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**SOUTH AMERICAN AIG REGIONAL COOPERATION MECHANISM (ARCM)**

**FOURTH AIG AUTHORITIES MEETING**

(Brasilia, Brazil, 23 to 25 May 2017)

**Agenda Item 12: Other matters**

**3D AIRCRAFT ACCIDENT RECONSTRUCTION AND ANALYSIS SYSTEM**

(Presented by CENIPA-Brazil)

**Summary**

The purpose of this working paper is to present an aircraft accident site analysis and reconstruction system capable of producing a high-quality 3D digital model from high-resolution geo-referenced digital aerial photographs and shoots obtained from a small unmanned aircraft system (UAS/drone).

- Annex 13 – Aircraft accident and incident investigation
- Doc 9756 – Manual of Aircraft Accident and Incident Investigation

**1. Introduction**

1.1 The implementation of the aircraft accident site analysis and reconstruction system seeks to provide an accurate context of the actual conditions at the accident site to the investigator in charge, thus improving the decision-making process, modernising aircraft accident investigation techniques, reducing operating costs, and maximising the efficiency of the work done by the investigation committee throughout the investigation process by SIPAER.

1.2 The aircraft accident site analysis and reconstruction system will consist of:

| Item | Description   |
|------|---|
| 1    | Small remotely piloted aircraft for the acquisition of digital, geo-referenced aerial photographs and shoots. |
| 2    | Licensing of software for the generation of detailed 3D models from digital photographs.                      |

**2. Definition of the problem – Justification**

2.1 Difficulties in planning and representing the wreckage in a reliable manner. The extension of the wreckage area and the terrain often hinder substantially a thorough examination of aircraft parts, so that the production of a high-resolution and quality sketch is severely hampered.

2.2 Difficulties in obtaining aerial images (photographs and shoots). The field investigator often needs to ask for assistance from third parties--who are alien to the investigation process--to obtain

aerial images. This work is normally performed off schedule, which compromises the independence of the field investigation team.

2.3 Difficulties in finding missing parts and pieces. Depending on the extension of the damage and the geography of the site, it becomes very expensive in terms of time and money to conduct a search for the missing parts of wrecked aircraft. Coverage of extensive areas in the proper timeframe is critical for the field investigator.

### 3. The solution found – 3D aircraft accident reconstruction system

3.1 CENIPA started conducting studies in early September 2015, in an attempt to reduce, if not eliminate, the impact of the three aforementioned factors. In this sense, it has been shown that the use of small drones with the following basic characteristics support 3D reconstruction and analysis of aircraft accidents:

- Easy manual piloting, automatic flight, take-off and landing functions, as well as hovering capabilities for capturing oblique (panoramic) and vertical (for mapping) images;
- Capable of monitoring and reporting, through telemetry, its altitude, position, and battery charge to the pilot, and automatically maintaining its altitude and geo-referenced position without intervention of the operator;
- The photographs and images produced by the UAS/drone, as well as the UAS/drone itself, shall be compatible and fully integrated with the 3D modelling software.

In conjunction with 3D modelling software of the following basic characteristics:

- Production of high-quality 3D models for recreating all types of aircraft accidents from digital photographs taken on the ground and by unmanned aircraft systems (UAS/drones);
- 3D models shall be precise and accessible so that the software may develop accurate reality meshes and 3D models from pictures taken with a simple digital camera (on the ground or on board a UAS/drone), providing fine details, defined contours, and geometric precision;
- Integration of geo-referenced data, supporting various types of positioning data, including GPS tags and control points. Also capable of importing any other positioning data, allowing the user to accurately measure coordinates, distance by air, and volumes;
- Automatic aerial triangulation and reconstruction, allowing the user to calibrate all images, automatically identifying the relative position and orientation of each photograph;
- Generation of 2D and 3D geo-referenced models in a wide variety of GIS or similar formats, high-resolution orthomosaics, and export of aerial triangulation to KML, XML, or similar compatible formats.
- Production of models of any size for publication on the web, capable of being seen through a free visualizer, allowing for instant exchange and display of 3D models.

3.2 **Appendix A** to this working paper describes the system and its operation.

### 4. Status of implementation

4.1 The system acquisition process was completed in December 2016. The implementation timetable has been as follows:

- 13 - 07/04/2017 – Reception of 3D hardware and software.
- 13 - 17/03/2017 – Course on drone and 3D software operation.

- Adjustment of operations up to 30/04/2017:
  - ✓ Development of CENIPA operational standards
  - ✓ Development of Operating Manual
- Drafting of an Operational Agreement with the Airspace Control Department by 30/04/2017.
- Testing in the operational flight system of the software.
- Full operation expected by 28/04/2017

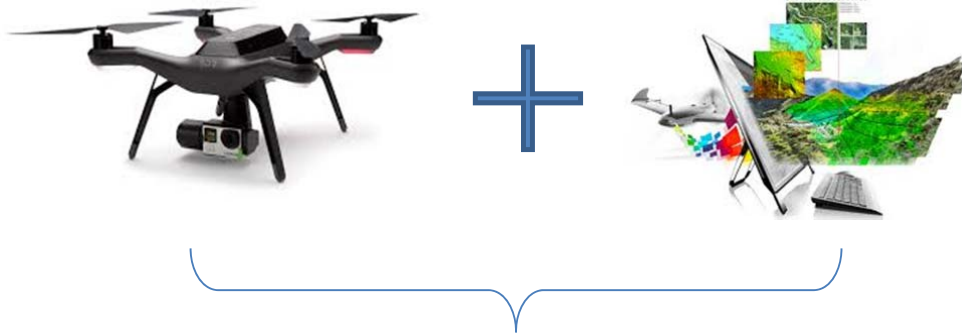
## **5. Suggested action**

5.1 The Meeting is invited to consider the implementation of a similar system in the ARCM for field activities of SAM regional investigators.

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## APPENDIX A

### 1. Overview of the 3D system concept



**a – Image collection by field team**



**b – Analysis of images and laboratory work for 3D modelling**



**c – Examples of some finished products (system testing phase)**

