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Multiple Airdrones Response System in forest firefighting

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M.A.R.S., Multiple Airdrones Response System, is an innovative platform for environmental monitoring. Monitoring is a prerequisite to design a land management plan to maintain its biodiversity and health, in order to optimally avoid the risk of hydrogeological instability and disaster, e.g., floods, volcanic eruptions, earthquakes, wildfires. The innovative potential of the M.A.R.S. project lies mainly in the ability to manage the logistics of drone swarms and in the modularity of the platform infrastructure, which is easy to move and equipped with an integrated system for automatically replacing payloads carried by drones, such as batteries, instruments, sensors, and disposable materials.
The platform is composed of several subsystems: one or more landing pads, a controller for the platform operation management, a cartridge case and a hive for the storage of payloads and drones respectively. In summary, M.A.R.S. drones are served, supplied, and housed, similar to a multi-copter drone carrier.

This type of technology would launch new possible applications in contexts where the use of Unmanned Aerial Vehicles has not yet been hypothesized, overcoming the current limits thanks to the use of individual drones in swarm configuration and to the possibility of extending the flight time by changing the batteries.
Therefore, we propose and demonstrate the applicability of M.A.R.S. in forest firefighting, as fires constitute the most critical and widespread threat to Mediterranean forests. After computing the critical water flow rate according to the main time-varying factors involved in the evolution of a fire, we obtain the number of linear meters of active fire front that can be extinguished depending on the amount of fluid carried by the available drones. Finally, by means of a cellular automata model, the development and evolution of a Mediterranean scrub fire are simulated and the change of the fire area over time is estimated both without any extinguishing effort and in case of M.A.R.S. drones intervention.

Parallel to the work of scientific research, computation, and simulation, we started to build the platform and test the technologies to be implemented for the concrete development of the system. Since precision landing is of fundamental importance to the project, flight and landing tests were performed. The purpose of this in-depth study was to verify the landing error range using two hexacopter drones (DJI F550 and S900) on which two Pixhawk Flight Controllers and two different GNSS RTK modules were mounted, also comparing the results with those obtained using GPS only.

M.A.R.S. is based on an industrial patent (2016) owned by Inspire S.r.l., start-up and spin-off of the University of Genoa. The project is by its nature highly interdisciplinary, as is the professional knowledge that characterizes the members who make up the working group.
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