Swarm Rescue Challenge 2023-2024

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CIEDS
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D'ÉTUDES POUR LA DÉFENSE
ET LA SÉCURITÉ

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Drone swarm competition

- Organized by **IP Paris** Interdisciplinary Center for Defense and Security (CIEDS) and the Defense Innovation Agency (AID)

- Objectives : Stimulate student interest in defense and security issues

- Organizers claim no rights / reuse of developed solutions

- Challenge in simulation only (python)

- Focused on **navigation, exploration and coordination** strategies between agents

- Intermediate evaluation by visioconference and final evaluation in person

- Judged on solution performance and quality of final presentation

2

Basic scenario

- A fleet of 10 drones at the start (rescue area)

- Aim: to rescue injured people (static or **mobile**) and bring them back to the rescue area

- Drones don't know the map or the location of people

- All drones use the same control function

- Drones are equipped with distance sensors and semantic sensors to detect people.

- Drones can communicate with each other within a limited range
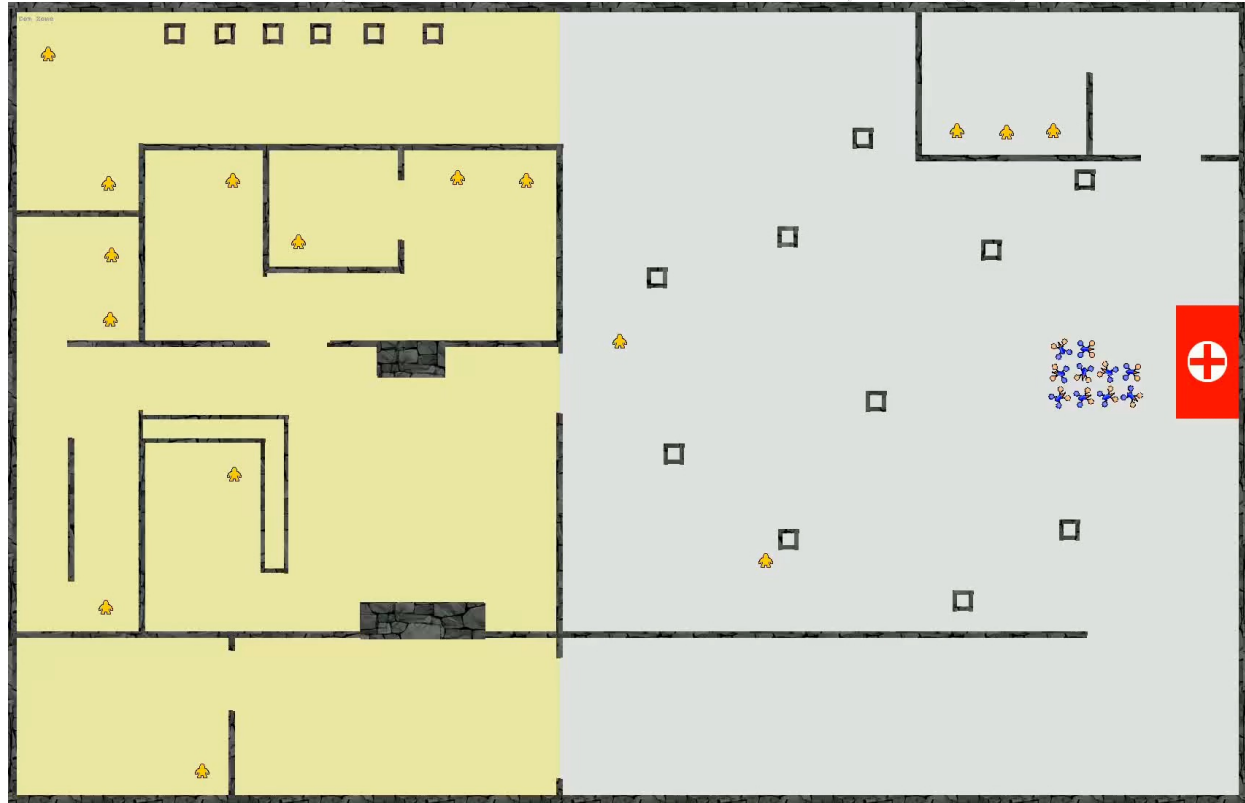

3

Scenario 2/2
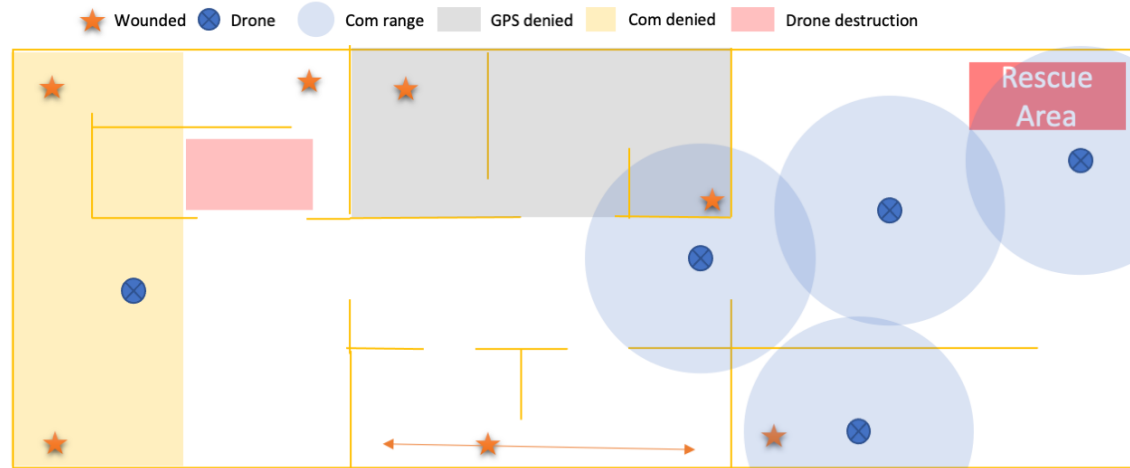
Difficulties

- Watch out for special areas:

  - **No Com Zone**: communication between drones is impossible

  - **Kill Zone**: drones entering this zone are destroyed or disabled.

  - **No GPS Zone**: GPS location of drones is impossible

4
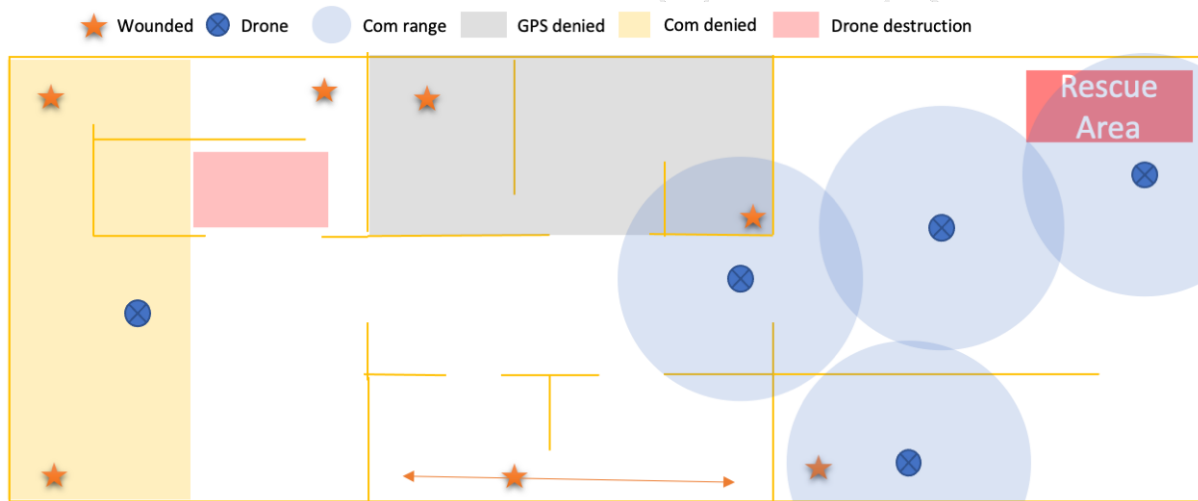
Challenge Simulator

Simulator in Python

- Open Source
- Win/Mac/Linux

Map of Final 2024

https://github.com/emmanuel-battesti/swarm-rescue
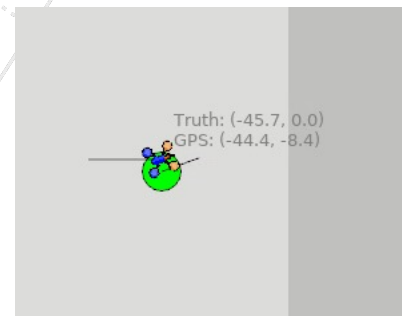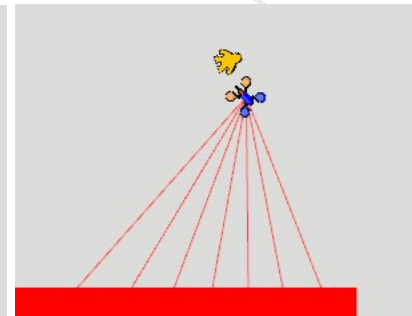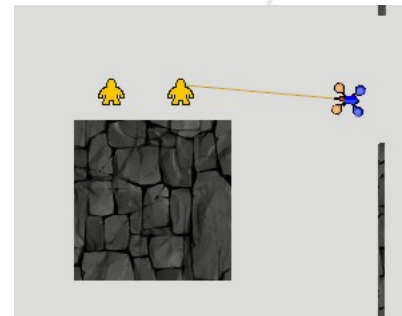
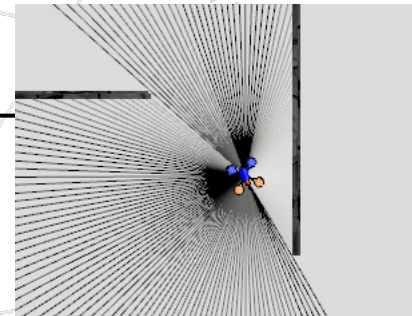# Available sensors

Robotic sensors

- Lidar: distance to obstacles over 181 beams (360°)

- Speed : speed wrt ground

Semantic Sensors

- Semantic: (object type, distance) on 35 beams (360°) for drones, injured person, rescue zones

GPS

- Position (x, y) noisy in the map, disabled in some areas

6
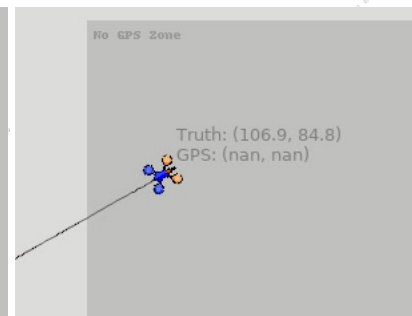
Available effectors

Communication

- All types of data can be transmitted (python object)
- Limited range, disabled in some areas
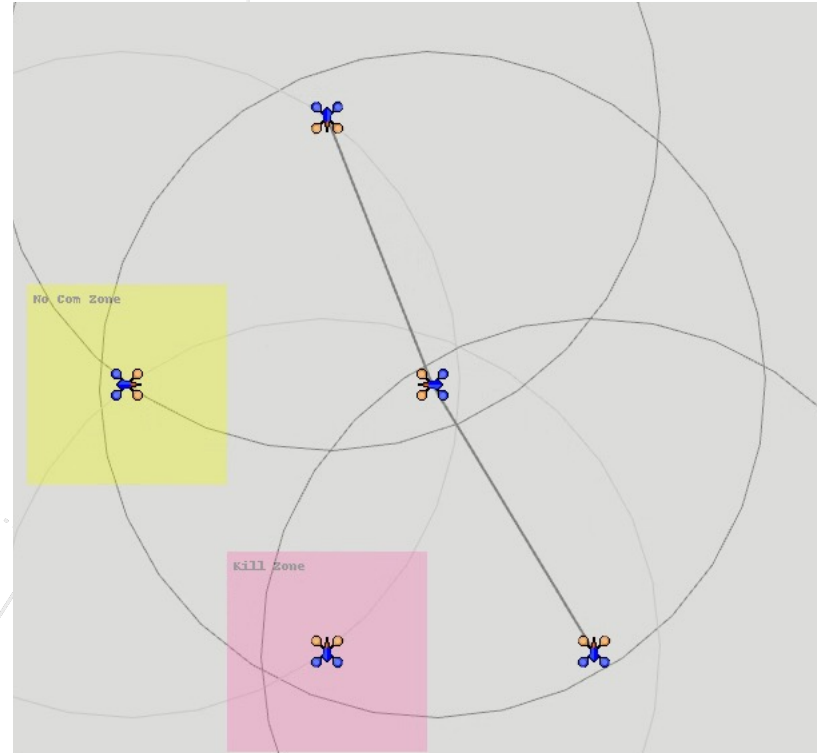
The drone can be controlled with

- Longitudinal force between -1 and 1
- Lateral force between -1 and 1
- Rotation speed

Grasp function

- Catching the injured person

NB : Life points

- 1 point lost on each collision

Metrics

- **R** : Number of injured person rescued in 3 minutes
- **E** : Percentage of map explored in 3 minutes
- **B** : Sum of life points of drones returning at the end
- **T** : Time remaining when all injured person saved
- Evaluated on unknown maps for final competition

Map Score
=
$$0.5 * R + 0.2 * E + 0.2 * B + 0.1 * T$$

Score

- Final score : Average score on 6 maps
- 3 maps without difficulties, 1 with each difficulty
- Automatically generated in the code

Environnement	Sc. Sauvetages	Sc. Exploration	Sc. Temps	Score Total
easy	0.76	0.99	0.00	72.76
no_com_zone	0.78	0.98	0.00	74.11
no_gps_zone	0.89	1.00	0.07	82.83
kill_zone	0.60	0.98	0.00	61.54

8

Support ressources
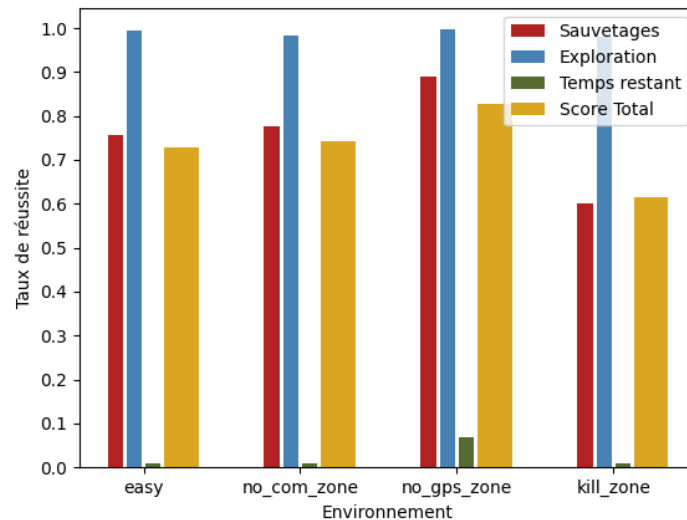
Demonstration behaviors

- Include a demonstration of random exploration and return using backward path following

- Include a mapping demonstration

Community ressources

- e.g. : PythonRobotics

- https://github.com/AtsushiSakai/PythonRobotics

Reinforcement learning interface

- Gymnasium interface to the simulator

- Single agent (for path following, obstacle avoidance, grasping, …)

- Prototype for multi-agent (exploration, coordination, …)

- https://github.com/minhpham160603/SwarmRL

Assessment scenarios

Code submission

- One week before evaluation

- Zip + install instruction

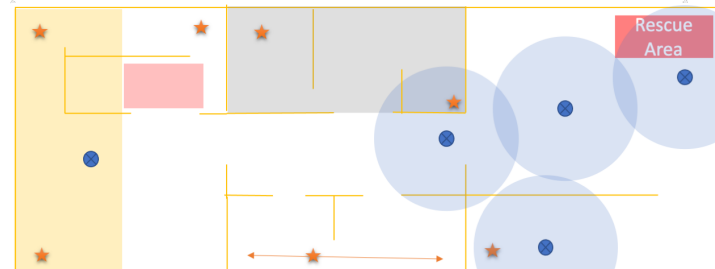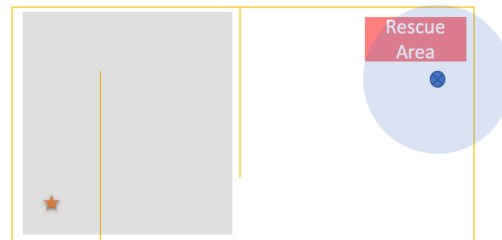## First Evaluation (December 2024)

- Focus on navigation functions

- A single drone, GPS loss

Second Evaluation (February 2025)

- Focus on collaboration functions

- Ten drones, loss of drones and communication

Final assessment (March 2025)

- Full scenario, unknown maps

- Presentation to the jury

10

Legend: Wounded · Drone · Com range · GPS denied · Com denied · Drone destruction

Participation

Participation

- Limited to students of IP Paris, ENSTA Bretagne, ISAE
- Groups of 2 to 5 people - Individual registration possible (to look for partners)
- Prizes for the three best teams (shared equally between members)

Calendar

- 15/10/2024: Challenge launched, V0 environment made available
- 03/12/2024: Interim review (videoconference) and first assessment
- 28/01/2025: Second intermediate point (videoconference) and second assessment
- 13/03/2025: Final evaluation and public presentation of projects

Registration on the website

https://bit.ly/swarm-rescue

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