 26209 5462 24509 24262 2768 23634 8465 36451	19418

Conclusion

Pursue Flee was the shortest as expected, as the pursuing agent could outsmart the agent which simply moved away from it.

Pursue Evade took longer than Pursue Flee as the evading agent was more intelligent at avoiding the pursuer than one that simply ran away.

Seek Flee took an unusually long amount of time, possibly due to randomness or a few large values caused by edges slowing down the seeking agent.

Seek Evade also didn't take as long as expected, as sometimes the fleeing agent got caught very quickly by the naïve seeker.

Experiment 4

The chasing agent will use the pursue behaviour to chase its chosen target. After being tagged the agent will freeze for a second before pursuing the closest target. The chaser will change targets if another target is considerably closer than its current target (50 pixels) otherwise it will continue to chase the target it picked first.

The fleeing agents use the evade behaviour until they get a certain distance from the chaser, then begin wandering unless the attacker goes within their safety distance again.

The chasing agent has a speed 1.1 times whatever the fleeing agent has, to ensure that it can be caught.

To prevent the agents running into the edges of the screen, there is a force active 20 pixels from the edges that increases the closer the agent gets to the edge.