

## 1. Flight Simulator

### 1.1. Parameters

- 1.1.1. The flight simulator shall be able to simulate at least one aircraft and at most ten aircrafts at a time.
  - 1.1.1.1. When the simulator starts up, the system shall ask the user to input the number of aircrafts to simulate.
- 1.1.2. The flight simulator shall run indefinitely until it is stopped by the user.
  - 1.1.2.1. There shall be a stop button for the user to stop the simulation.
- 1.1.3. There shall be three temporary input parameters for each of the aircraft.
  - 1.1.3.1. There shall be a “heading” parameter.
    - 1.1.3.1.1. Both 0 and 360 degrees shall point to the top of the screen. 90 degrees shall point to the right of the screen. 180 degrees shall point to the bottom of the screen. 270 degrees shall point to the left of the screen.
  - 1.1.3.2. There shall be a “x position” parameter.
    - 1.1.3.2.1. The “x position” shall increase as the aircraft approaches the right side of the screen. It shall also decrease as the aircraft approaches the left side of the screen.
  - 1.1.3.3. There shall be a “y position” parameter.
    - 1.1.3.3.1. The “y position” shall increase as the aircraft approaches the top of the screen. It shall also decrease as the aircraft approaches the bottom of the screen.
- 1.1.4. There shall be a two permanent input parameters for each aircraft.
  - 1.1.4.1. There shall be a “number of sides” parameter. This will determine the number of sides the polygon followed by a control policy will have, as mentioned in 1.3.5.
  - 1.1.4.2. There shall be a “diameter” parameter. This will determine the diameter of the polygon followed by a control policy, as mentioned in 1.3.5.
- 1.1.5. Initial conditions for each aircraft shall be set by the user.
  - 1.1.5.1. When the simulator starts up, the system shall ask the user to input each of the five parameters for each aircraft.
- 1.1.6. There shall be two more parameters for each aircraft, which shall not be set by the user as an initial parameter.

- 1.1.6.1. There shall be a “linear velocity” parameter. This parameter shall be initialized to 0 kilometers per hour.
- 1.1.6.2. There shall be an “angular velocity” parameter. This parameter shall be initialized to 0 degrees per second.

## 1.2. Limitations

### 1.2.1. Physical parameters

- 1.2.1.1. The “heading” parameter, as mentioned in 1.1.3.1.
  - 1.2.1.1.1. This parameter shall be between 0 and 360 degrees.
- 1.2.1.2. The “x position” parameter, as mentioned in 1.1.3.2.
  - 1.2.1.2.1. This parameter shall be between 0 and 500 kilometers.
- 1.2.1.3. The “y position” parameter, as mentioned in 1.1.3.3.
  - 1.2.1.3.1. This parameter shall be between 0 and 500 kilometers.
- 1.2.1.4. If an aircraft attempts to exceed the limits of the “x position” or “y position” parameters, it shall stay at its current location on the screen.
- 1.2.1.5. The “number of sides” parameter, as mentioned in 1.1.4.1.
  - 1.2.1.5.1. This parameter shall be between 3 and 15.
- 1.2.1.6. The “diameter” parameter, as mentioned in 1.1.4.2.
  - 1.2.1.6.1. This parameter shall be between 50 and 225 kilometers.

### 1.2.2. Dynamics

- 1.2.2.1. The linear velocity of each aircraft shall be between 200 and 1200 kilometers per hour.
- 1.2.2.2. The angular velocity of each aircraft shall be between 0 and 5 degrees per second.

### 1.2.3. The simulator shall have no obstacles.

## 1.3. Control

- 1.3.1. A control policy shall specify an aircraft’s heading, x position, y position, linear velocity, and angular velocity at all times during the simulator’s operation.
- 1.3.2. Each aircraft shall only have exactly one control policy.
- 1.3.3. The simulator shall have at most ten control policies at a time.
  - 1.3.3.1. Each aircraft’s control policy shall be chosen from these ten policies.
- 1.3.4. Each aircraft’s control policy can be different from every other aircraft’s control policy.
- 1.3.5. Each control policy shall be able to guide an aircraft to follow a polygon.
  - 1.3.5.1. The number of sides of the polygon shall be specified by the user, as mentioned in 1.1.4.1.

1.3.5.2. The diameter of the polygon shall be specified by the user, as mentioned in 1.1.4.2.

1.3.5.3. The polygon shall be circumscribed by a circle with the same diameter as the polygon.

1.4. Rate of Operation

1.4.1. The simulator shall tick once every second.

1.4.1.1. At each tick, the simulator shall update each aircraft's heading, x position, y position, linear velocity, and angular velocity according to the control policy's input.

Q1: 2 hours

Q2: 1.5 hours

Q3: 1 hour

Q4: 4 hours

Q5: 2.5 hours