On the use of swarms of autonomous aerial vehicles for disaster monitoring

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Participation in National and European Projects

Robotics

Energy Management Systems

ConvCAO Robotics Team


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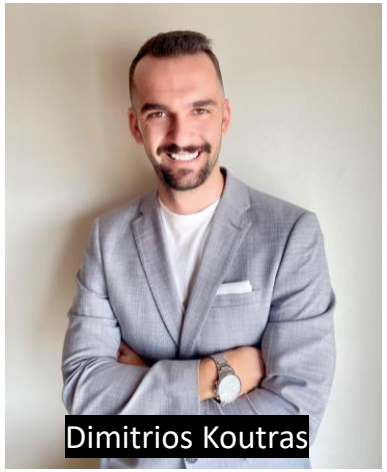
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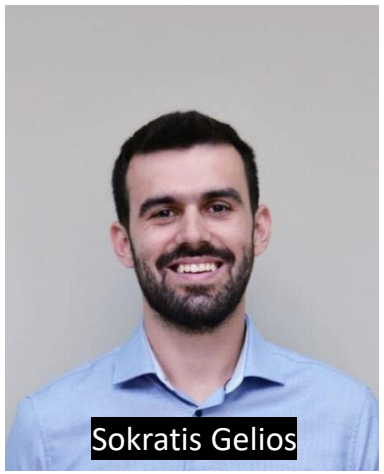
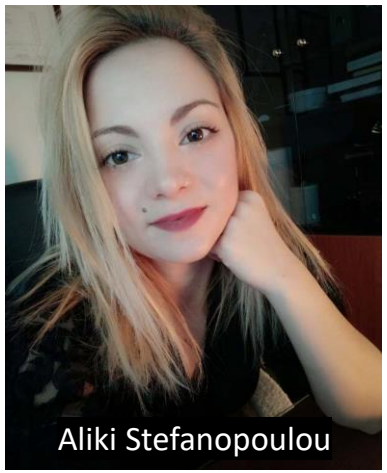

Sokratis Gelios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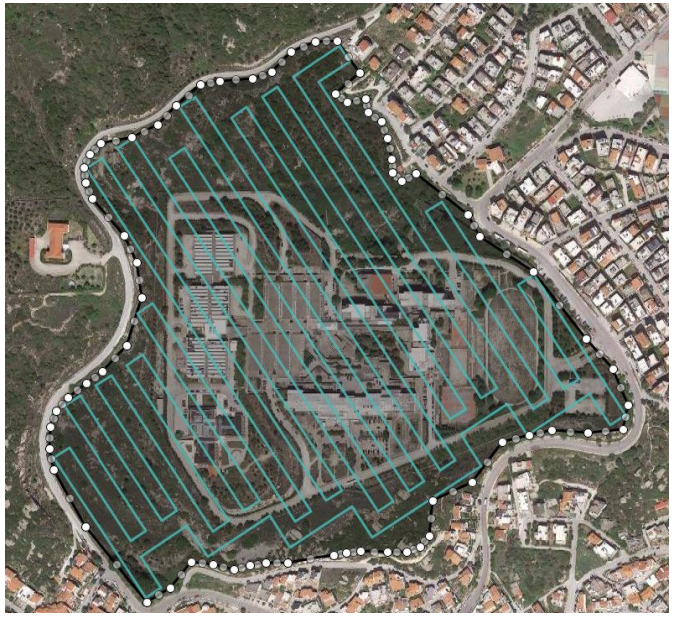
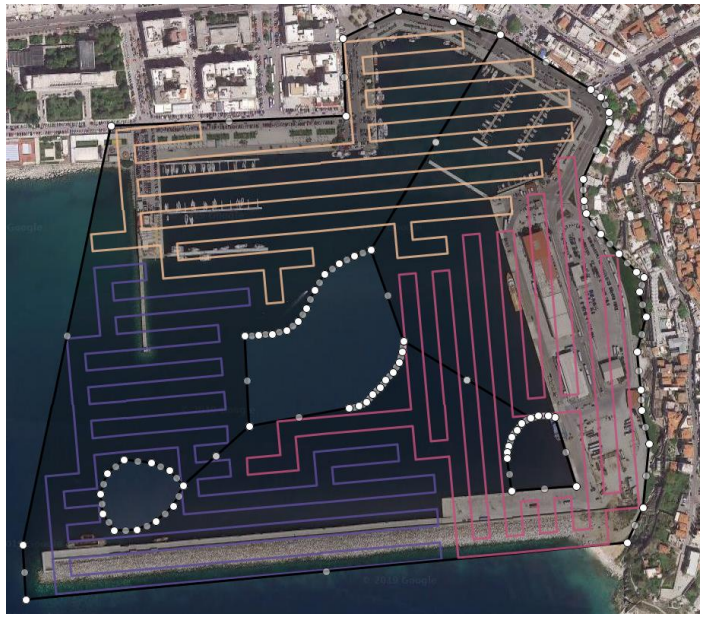
Depolying a swarm of UAVs for Coverage Mission Planning

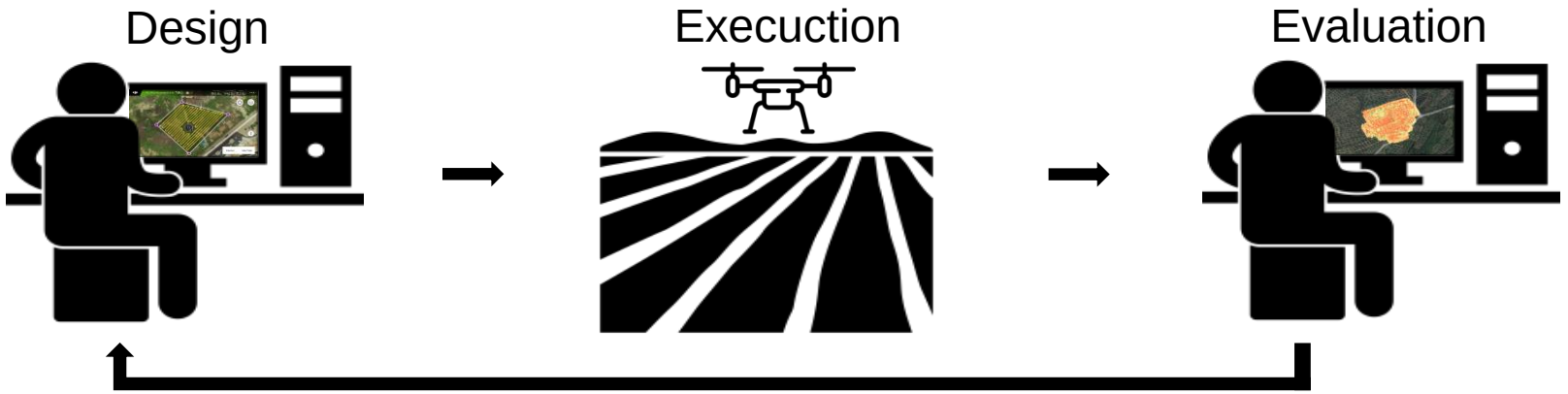
- Input:
  - Area of Interest that we want to cover
  - Swarm of UAVs (Unmanned Aerial Vehicles) with given flying capabilities, sensors, etc.
- Output:
  - Navigate fully-autonomously the UAVs so to “see” each point of the Area of Interest
  - Avoid obstacles and “no-fly zones”





Iterative procedure (sometimes using tele-operation

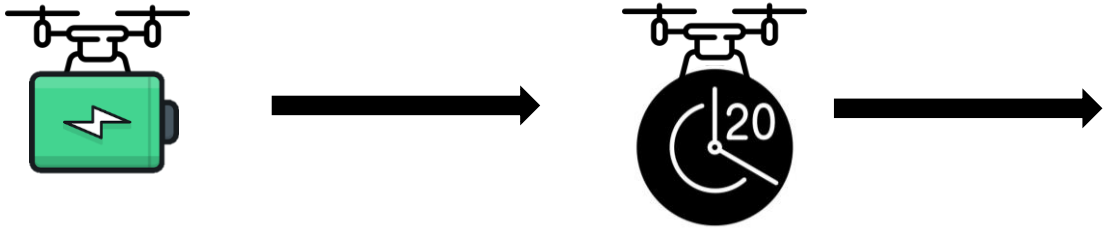
"Conventional" Approach:



Battery/Fuel

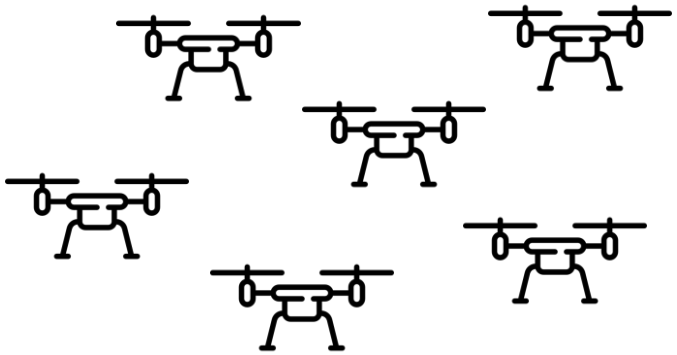
Flight time

Constraint:

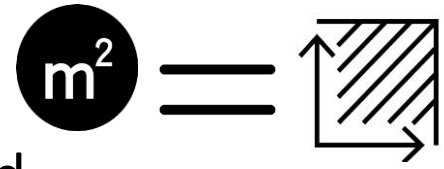


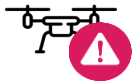
- m^2 coverage
- Time to complete mission
- Need for recharging station
- etc

Why many UAVs?

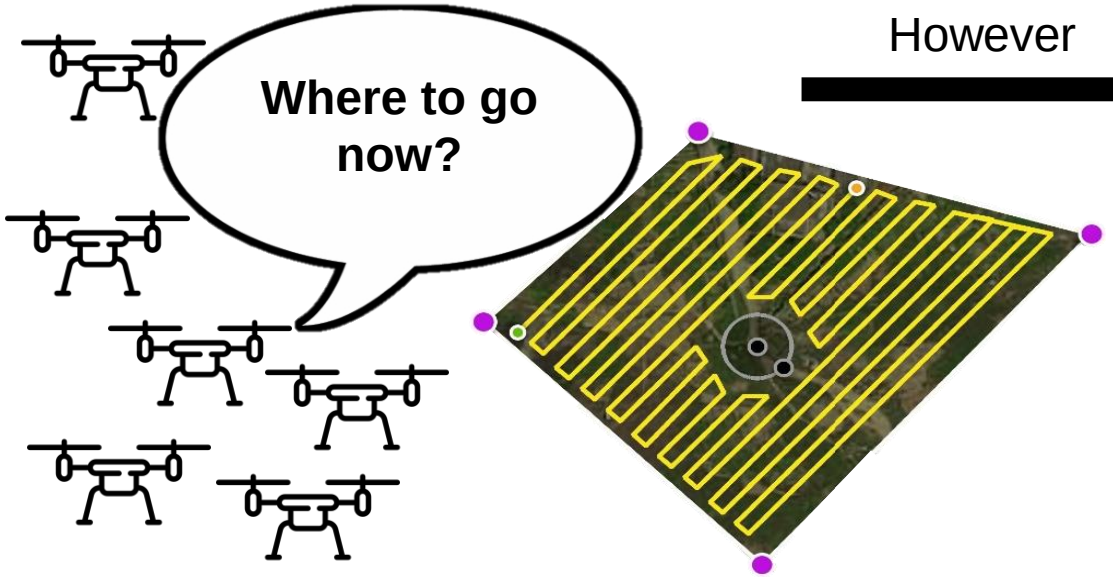


Advantages

1. Total covered  number 
2. Many sensors simultaneously 

3. Fault tolerance 

Problem

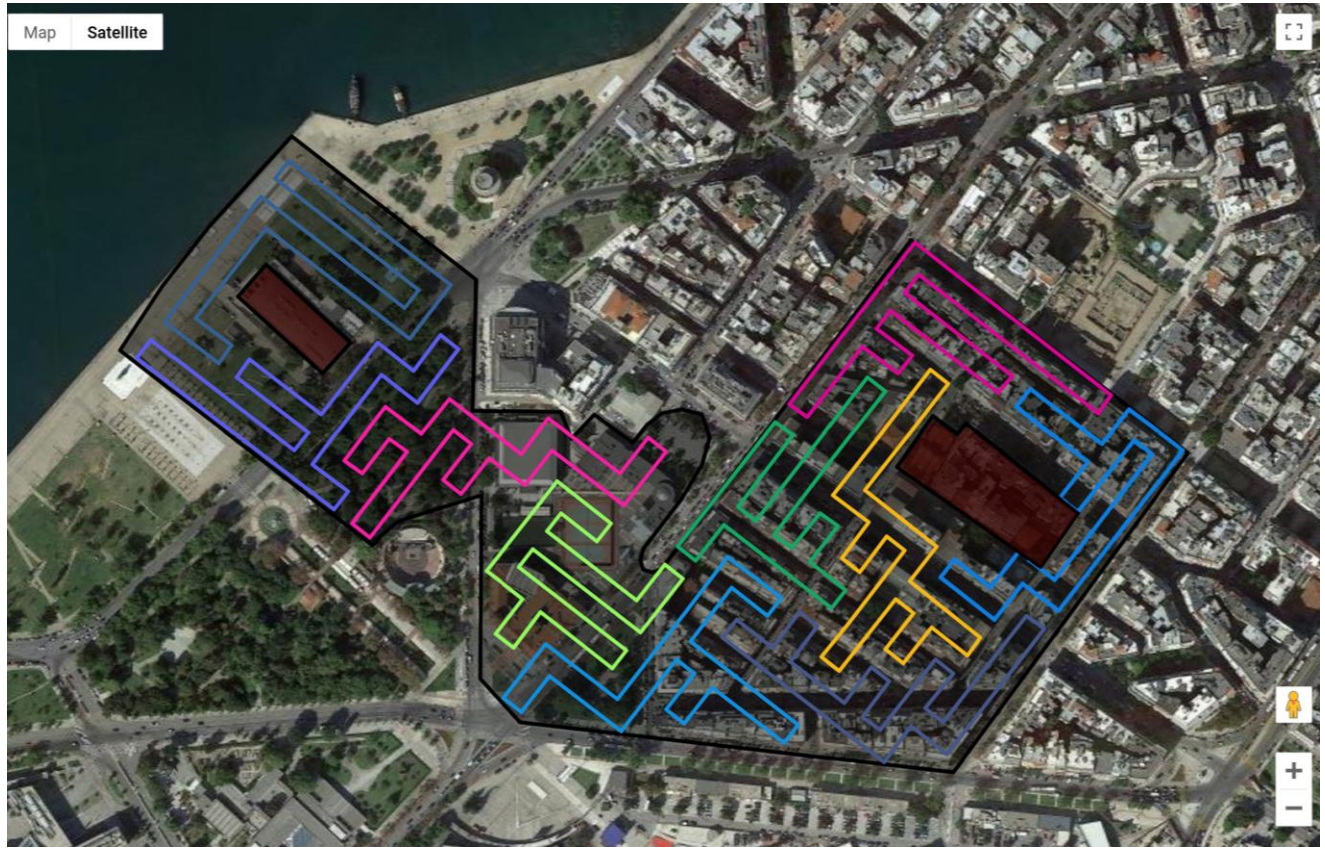


However

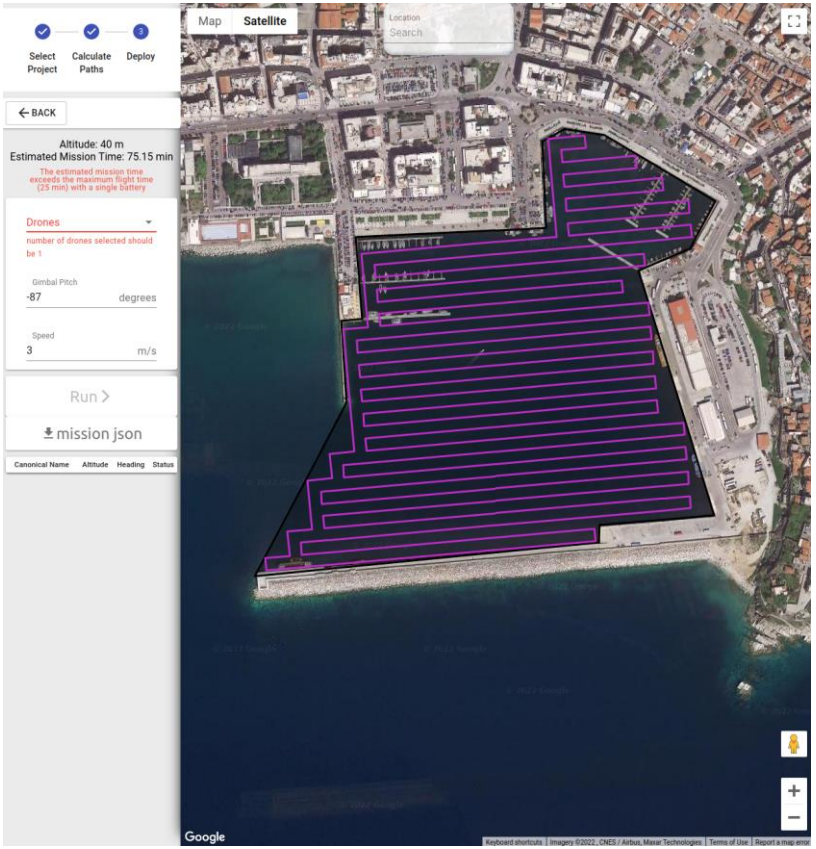
1. Need for  simultaneous management
2. Job assignment 
3. Areas with complex geometry, obstacles, no-fly zones 

Our platform

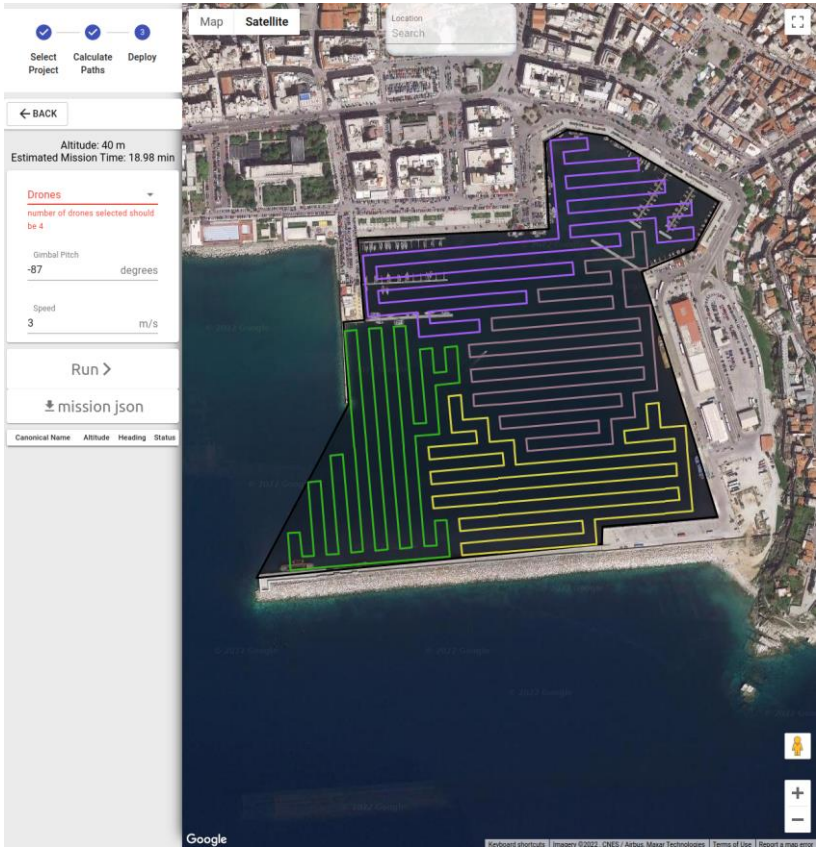
- Real-life optimal missions
- Attributes
  - Multiple vehicles
  - Complex areas with “no-fly zones” and obstacles of arbitrary geometry
  - Energy efficient trajectories
  - Division in areas so that each drones spends the same/optimal time/energy (allows also for drones with different capabilities)



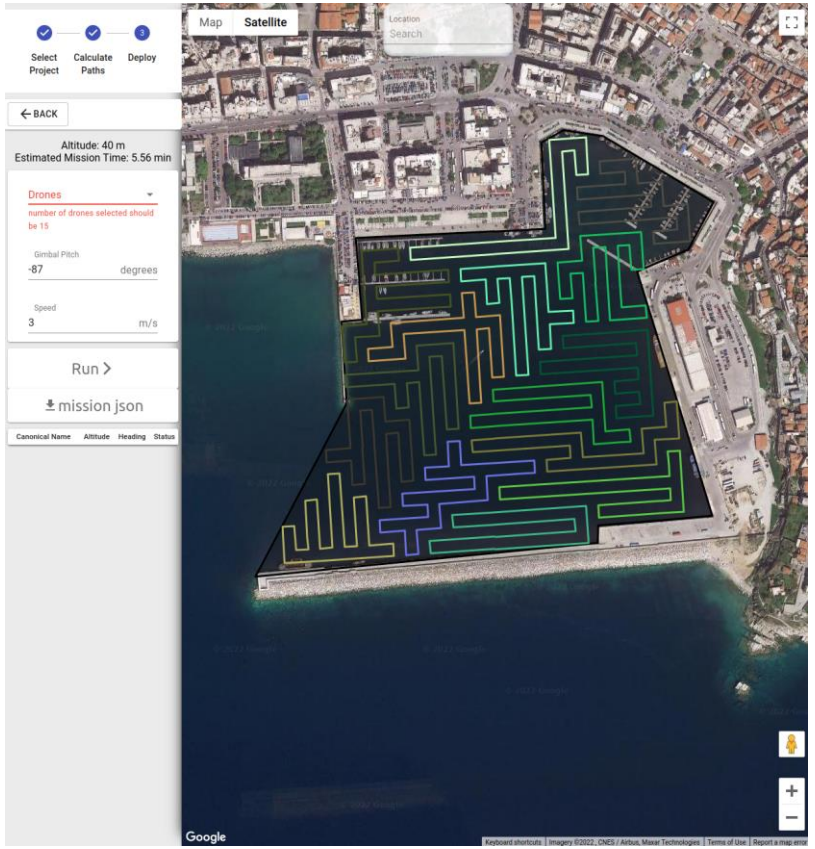
Examples (no drones 1, 4 and 15)



1 drone: 75.15 min



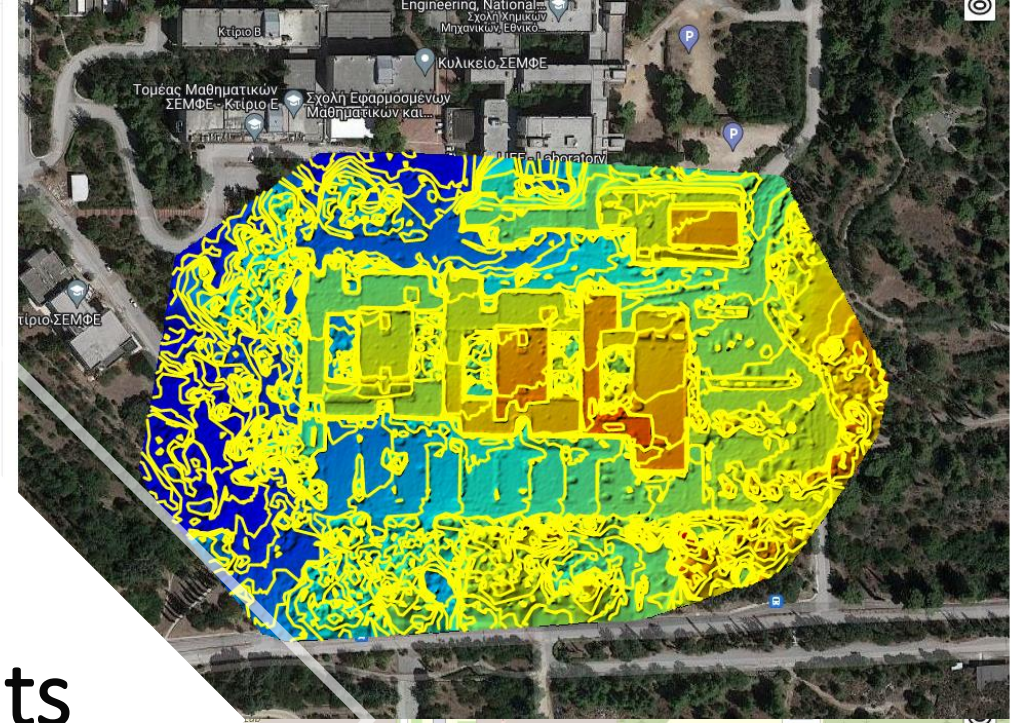
4 drones: 18.98 mins

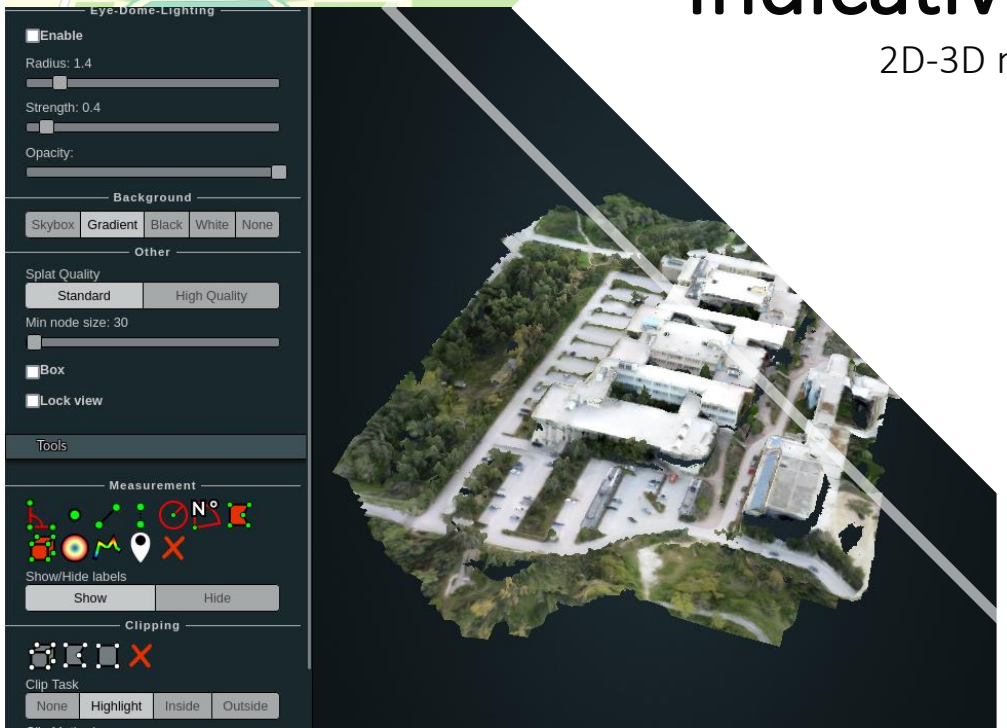


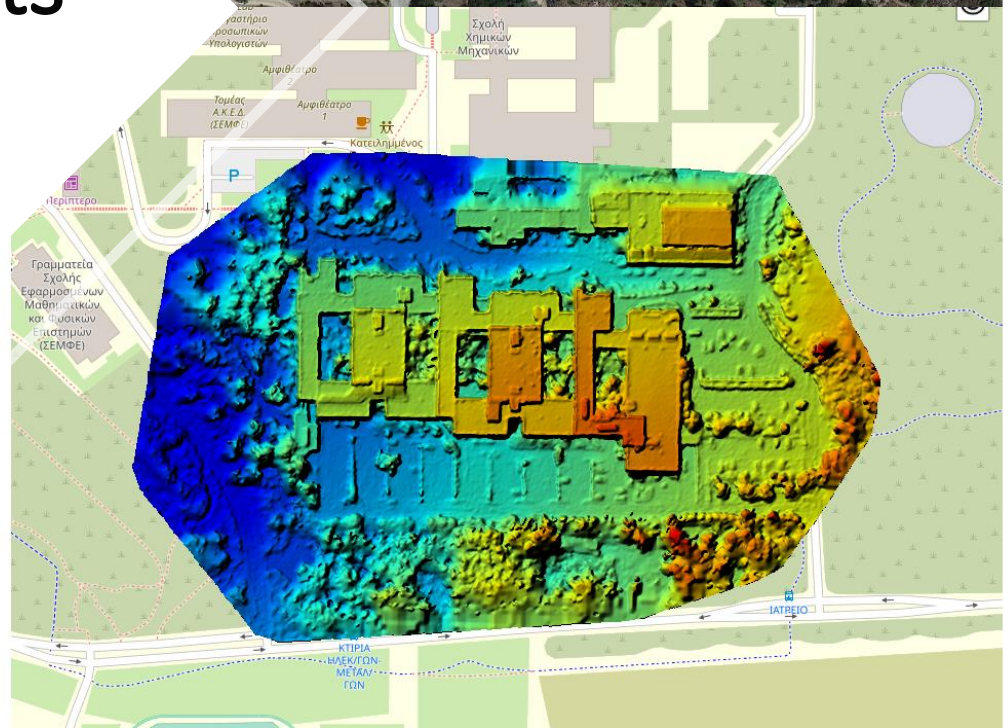
15 drones: 5.56 mins

Indicative Results

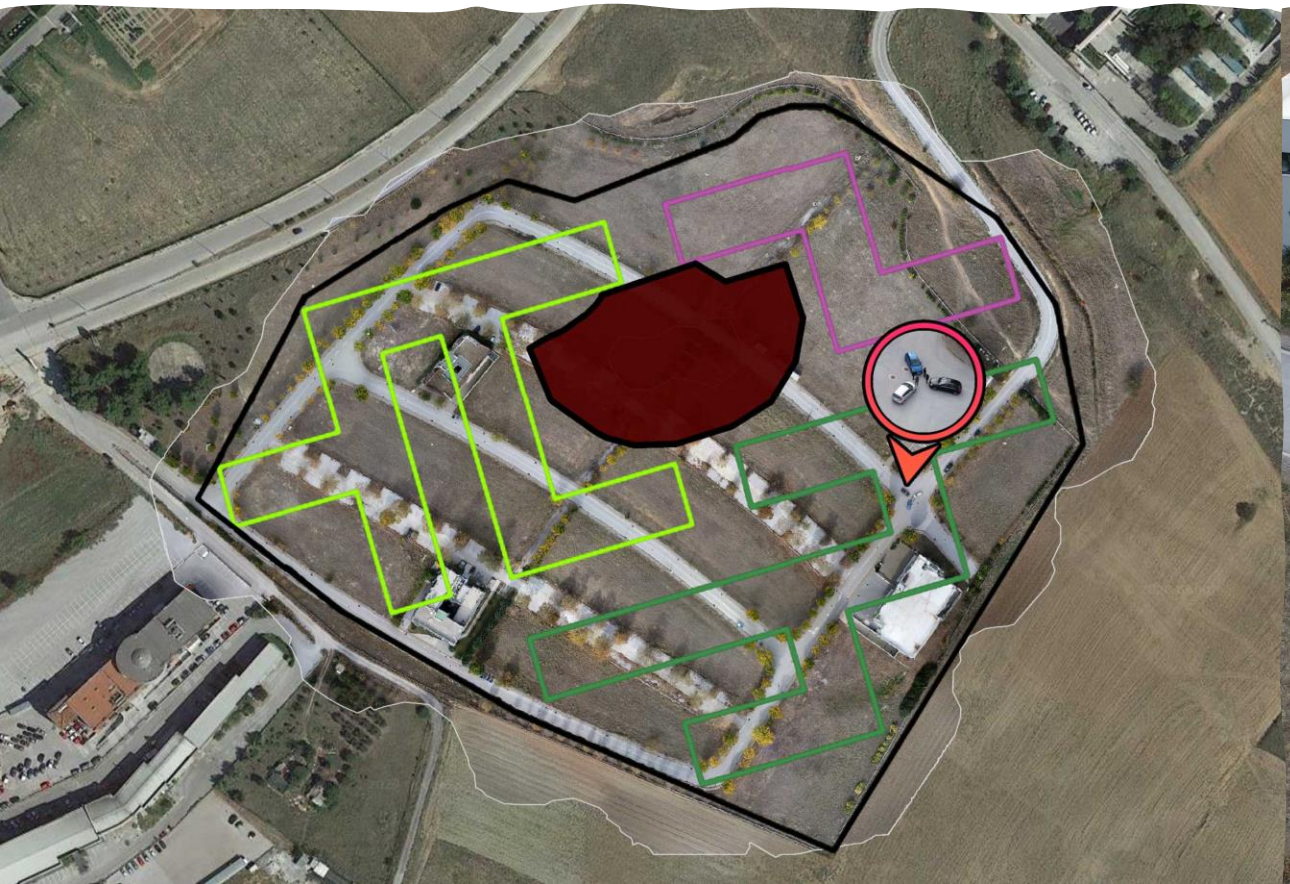
2D-3D mapping

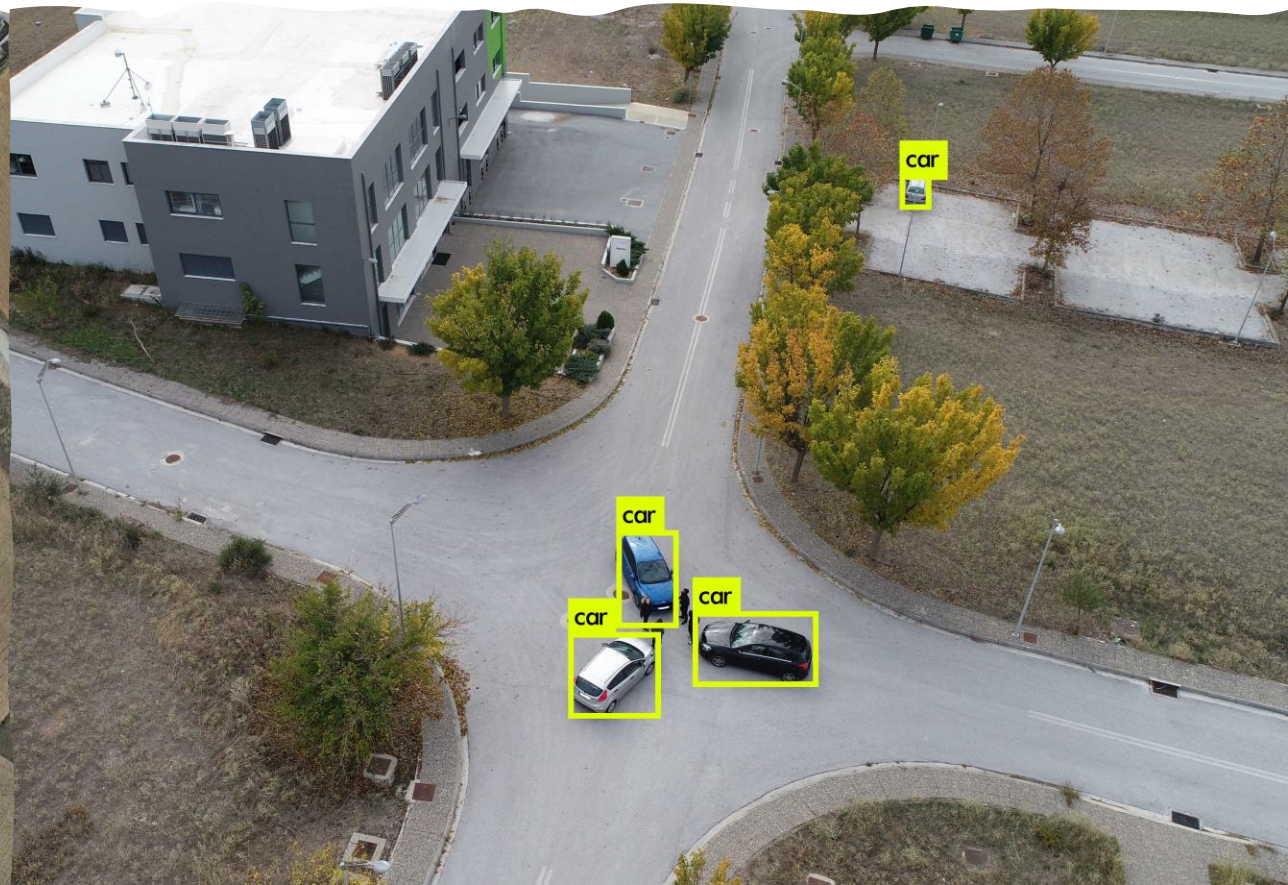






Indicative Results
Detection of Objects of Interest



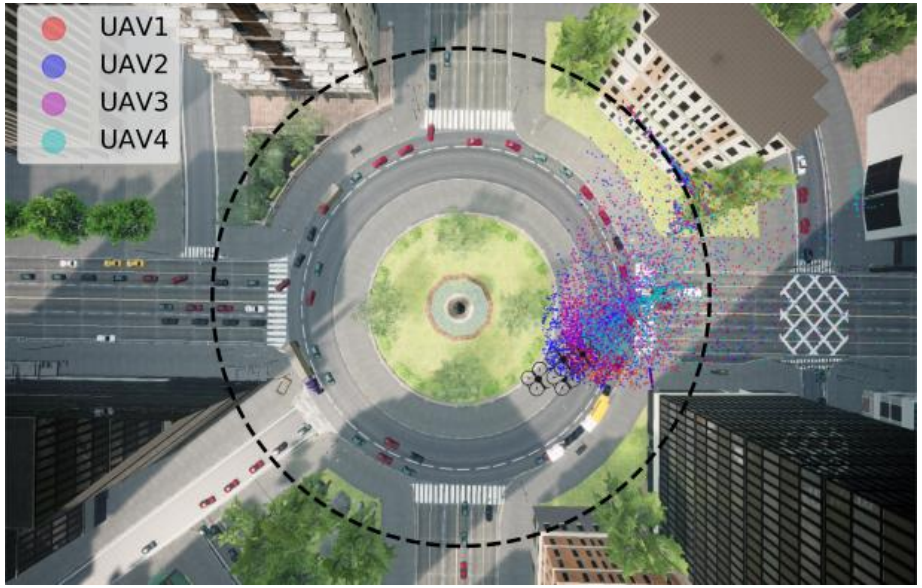


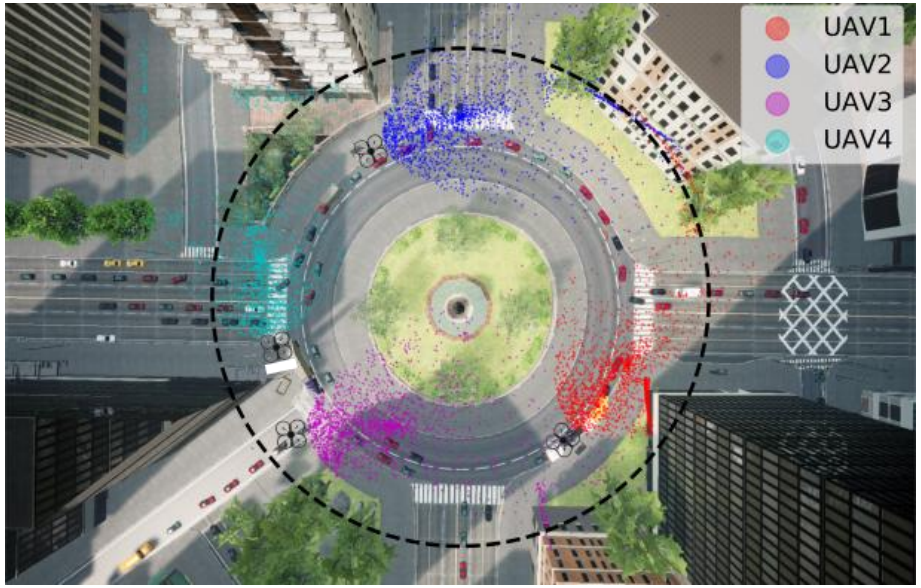
Cooperative/Autonomous Swarm of Drones for Optimal Detection of Mulitple Moving Objects of Interest

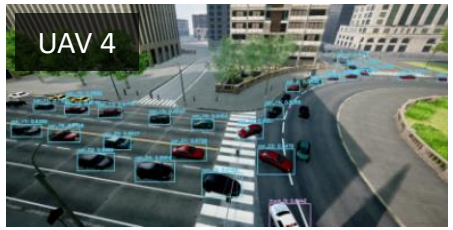
- Given:
  - A swarm of drones/UAVs able to autonomously navigate themselves in real-time
  - A given Area of Interest
  - A number of dynamically moving objects
  - Each drone has an object recognizer (for multiple objects of interest)
- Find:
  - Real-time navigation of drones in real-time to maximize number and accuracy of objects detected/recognized

Example

Moving UAVs in real-time so as to maximize the number and accuracy of vehicles detected/recognized`







Thank you for your attention!!