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Experiment results on test methods for detection and avoidance (DAA) systems for unmanned aircraft systems

Résultats d'expériences sur les méthodes de test des systèmes de détection et d'évitement (DAA) pour les systèmes d'aéronefs télépilotés

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Foreword

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Introduction

With rapid technological advancements, unmanned aerial systems (UAS) technology is continuing to become more autonomous in operation and accessible to consumers. Today, the use of UAS technology is not only prevalent for entertainment purposes but also extending into more various industrial applications such as logistics, disaster relief, powerline inspection. There is an increasing number of UAS operations in low altitude airspace where the safety considerations can be quite complex, especially in the context of urban areas. All types of UAS operating in such areas must be able to avoid ground obstacles like high-rise buildings, cranes, public utilities such as power grid and mobile network antennas, along with airspace users that share the same airspace such as low-flying helicopters, UASs and kites. Micro-weather patterns also pose a challenge by bringing about uncertainty, invisibility, and unpredictability.

A detection and avoidance (DAA) system is one of the key onboard systems to address these challenges. By sensing the surrounding situations, the DAA system can examine the size and distance of a particular obstacle, apply trajectory planning, and then calculate the possibility of collision. It orders the flight control system to make UAS slow down, fully stop or completely offset the obstacle in a fully autonomous manner. The function and performance of the DAA system is closely related to its safety speed, which has a direct impact on the scope of UAS. Failure detection also causes instability and unexpected braking.

A related document about the DAA system, ISO 15964, is currently under development and will focus on the standardization of hardware and software of each component of DAA such as sensors, computers, and interfaces. There is an expectation that there will be further work to standardize the test and evaluation methodologies of DAA capability to ensure that operators' safety and quality meet the minimum requirements, specifically for on-board/off-board DAA systems.

To achieve a safe and secure operating environment, it is significant to develop a technical report that provides examples for test results for the safety and quality of DAA systems. This document will offer reference to latest, detailed real-world applications of modelling and simulation, equipment tests, and flight tests.

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Experiment results on test methods for detection and avoidance (DAA) systems for unmanned aircraft systems

1 Scope

This document provides a report on tests that were performed to ensure the "safety and quality" requirements of detection and avoidance (DAA) systems used between UASs and other objects, including aircraft. This document describes test methods and the results of related experiments, which successfully meet the requirements of a DAA system architecture with radar and optical sensors.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Test subject

DAA targets break down into cooperative, non-cooperative, and other hazards as defined in ISO 21384-3:2023, Table 1 and Table 2. The test subject covered in this document is the applications of non-cooperative DAA systems that are installed onboard the UAS for the operational procedure defined in ISO 21384-3.

5 Evaluation and test method

5.1 General

This document is expected to serve as a useful reference for the standardization work on the test and evaluation methods of DAA capability to ensure that operators' safety and quality meet the minimum requirements.

5.2 Type of detection and avoidance

This document's applications of DAA systems are limited to test evaluations of avoidance of aircraft approaching in flight, including helicopters flying at high speed to the proximity of UAS in flight.

Flight tests to evaluate the avoidance action are consistent with the 6-step operational procedure defined in ISO 21384-3. The applicable relative speed varies across different applications of DAA systems, while this document is limited to the test method of manned aircraft and UAS flying at the relative speed of up to 200 km/h and of UAS and UAS flying at the relative speed of up to 100 km/h.

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