**Drone Battery System Integration Guide**

This guide explains how to integrate the drone battery management system into your existing simulation. The battery system models the energy consumption of drones based on distance traveled and adds recharging functionality when battery levels get low.

**Overview of Changes**

The implementation adds:

1. Battery tracking for each drone
2. Automatic return to charging station when battery is low
3. Battery recharging at the designated charging station (35, 35)
4. Enhanced task assignment considering battery constraints
5. Statistics collection for battery usage

**Key Components**

**1. Enhanced Drone Class**

The Drone class has been extended with battery-related attributes and methods:

* **Battery Attributes:**
  + max\_battery: Maximum battery capacity (in distance units)
  + battery: Current battery level
  + low\_battery\_threshold: When to trigger return to charging station (default: 20% of max)
  + home\_x, home\_y: Coordinates of charging station (default: 35, 35)
  + distance\_traveled: Total distance tracked for statistics
* **New Methods:**
  + check\_battery\_for\_task(): Verifies if battery is sufficient for a task
  + go\_to\_charging\_station(): Sets drone to return to charging point
  + recharge(): Instantly replenishes battery (simulating battery swap)
  + update\_battery(): Reduces battery based on distance moved

**2. Updated DroneFleet Class**

The DroneFleet class has been modified to handle battery constraints:

* **New Features:**
  + Enhanced drone selection logic to check battery sufficiency
  + Task queue handling with battery awareness
  + Battery statistics collection
  + Task reassignment when battery constraints prevent completion

**3. Simulation Tracking**

The simulation now includes comprehensive battery tracking:

* Records battery levels over time
* Tracks charging events
* Calculates efficiency metrics
* Provides detailed end-of-simulation reports

**Integration Steps**

1. Replace your existing Drone class with the enhanced version
2. Update your DroneFleet class with the battery-aware implementation
3. Add battery tracking to your simulation loop
4. Add battery statistics reporting to your simulation output

**Configuration Options**

You can adjust these parameters based on your simulation needs:

* max\_battery: Set the maximum battery capacity (default: 500 distance units)
* low\_battery\_threshold: Adjust when drones should return to charge (default: 20% of max)
* Charging station location: Default is (35, 35), can be modified in the Drone

**Additional Notes**

* Drones will automatically return to the charging station when battery is low
* When a drone can't complete a task due to low battery, the task is returned to the queue
* Task assignment includes battery estimation to ensure task completion is possible
* The battery measurement unit is distance (same as drone movement), which simplifies the model

**Performance Considerations**

* The battery system adds computational overhead to check battery levels
* For large simulations, you might want to adjust frequency of battery checks
* Consider increasing initial drone count to compensate for drones that may be charging