International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)

INFORMATION PAPER

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Santo Domingo, Dominican Republic, 15 to 17 November 2023

Agenda Item 6: Other business

PAPI CALIBRATION USING DRONES

(Presented by FRACS/Heliper)

EXECUTIVE SUMMARY

This information paper presents information about the implementation of the calibration of visual aids to navigation and in particular PAPIs using drones and the CAVOC method used by France Aviation Civil Services in association with Heliper that was certified by the French DGAC.

The meeting is invited to learn about the CAVOC method and to look at its deployment in Latin America in order to facilitate the regular calibration of aids to navigation in the most efficient and economical way.

Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency
References:	• ICAO Annex 14; • ICAO DOC 9157 Part 4.

1. Introduction

1.1 PAPI units' elevation setting angles have to be regularly checked, this is an obligation that should be enforced by national regulations in compliance with ICAO standards.

1.2 The monitoring of PAPI installations and their regular verification often involves the implementation of costly means and the neutralization of airport facilities for a significant period of time. This is the case with flight inspections or the nacelle method.

1.3 An efficient and less expensive method possible is the use of drones as indicated by ICAO Doc 9157 §8.3.43. However, in most cases, as with other common methods, it relies on the judgement of the human eye without ensuring the repeatability of the measurement.

1.4 The implementation of a simple, inexpensive method based on the safe use of drones and ensuring accurate measurement is desirable to ensure regular adjustment and calibration of PAPI units for all aerodromes.

1.5 Today's technology makes it possible to envisage these measurements thanks to the implementation of drone calibration by automatically exploiting the drone's imagery with guaranteed accuracy and repeatability of measurements.

2. Discussion

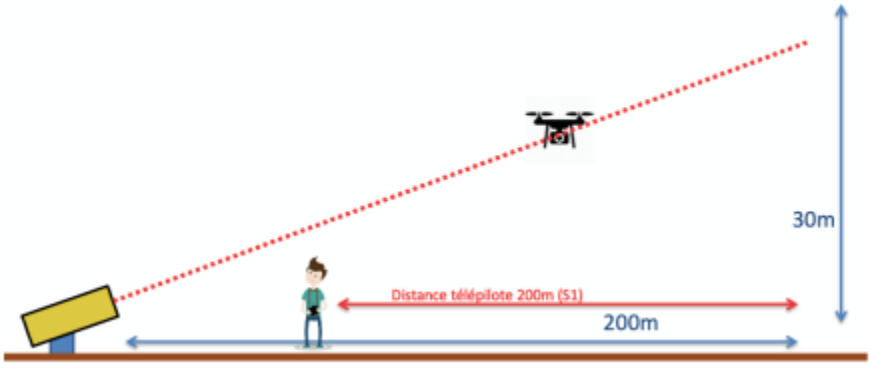
2.1 The CAVOC method (Calibration of Visual Aids by Colorimetric Objectivity) was developed in collaboration between the Flight Control Unit (CEV) of the Department of Technology and Innovation (DTI) of the French DSNA (Directorate of Air Navigation Services) and the Defense Calibration Centre (CCD).

2.2 The objective of the CAVOC method is to ensure the measurement of the elevation setting angle of a PAPI unit, including both the measurement system (or equipment) intrinsic to the drone according to a well-defined measurement protocol. This method was developed as an alternative to other methodologies commonly in use: flight control, nacelle or alidade, which were previously required for periodical checks of PAPI units, as these methods were particularly time-consuming and expensive.

2.3 The emergence of this new method based on new technologies required evaluation and validation by the French supervisory authority, the Direction de la Sécurité Aérienne (Directorate of Aviation Safety), which relied on the Civil Aviation Technical Service (STAC) to compare the different PAPI calibration measurements.

2.4 The advantages observed for the CAVOC Drone system during the experiment are the followings:

- Measurement system that is easy and quick to implement (general installation, synchronization of the drone with the reference station) allowing a reduction in runway occupancy time (time required to set up the 4 PAPI units estimated at 20 minutes);



Easy-to-implement method

- Measuring system allowing rapid clearing of the runway in case of emergency or if necessary, without disruption to traffic; and
- Direct and automated measurement of the setting angle of a PAPI unit (limiting the risk of misinterpretation by a human observer).

2.5 All the parameters monitored (accuracy and measurement fidelity) of the CAVOC Drone method respect the defined limits. The analysis of the results obtained thus made it possible to obtain validation by the French authorities.

2.6 The method is based on an automatic detection of the color transition in real time, using image processing algorithms. In particular, it has the advantage of allowing real-time adjustment of the PAPI.

Real-time color transition detection

2.7 The flight is carried out safely:

- The drone is equipped with an ADS-B receiver;
- The drone can land in case of emergency in a matter of seconds (automatic Return-To-Home);
- The flight is carried out visually under scenario S1 (maximum distance of evolution: 200 m from the remote pilot);
- A virtual barrier can be defined, adjustable in distance and height, in order to limit the area of evolution of the drone; and
- The drone and the station as well as all the equipment used are frangible.

2.8 France Aviation Civile Services, created by the French DGAC to share its know-how, has joined forces with the company Heliper, to promote and implement the CAVOC method in Latin America and thus allow the verification and inspection of the many PAPI installations in the region in an efficient and economical way.

2.9 The implementation of the CAVOC method on aerodromes, particularly those not equipped with ILS, is expected to provide safety and economic benefits.

2.10 Work is underway to develop methods based on the same principles for ILS. These are expected to be completed by the end of 2023 and will enable ground-based calibrations with the aim of reducing the frequency of in-flight inspections of landing aids.

3. Conclusions

3.1 The CAVOC method used by France Aviation Civile Services in association with Heliper has been certified by the French DGAC.

3.2 It provides the required measurement accuracy and repeatability, unlike many other methods based on the human eye,

3.3 In addition, operated by or with a technician who is an expert in the adjustment of visual aids, it instantly makes it possible to correct the defects observed during calibration, to adjust the PAPI and to immediately perform a calibration to verify the operationality of the device.

3.4 As the drone system used is a small commercial drone to which software functions have been added, it is transportable and operable anywhere without any particular transport complication.

3.5 Operated in accordance with the regulatory framework in force for drone operations, it offers great flexibility of implementation without major constraints on the operation of the aerodrome. This is particularly true for aerodromes that are not equipped with ILS and are not subject to regular flight inspections.

3.6 For aerodromes equipped with ILS, the implementation of drone calibration under study can provide regular adjustments and maintenance to reduce the frequency of in-flight inspections while maintaining the required level of safety.

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