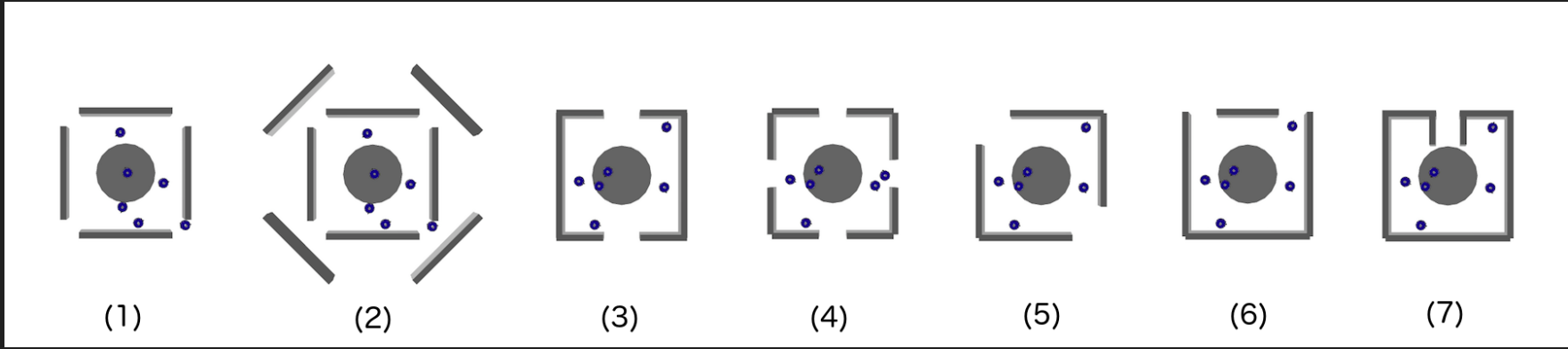
Coevolution between iAnts and Obstacles

Troy Squillaci

Project Inspiration

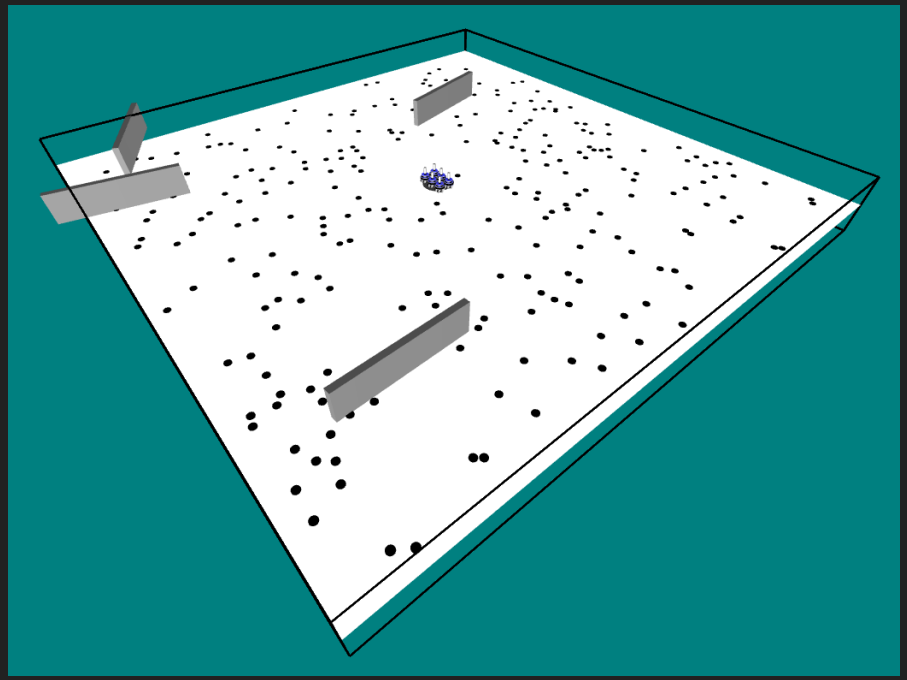
Obstacles in Complex Systems



Can obstacles be evolved to inhibit the foraging capabilities of iAnts?

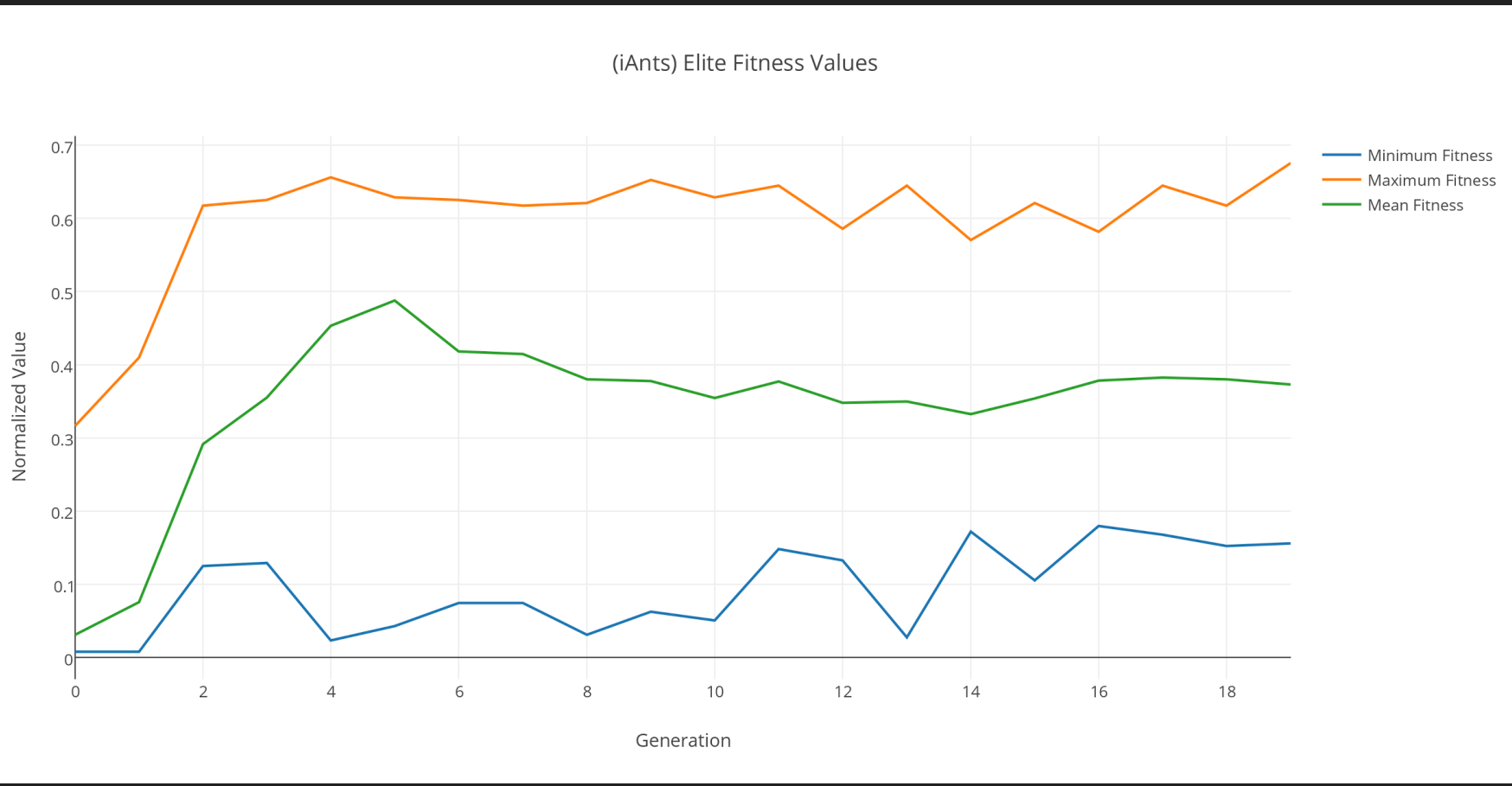
Simulation Parameters

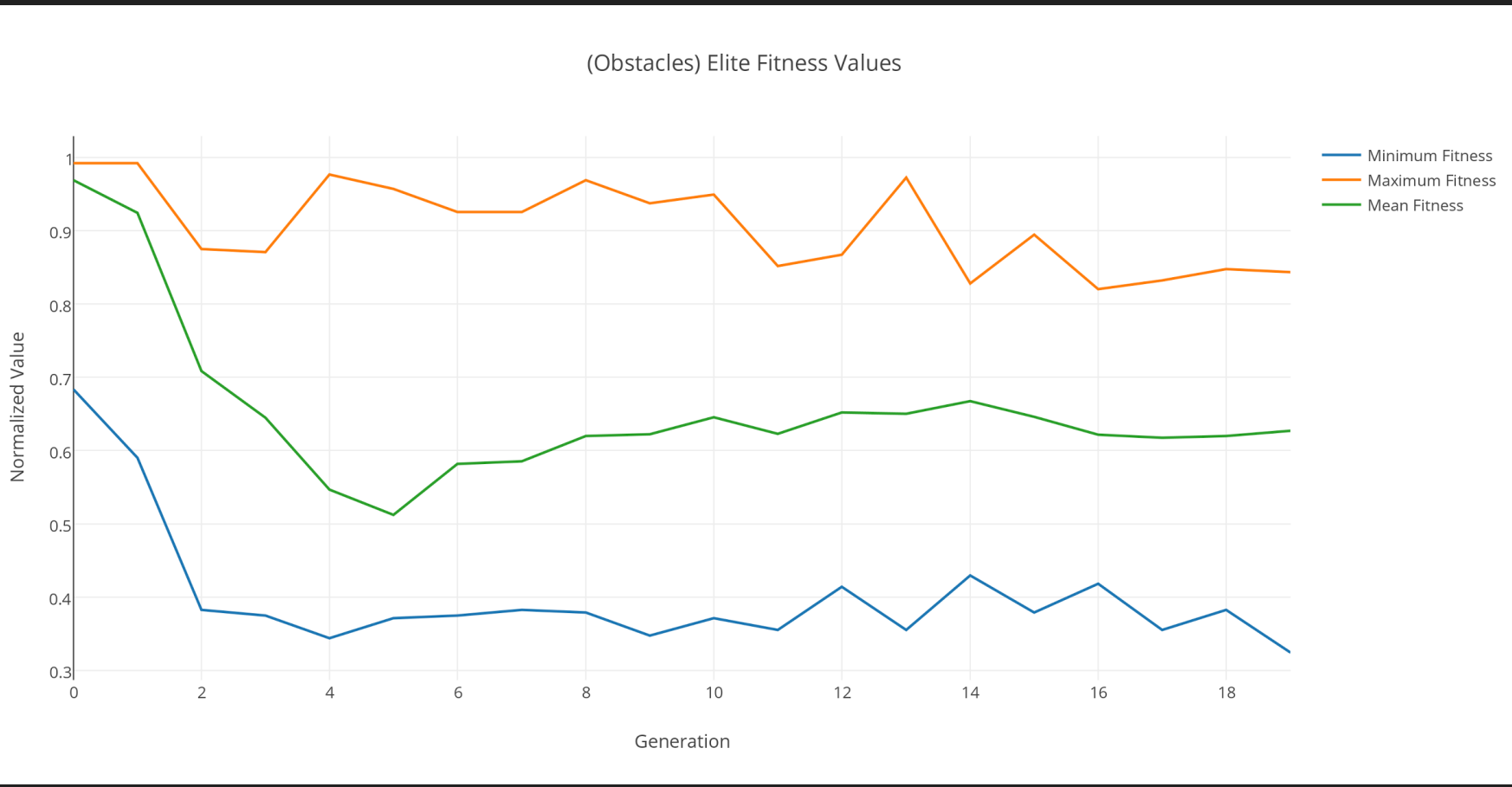
- Simulation
  - 256 Randomly Distributed Food Tags
  - 30min Simulation Time
  - 40 Population Size, 20 Generations
  - Truncation Selection (Elite Size 8), One-Point Crossover, Gaussian Mutation
- iAnts
  - Six Agents
  - Standard CPFA Parameters Evolved
- Obstacles
  - Four Agents
  - Fixed Size (2, 0.1, 0.5)
  - Orientation and Position Evolved
  - Nest Obstruction Prevented

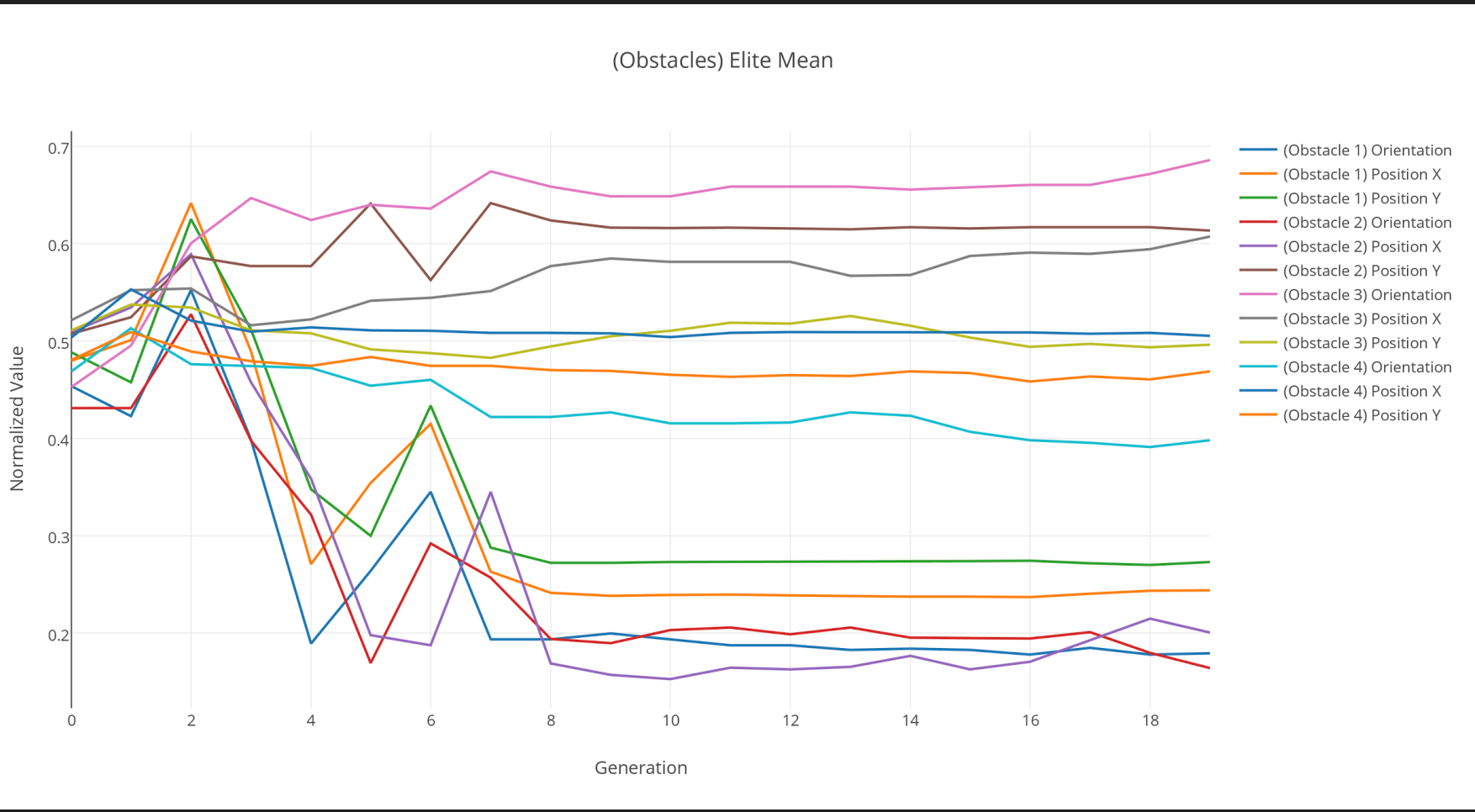


GA Features

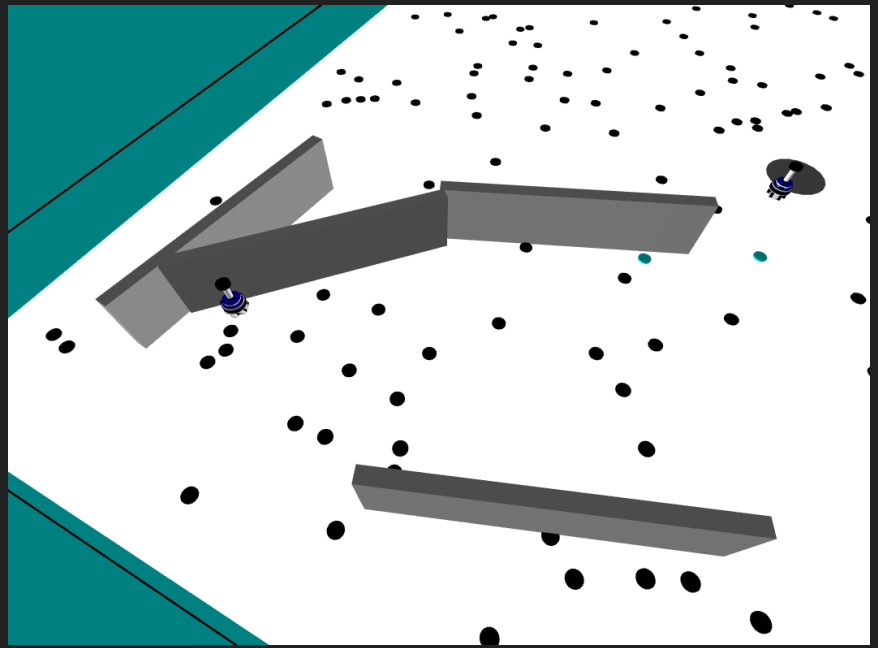
- Uniform-Normal Population Initialization for Diversity
- Dynamic Code Injection
  - Alter functions at runtime (selection, crossover, mutation, etc…)
  - Change which function is used at runtime (example: truncation to tournament selection)
- Multi-processing
  - Divide and conquer ARGoS simulations, utilizing all processing cores.
- JSON configuration for describing the GA and agents, minimal code fiddling needed to completely change GA functionality.
- Extensive logging.

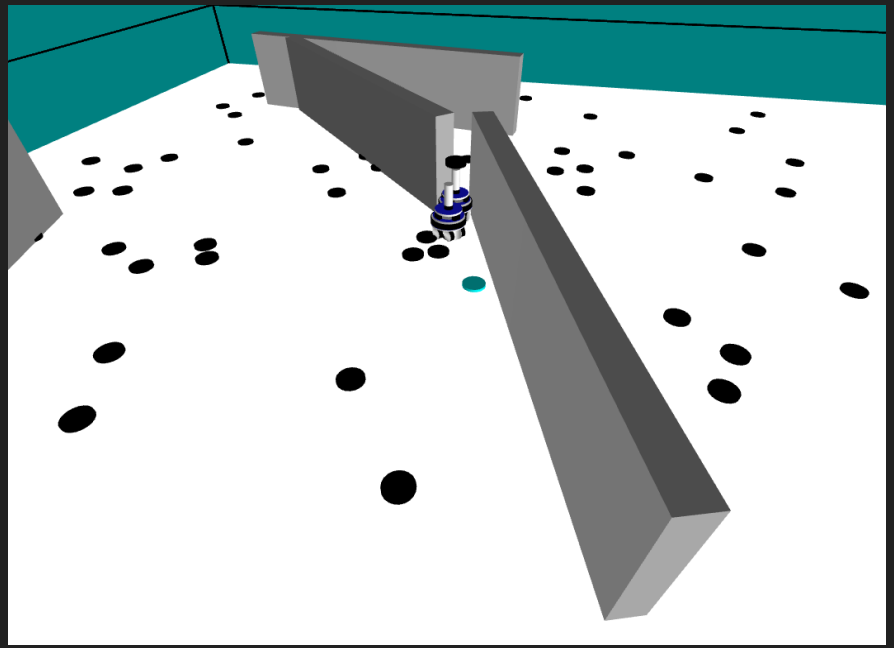

(iAnts) Elite Fitness Values
Minimum Fitness
Maximum Fitness
Mean Fitness
Normalized Value
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14
16
18
Generation


(Obstacles) Elite Fitness Values
Minimum Fitness
Maximum Fitness
Mean Fitness
Normalized Value
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0
2
4
6
8
10
12
14
16
18
Generation

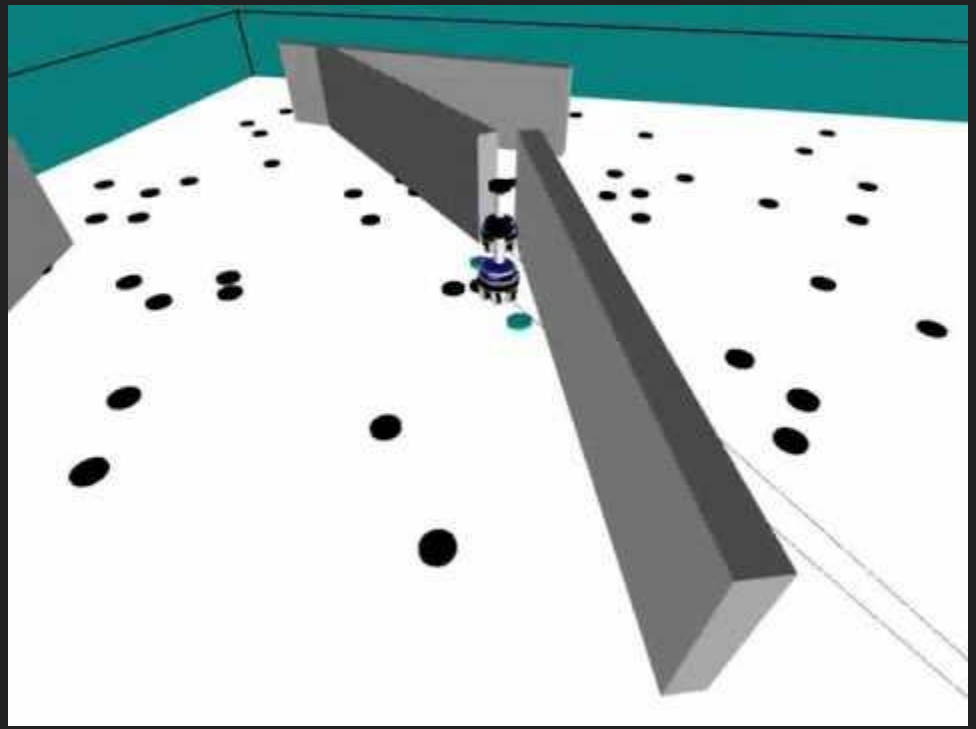

(Obstacles) Elite Mean
Normalized Value
0.7
0.6
0.5
0.4
0.3
0.2
0
2
4
6
8
10
12
14
16
18
Generation
(Obstacle 1) Orientation
(Obstacle 1) Position X
(Obstacle 1) Position Y
(Obstacle 2) Orientation
(Obstacle 2) Position X
(Obstacle 2) Position Y
(Obstacle 3) Orientation
(Obstacle 3) Position X
(Obstacle 3) Position Y
(Obstacle 4) Orientation
(Obstacle 4) Position X
(Obstacle 4) Position Y

Example of Elite Obstacle Configuration (Gen 20)





Video of Obstructed iAnts



Current Issues

- FItness Function
  - Obstacle Fitness = 1 - iAnt Fitness
  - Obstacles initially outperform iAnts, is this beneficial or detrimental?
- Other
  - Currently, portions of obstacles can be out of bounds of the arena.
  - ARGoS occasionally enters an infinite loop, ruining the entire GA run. Ideas?

Future Plans

- Stationary Food Clusters (Constant Seed, Cluster Distribution)
- Tilting Obstacles (could result in the formation of ramps and pits)
- Attempt to implement novelty search for either or both sets of agents.