Swarm-PI Users’ Manual and General Information

*About:*

This research was begun by Professor Stephen Majercik and Professor Mauceri and expanded upon by Jack Truskowski and Grace Handler beginning in May 2015 through May 2016.

The software used for this research is Max (Cycling ’74) with externals written in C through XCode. The visual representation mimics flocking behavior with the end goal of using this flocking behavior to create sounds that together are musically pleasing. Individual members of the flocks are referred to as boids.

*How to run the simulation:*

1. Ensure Max 7 (Licenses can be purchased from the Cycling ’74 website) is downloaded on the computer you are using.
2. Open the file with a title beginning with “ControlPanel…” in the folder “IS\_2016.” The file must be within this folder to run properly.
3. Once open, look to the very bottom left of the Max window and make sure it looks like Figure 1:



Figure 1

* 1. The lock symbol should appear in the locked position.
  2. The system should be in “Presentation Mode” (the symbol is green).



Figure 2

1. To run the simulation, you must first choose a preset in the “Preset storage” section or manually create one where at least one flock has a population above 0.
   1. To choose a “Preset,” click one of the lighter gray boxes in the preset storage box.
   2. If you create something manually and would like to save it as a preset so it can be used in the future, Shift-Click on an unused box (dark grey) to save.
   3. Presets can be cleared by adjusting the number picker on the right of Figure 2 and clicking the 'bang' object next to the picker.
2. To run the simulation continuously, press the X labeled “Run.”
   1. Note: To run one time step, press the O (next to the x). This can be useful for debugging, because it only does one FlightStep.
   2. The visual will appear in a black box that opened when you opened Max called “boids2.” This box might be behind something but should be open on your desktop. You can resize the box to make it bigger or smaller as you would with any application.
   3. The visual can be rotated by dragging inside the "boids2" box. Zooming is done by holding down command and dragging. Panning is done by holding down control and dragging. (Note: These instructions are for Mac users.)
3. Optionally, a total of six attractors (with IDs 0 – 5) can be added in the section labeled “Attractors.”
   1. First, ensure the ID is correct.
   2. Second, set the x/y/z position values by clicking on the box, typing a number, and pressing enter. Note that the world’s dimensions are 10 x 10 x 10.
   3. Third, set the radius of the attractor. This is the area where boids will be attracted to an attractor.
   4. Then, click “Add Attractor,” and repeat as necessary for additional attractors.
   5. To delete an attractor, ensure the ID is the one you’d like to delete, and click “Delete Attractor.”
4. In the section called “Other Parameters”:
   1. Optionally, you can change the birth location of the boids. The default birth position is in the center.
   2. Optionally, you can change the “Mode” to 0, 1, or 2 to change the information provided to Max by the external. Descriptions of the modes are in the green box on the right. Mode does not currently affect the simulation but may in the future.

*Parameters of flocks:*

Note: For reference, the simulation has dimensions of 10x10x10.

**Population [< 1000\*]:** The population refers to the number of boids in the respective flock. \*The sum of the boids in all flocks cannot exceed 1000.

**Speed [1.0 – 8.0] :** The speed is the final magnitude after all the velocity components are added. This means boids can travel faster and slower than the maximum and minimum speed if this parameter is too high or low.

***Maximum Speed (Max) [3.0 – 10.0]:*** Upper bound for boid speed

***Minimum Speed (Min) [0.5 - 5.0]:*** Lower bound for boid speed

**Inertia [6.0 - 15.0]:** The inertia is the resistance of the boids to change speed and direction. Because there is no surface or “gravity” involved, this can be understood as similar to mass of a boid. It is calculated by multiplying the old direction by the inertia value, then dividing all the other components by inertia.

**Accel [not used]**

**Center [0.0 – 15.0]**: Center is a component of velocity, where boids feel attraction to the average position of their neighbors. (In the Boids context, this is their 'cohesion' instinct)

**Attract [0.0 – 15.0]:** Attract is a component of velocity where boids (per flock) feel attraction to the closest attractors. (This is a value for boids. There is also a radius for each attractor that controls which boids will feel the attractor.)

**Match [0.0 – 15.0]:** Match is a component of velocity, where boids feel attraction to the average direction of their neighbors. Match works the same as center, except it changes direction not position. (In the Boids context, this is their 'alignment' instinct)

**Sep Dist [based on world size: 10 x 10 x 10]:** Separation distance controls what the closest distance boids can be to their neighbors, where when they get closer than this, a separation component of velocity will kick in.

Closest separation distance with flock: 0.05 – 0.20

Furthest separation distance with flock: 0.20 – 0.50

Avoidance of other boids: > 4.0

**Sep Wt [0.0 – 15.0]:** Separation weight is a component of velocity, where it controls how much boids will try to maintain the specified separation distance.

Component of velocity -- How much boids will try to maintain the specified Separation Dist (The combination of Sep Dist and Sep Wt is the 'separation' instinct in the Boids simulation)

**NRadius [0.0 – 25.0]:** Neighbor radius controls how far away the boids will have neighbors from themselves.

**Age [look up max]:** Age determines how love boids will “live” which means the number of time steps boids in the flock will stay alive. For testing purposes, setting this value to -1 makes the boids live forever.

**\*\*\***NOTE: For the parameters that are components of velocity, the absolute value does not matter so much as its relationship to the other components of velocity. **\*\*\***