Wireless Networks
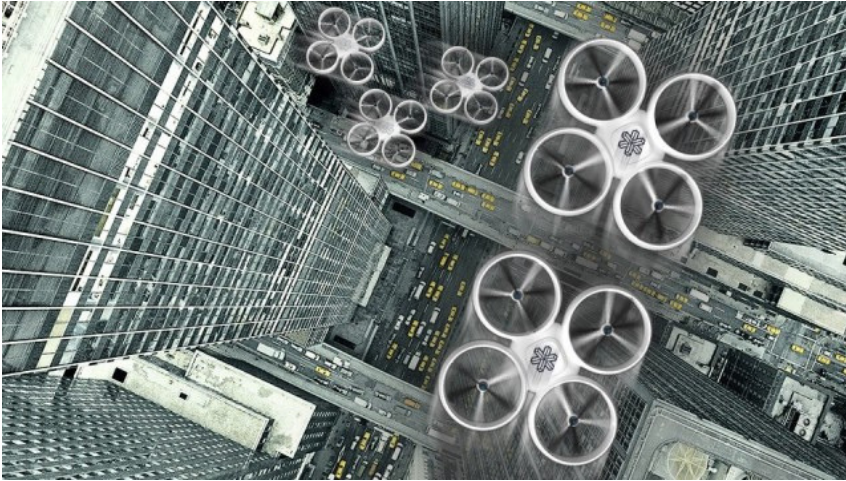
University of Padua
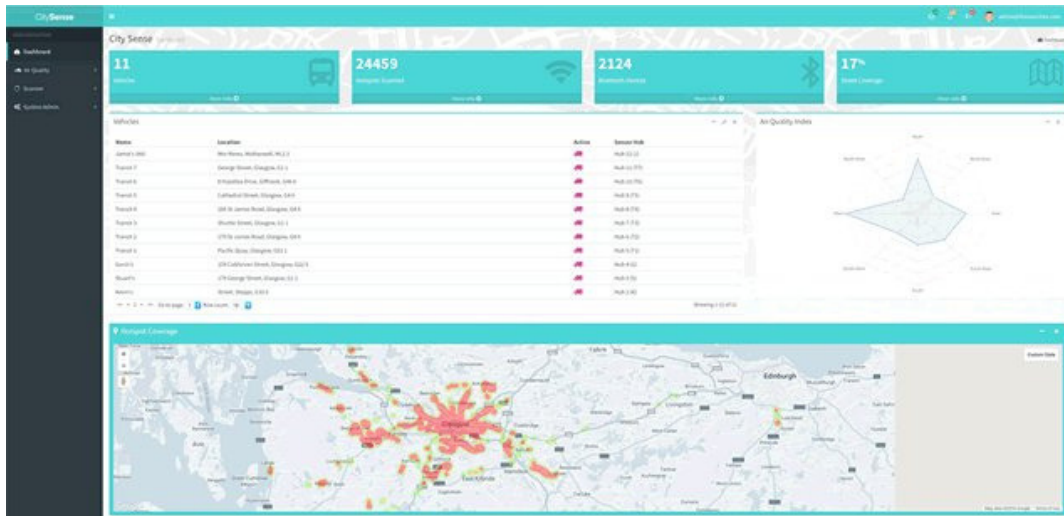
A Survey of Drone Networks, Drone Swarms and Air Pollution Monitoring Systems

Casagrande Marco - 26/02/2018

Survey Overview

Drone networks and swarms

Air pollution sensing and monitoring

Air Pollution

Low-cost sensors

Hive UAV,
Scentroid

Wireless Sensor Networks

Static SNs

+) Accuracy, loose contraints

-) Immobility, coverage

Vehicle SNs

*) In between SSNs and CSNs, unique pros and cons
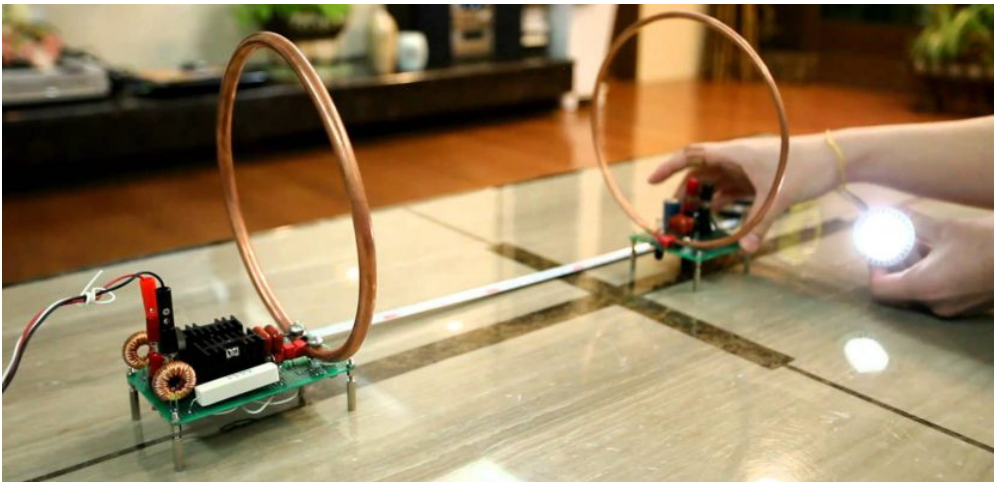
Community SNs

+) Cost-efficiency, coverage

-) Inaccuracy, unreliability, privacy

Drone Networks

Challenges:

- Vertical axis
- Constraint-driven
- Lack of standards
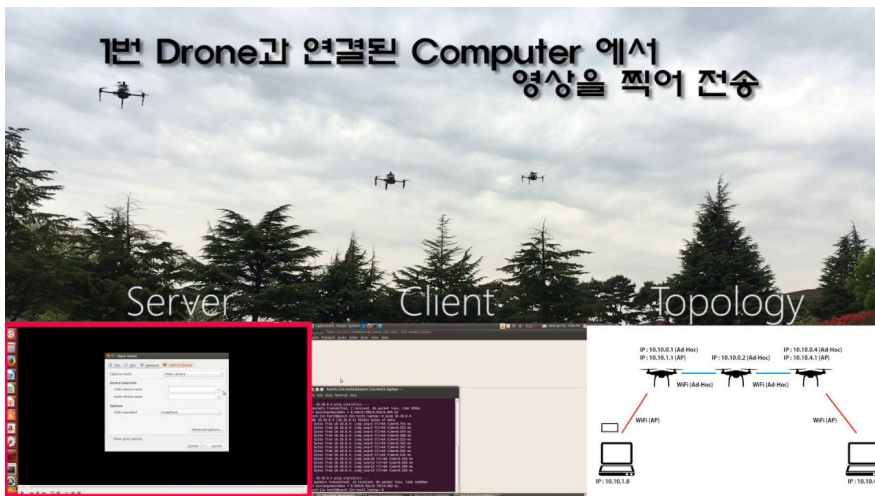- Different requirements for difference scenarios

Wireless Power Transfer

Drone Systems

Centralized systems

- Motion capture system
- Central controller
- Controlled environment

Decentralized systems

- Ad-hoc networks
- Internal controller
- Communication between drones
- Many issues

Drone Swarms

Improving efficiency through wider coverage and unit specialisation

- Artificial, continuous and discrete swarms
- Cognitive infocommunication

Drone Monitoring and Sensing

Pros:

- Mobility, manouverability, flexibility
- Vertical deployment
- Cost-efficiency (mainteinance, specialisation)
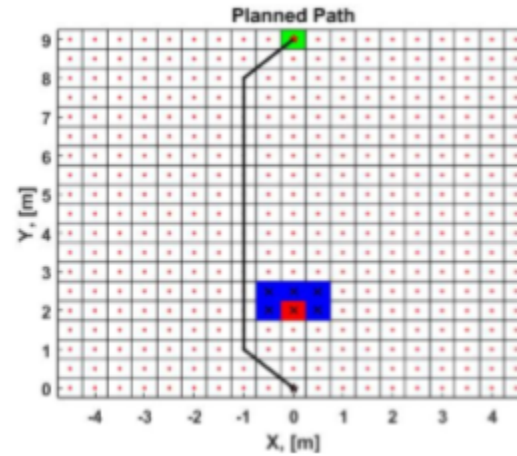- Dynamic adaptation (behaviour)

Cons:

- Low-cost sensors => inaccuracy
- Bad weather conditions => low performance
- Constraint-driven => low autonomy
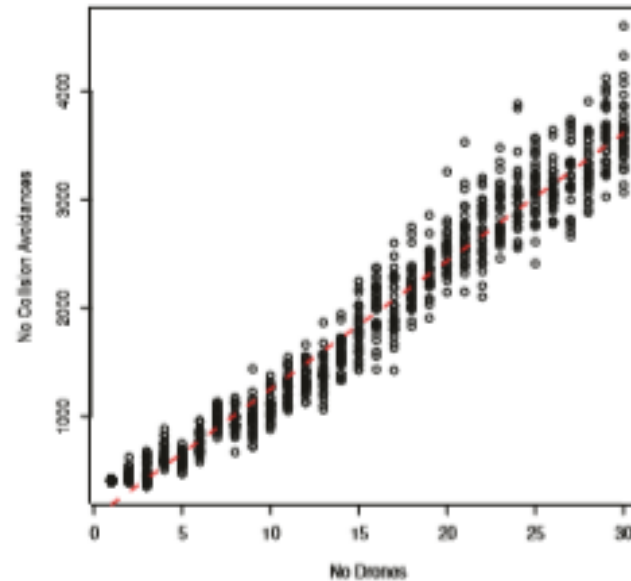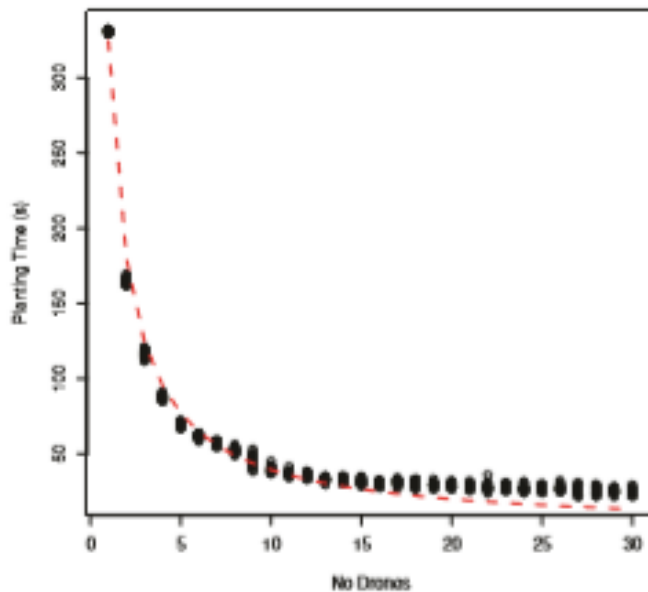- Real-time communication => unreliability

Drone Movement

Coordination

Spatial management

Collision avoidance

Data Dissemination

Propagating information to other entities: drones, stations...

Goals:
- Time and resource efficiency
- Dynamic adaptation
- Improved data integrity

Different approaches:

- Simple broadcasting
- Base-to-field-to-base traveling entity
- Future path evaluation
- Data samples tracking (flags)

Conclusion

- Drones are valuable assets for air pollution monitoring, but only in specific scenarios (emergency, accuracy not required, controlled environment)
- Energy autonomy and weather conditions are major drawbacks
- Standards not defined yet
- Further research is needed to develop algorithms (collision avoidance) and protocols (communication)