Autonomous unmanned helicopter systems for cross-country low-altitude remote sensing

Our SMR-1 helicopters are designed to be operated safely and efficiently without a human pilot for capturing data with high-quality sensors in any terrain.

Description

CSIRO has been developing autonomous\(^1\) single rotor helicopters for low-altitude cross-country flight in non-populous areas for more than a decade. The helicopters have been successfully deployed for weed survey applications (Merz, et al., 2016)\(^2\) and crop monitoring (Chapman, et al., 2014). They have also been successfully tested for remote infrastructure inspection in unknown environments (Merz, et al., 2013)\(^3\).

We utilise a modular design concept to accommodate for a large variety of applications (Merz, et al., 2011)\(^1\). For every new application, we optimise the sensor payload, the aircraft control system and tools for flight planning enabling the aircraft to deliver high-quality data efficiently without compromising safety. Our solutions also include tools to facilitate the analysis of remote sensing data and flight data.

Our prototype systems have been developed to Technology Readiness Level (TRL) 6/7. They are based on a small-size RC helicopter but are designed to be scalable to larger aircraft which offer more payload capacity and endurance. Currently, the technology is being integrated into a Yamaha RMAX helicopter with a gross weight of nearly 100kg.

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\(^1\) We define autonomous aircraft as an aircraft that does not require a human pilot to dependably fly a specified mission in a specified environment.


\(^3\) [https://confluence.csiro.au/display/AAR/Aircraft+Autonomy+Research](https://confluence.csiro.au/display/AAR/Aircraft+Autonomy+Research)
Key features

- flight operations with minimal user interaction and training
- easy helicopter transport in a SUV or small van and setup in less than 30min
- autonomous take-off and landing at suitable locations (10m diameter open space, slope<5°)
- GPS-based 3D trajectory following within specified control error tolerances
- detection and avoidance of static obstacles and terrain following flight mode
- health monitoring and fail-safe modes including onboard flight planning to emergency landing sites
- human operator initiated aircraft avoidance, mission abort and flight termination over a long range radio link

Current helicopter specifications

- 12.4kg gross weight, 1.78m rotor diameter, 22.5cc petrol engine
- ~1h endurance with 1kg user payload (without obstacle avoidance and terrain following system)
- 5m/s cruise speed, 10m/s maximum wind speed, >1200m AMSL altitude (ISA conditions)

- multi-view angle camera payload for operations in mountainous terrain and multi-spectral camera payload for crop monitoring, cameras managed by flight computer and all images geo-referenced
- flight plan generation for operations in mountainous terrain incorporating environmental, aircraft, airspace and sensor payload constraints
- sensor payload data visualisation and analysis

References


