Development of a New Swarm Search and Rescue Model

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Overview

- Gap: Identifying, tracking and simulating the elements that impact Search and Rescue scenarios involving a swarm of drones
- Why it matters: Improving the efficiency and success rate of SAR with drones increases the speed and effectiveness of life-saving missions
- Research Question: How can we apply the use of simulations to increase the efficiency of Search and Rescue using drone swarms

The simulation currently has a swarm of drones randomly searching for a stationary target. The drones' paths are also drawn for analysis. The drones have a probabilistic radius in which as they get closer to the target, the chance of successfully finding the target increases.

Model Features

- Includes drones searching for a target
- Scenario size is scalable
- Changeable parameters like drone speed, # of drones, drone search radius
- Probabilistic individual drone search radius

Future features include new drone search patterns (nonrandom), smarter drones, movement of the target. Other future features are environment cover and consensus algorithms.

Other Features

- Start screen to allow for parameter changing
- Statistics screen for after simulation has finished

The simulation opens to a start screen that has multiple options for changing parameters such as simulation size or speed of drones. After the model runs a statistics screen is shown.

The Model

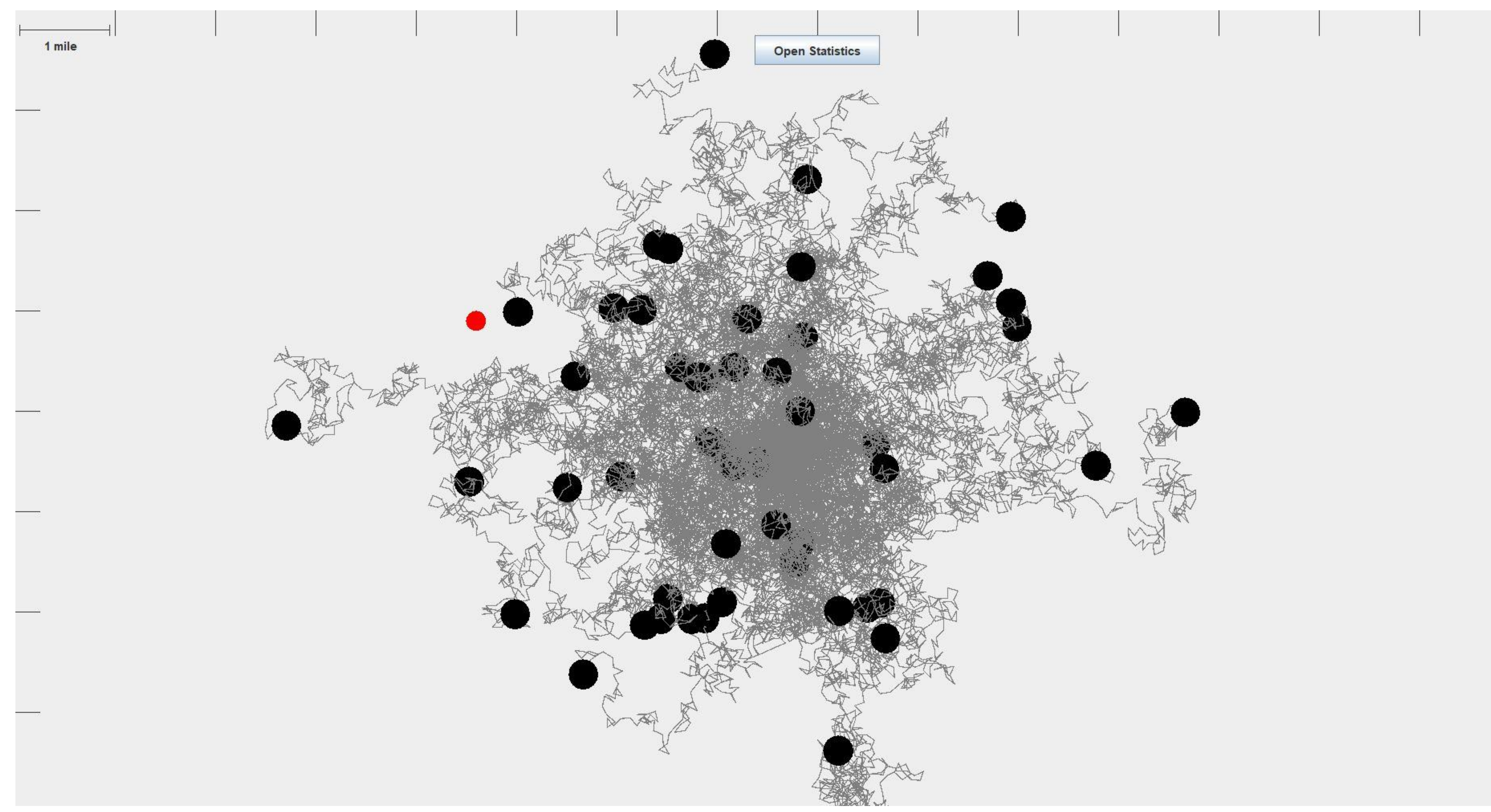

Figure 1: This simulation run shows a square mile "forest" area where a search and rescue operation is occurring using drones to search randomly for a target

of Drones vs Find Time

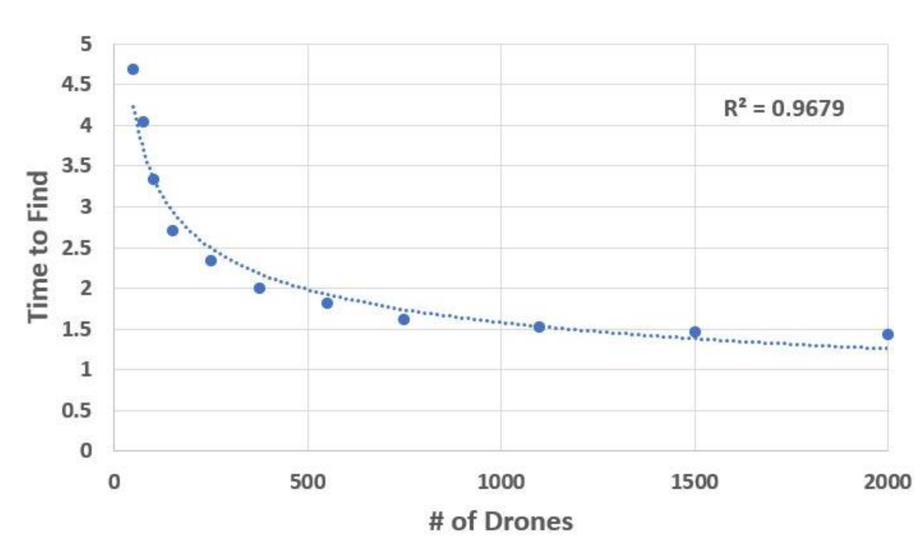

Figure 2: Relationship of # of Drones vs TTF; shows optimal drone concentration at 500 for 120mi² or 4.2 per mi² (3 Runs Averaged)

Probabilistic Search Radius

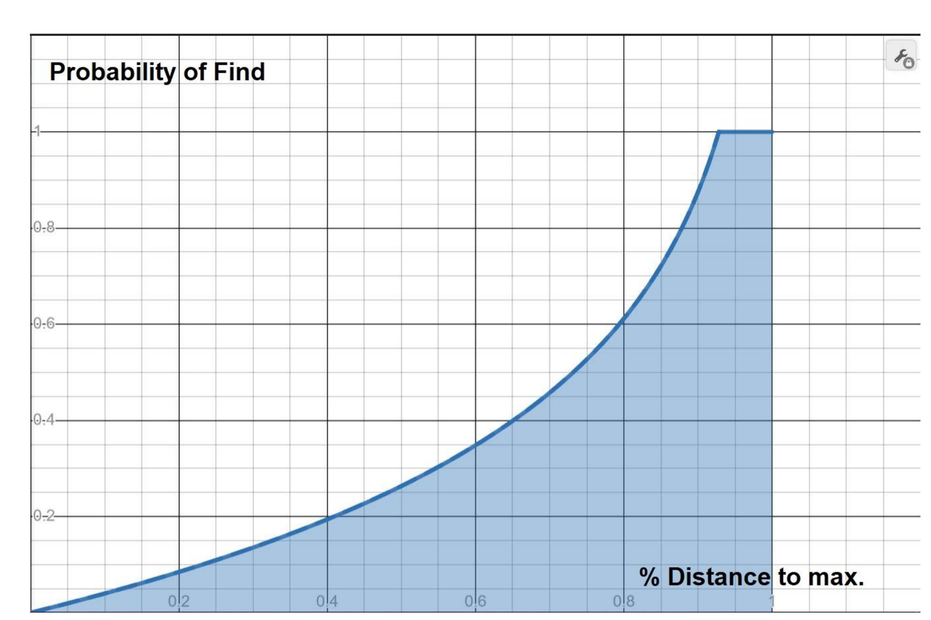

Figure 3: Probability (y) of a drone spotting the target from a distance (x, as a percentage of the drone's maximum search radius)

Feature timeline

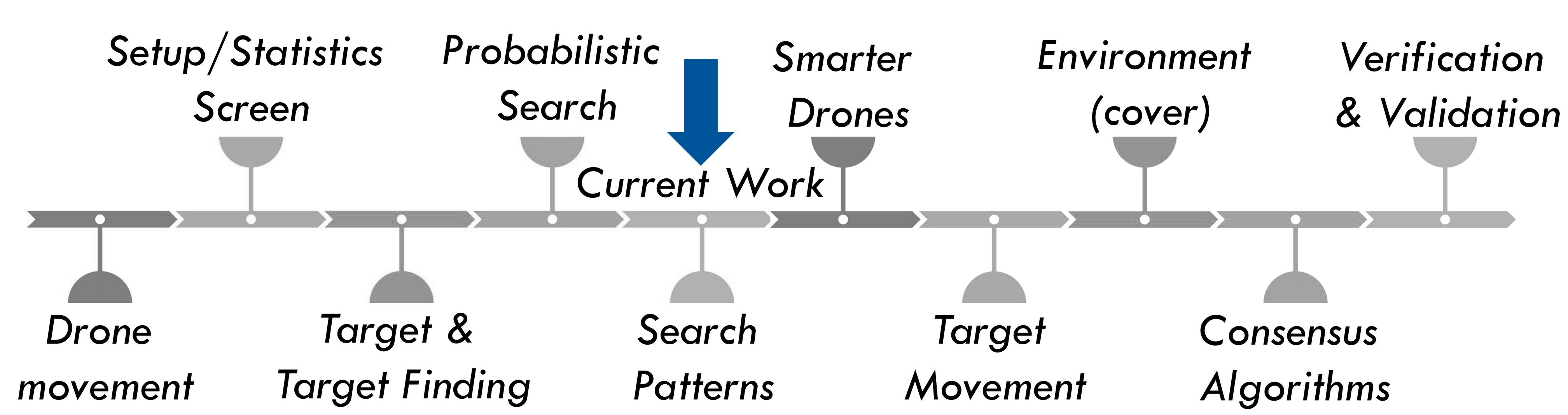

Figure 4: Timeline of features (implemented and future)

Multi Agent Systems

- Multi Agent Systems (MAS) are any system of devices working together
- Drone Fleets are the prime example of a MAS
- MASs can be distributed or centrally controlled
- Consensus algorithms play a large part in distributed MASs

Multi-Agent System research has multiple real-world applications, such as: drone fleets, communications systems, autonomous vehicles and more.

Drones in Search & Rescue

- Drones are the future of Search and Rescue Operations
- Quicker search times and aerial views are more efficient than human searches
- Drones are autonomous, cutting down on human error

The advantages of drones in SAR are more efficiency, higher success rate and less human error possibilities. Disadvantages include large infrastructure requirements and cost.

Future Work

- Current work includes real life relevancy and drone patterns such as a grid search as opposed to randomly searching
- Future features are improvements such as smarter drones, target movement, and an environment with landscape features like trees
- Adding consensus algorithms to the drones is the long-term goal for the simulation

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