Automating the design of efficient UAV swarming behaviours

PCOG Yearly Meeting

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Introduction

Covering an area with a swarm of Unmanned Aerial Vehicles (UAVs)

Quality of the coverage by the swarm: $\begin{cases} \text{the coverage speed} \\ \text{the swarm connectivity} \end{cases}$

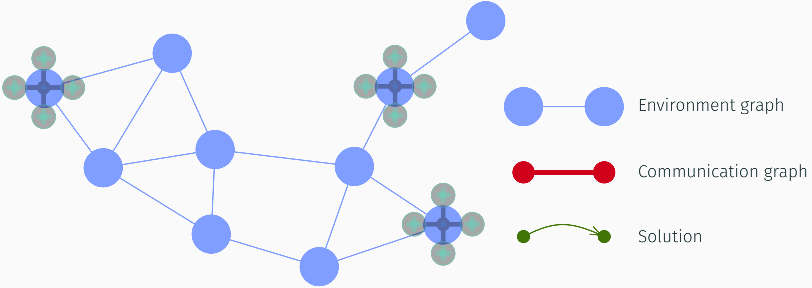
Steps

1. Defining a bi-objective optimisation model
2. Generating distributed heuristics for that model

Optimisation model

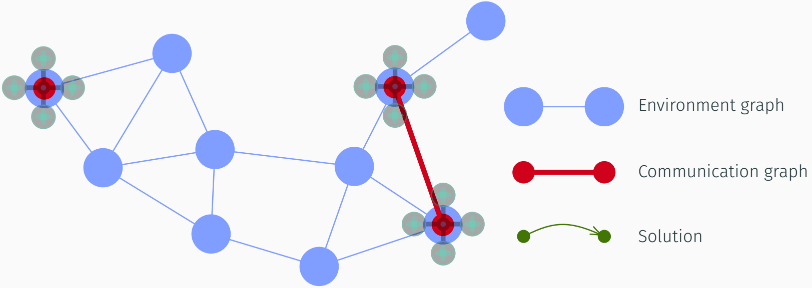
Environment graph

The environment graph is a set of vertices on which the UAVs can move.



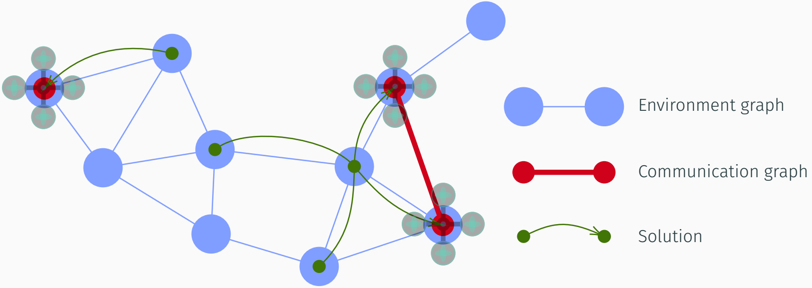
Communication graph

The communication graph links two UAVs close enough for communicating.



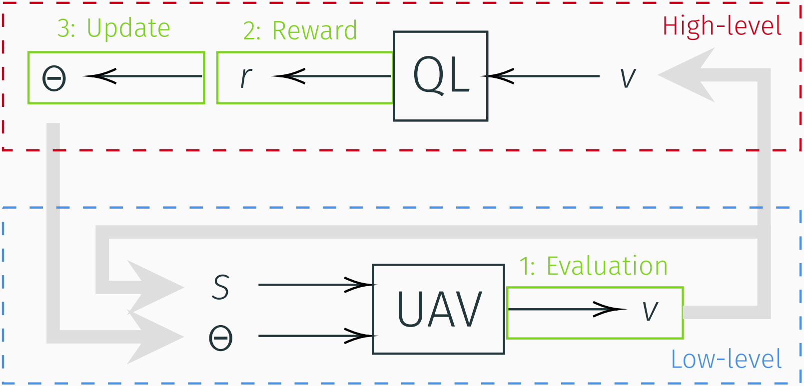
Solution

A solution of CCUS is a set of paths. It is feasible iff the paths are cycles and their union covers the environment graph.



Hyper-heuristic

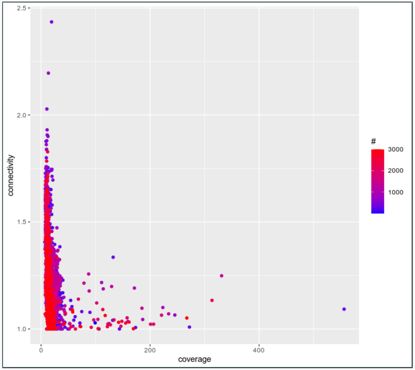
Q-Learning Hyper-Heuristic (QLHH)



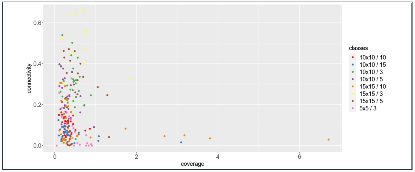
Experiments

Stability

Training (5x5 - 3 UAVs)



Testing



$$s^o(S, I) = \frac{O^o(S) - l^o(I)}{u^o(I) - l^o(I)}$$

with, according to the objective o,

- $O^o(S)$ objective value of the solution S
- $l^o(I)$ lower bound of the instance I
- $u^o(I)$ upper bound of the instance I

Conclusion

Future works

→ Studying more instance classes

→ Considering Pareto-based approaches

- Being more flexible according to the context

→ Adding a new objective to the optimisation model

- Considering more complex scenarios
- e.g. an objective for tracking a target