Heterogeneous airborne drones in flotilla formations for infrastructure surveillance missions

For large utility companies such as EDF (electricity) and the SNCF (railroads), the need to have flotillas of drones to monitor their widespread infrastructures, has become a necessity. However, the different flight modes of drones makes their inter-operability difficult. The AIRMES Project focuses on inter-drone communications to improve on their capacity to fly and manoeuver in safe formation.

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In the field of aerial drones, whereas it is now relatively easy to control a single vehicle and even a fleet of homogeneous machines in flight formation, when you have to control a set of heterogeneous vehicles (different sizes, propulsion units ...), the situation is one of 'sensitive aerobatics'. This is all the more self-evident when the machines are supposed to communicate and coordinate their moves to carry out a specific mission, or where an individual drone is supposed to carry out one task as a function of the other drones' situations/assignments.

This is the overall objective of the AIRMES Project "Heterogeneous drones in air-fleet formations" as registered in the framework of the 20th call for projects under a single, interministerial funding scheme. Certified by the 'Pégase' competitivity pole and co-certified by three other poles, viz., Astech, i-Trans and Mer Méditerranée, the research programme is entrusted to the UTC-Heudiasyc Laboratory (UTC and CNRS) in a partnership with the national electricity utility EDF, the rail company SNCF and Aéro-Surveillance, a drone company (assembly and integrated systems). The project is supervised by Eurogiciel, a service sector company specialists in project assistance.

Co-operation to detect abnormal conditions

For large utility companies such as the SNCF and EDF, the need to monitor their widespread infrastructures, grid equipment and networks is vital but also leads to high-level costs in a context of high level technological challenges. There is no doubt that aerial drones have a role to play, both in terms of safety and also for maintenance surveillance campaigns.

"Today we indeed frequently use drones for this sort of mission", explains Flavien Viguier, science & technology executive working for SNCF on the AIRMES project. However, to be able to operate a fleet of heterogeneous drones flying in formation, each equipped with specific sensors and analytical software for a given scale of inspection calls for a sophisticated level of co-ordination. "For example, a first drone dispatched to a site may detect large scale defects and then signal this to another drone with other different sensor equipment which will then move to the site and carry out an in-depth inspection of the potential, abnormal situation", explains Flavien Viguier.

Communicate to take action together

The task may appear simple but the implication is that machines with different flying modes should be capable of keeping close formation with each other and able to co-ordinate their actions so as to attain the best possible analysis of the situation. "The main challenge in this project is to develop a secure communication exchange among the drones", explains Flavien Viguier.

On one hand, these aerial robots must be able to fly without colliding into each other and, on the other, we must be in a position to guarantee that no jamming of the communications between drones and command centre is possible. "The communications control box is limited in size, to comply with the world of airborne drones and also to ensure safe data exchanges with the machines which are vital to success in accomplishing the missions", adds

Flavien Viguier.

Steps towards machine autonomy

The aim of AIRMES is to incrementally progress towards machine autonomy. Today an aerial drone is necessarily " monitored " by a pilot who can intervene if needed to abort/modify a mission. In, for example, the SNCF rail surveillance programmes, an SNCF expert backs up the pilot to provide his professional experience and, if need be, take decisions to optimise the mission in compliance with French railroad regulations.
The AIRMES team wish to demonstrate that it is possible to improve notably on communication and fleet autonomy reducing the number of pilots and securing safer flights. With this aim in mind, the first phase of the project is to control a fleet in flight with several pilots and then move to a single pilot configuration. Progress here will be attained by increasing the level of autonomy of the drones enabling them to analyse the sensor images and take appropriate action in pursuit of the assigned mission objectives. Detection, image analysis, pattern/object recognition, decision protocols and coordination of actions ... operating a flotilla of aerial drones raises numerous questions and challenges. The AIRMES project should commence in early 2016. The actors will then have three years to come up with valid answers to the questions raised ... and to discover and frame new questions for the future.