

International Civil Aviation Organization

ICAO

**Twenty Fifth Meeting of the Communications/
Navigation and Surveillance Sub-group (CNS SG/25) of
APANPIRG**

Video Tele-Conference, 18 – 22 October 2021

Agenda Item 12: Discuss and share experience and application of new technology, including big data analysis, artificial intelligence, Digital Tower, counter UAS detection and identification system, UTM, etc.

**TRIAL INSPECTION ON CNS OUTSTATIONS BY DRONE TO ENHANCE
MAINTENANCE WORK IN HONG KONG, CHINA**

(Presented by Hong Kong, China)

SUMMARY

This paper provides information about a trial conducted by Hong Kong, China to explore potential applications and benefits of using drone to support maintenance work for CNS facilities at remote outstations, and encourage States/Administrations to consider cost effective and proven technologies to enhance CNS maintenance work.

1. INTRODUCTION

1.1 With rapid advancement of civilian drone technologies and increased affordability, drone has created many interesting and innovative applications. For example, site inspection, geographic mapping, surveying, photography, videography, delivery, and emergency response, etc.

1.2 Hong Kong, China has recently conducted a trial inspection by drone at one of its remote outstations, namely Cheung Chau Outstation (see Figures 1-2), to explore potential applications and benefits of drone to support CNS maintenance work in remote outstations.

1.3 Typical maintenance tasks in a remote outstation include maintenance of on-site CNS equipment, building structure, building services provisions and related site facilities such as fencing, and cutting of vegetation, etc. The trial aimed to gauge benefits and practicality of site inspection by drone to support the above-mentioned maintenance tasks.

Agenda Item 12

18-22/10/21

2. DISCUSSION**Visual Inspection of Site and Equipment**

2.1 CNS outstations are typically located outside the city/airport areas and in our case, an outlying island. Part of the Cheung Chau Outstation is built along steep slope with fencing, posing risks to maintenance personnel in terms of access and physical labour. CNS equipment at outstations is usually mounted on tall structures. For instance, radar antenna protected by a radome at top of a tower and DVOR/DME antenna installed on counterpoise. Use of drone to carry out inspection at outstations will provide the following benefits.

2.2 Maintenance staff could conduct site inspection by drone while keeping safe from hazardous locations thereby reducing risks in occupational safety and health (OSH). With ease, drone can access places difficult to safely access by human and provide unique views for real-time inspection and visual records for post-flight analysis (see Figures 3-6). Follow-up drone inspection to check for progress/deterioration of marked trouble spots will be a task suitable for drone. In future, if Beyond Visual Line of Sight (BVLOS) operation is allowed, drone inspection would be even more attractive for our case. In contrast, inspection by maintenance personnel, which often requires safety precautions/training, bulky protective gear, harness, support and accessibility features, can hardly match with efficiency of drone inspection. Savings in cost and labour as well as reduction in OSH risks are obvious to justify drone inspection.

Building Diagnostics and Building Information Management

2.3 Drone inspection can go beyond visual inspection. More sophisticated building / structural inspection is feasible with relevant technologies equipped on board.

2.4 **Thermographic Building Diagnostics** – renovation work at Cheung Chau Outstation had been carried out recently. Thermographic scanning by drone was conducted to unveil potential defects, such as moisture penetration or water ingress at building roof-top, that was not detectable by naked eyes. The technology is based on the principle that any moisture trapped within the fabric of a building will cause a temperature differential relative to the surrounding concrete. Thermal images showing the temperature distribution could reveal such defects (see Figures 7-10). In the conventional way of manual scanning, it could be extremely difficult to map the entire building/structure, especially for tall structures or roof-tops that are not easily or safely accessible. A drone equipped with infra-red camera offers a safe and efficient alternative to conduct comprehensive thermographic scanning.

2.5 **BIM for On-site Building and Structures** – Point clouds that are compatible Building Information Modeling (BIM) software could be obtained with drone equipped with high resolution camera. The realistic 3-dimensional model so generated could be useful for planning/revamp of future/existing outstations. BIM, if conducted during early construction stage, could benefit all construction stages, including initial site survey and design, volume and elevation measurements and comparisons, and quality assurance. Comparatively, conventional ground surveying methods will take more time than drone to map out the structure (see Figures 11-12).

Limitations

2.6 Despite the benefits of outstation site inspection by drone, there are site-specific factors which might affect the applicability, scope and regularity:

- a) Weather – drone flight sometimes not feasible under adverse weather, although human inspection is also normally not practiced during adverse weather;
- b) Site location – a site in vicinity of a flight path might prohibit drone flight;
- c) Interruption of service – CNS service outage is generally necessary during drone inspection although human inspection would require the same, and drone inspection generally would take less outage time; and
- d) Formation of a drone inspection team – staff resources, service and equipment cost, personnel licensing, continuing training/practice, be it taken by outsourced or in-house staff, are obvious factors to consider.

Way Forward

2.7 The use of drone unfolds a cost effective way to support maintenance work of CNS outstations as demonstrated in the trial conducted at the Cheung Chau Outstation. Hong Kong, China will further look into other potential use cases of drone to enhance the overall robustness and efficiency in our CNS maintenance work.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper;
- b) encourage States/Administrations to consider and implement cost effective and proven technologies to enhance CNS maintenance work; and
- c) discuss any relevant matter as appropriate.

Attachment



Figure 1. Overview Photograph of Cheung Chau Outstation taken by Drone



Figure 2. Drone Used for the Trial



Figure 3. Use of Drone to Inspect Security Fencing along Steep Slope



Figure 4. Close-up Image of the Security Fencing taken by Drone



Figure 5. Close-up Inspection of Lightning Rod by Drone

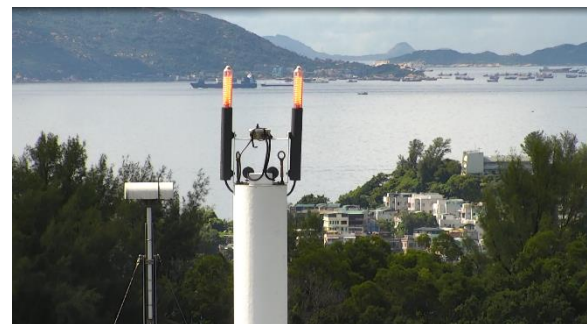


Figure 6. Close-up Inspection of the DME Antenna by Drone



Figure 7. Image of Site Building by Drone

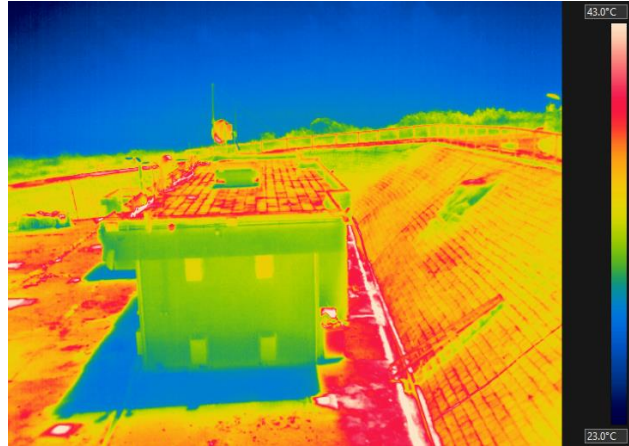


Figure 8. Thermal Image of Site Building by Drone



Figure 9. Image of Building Roof-top by Drone

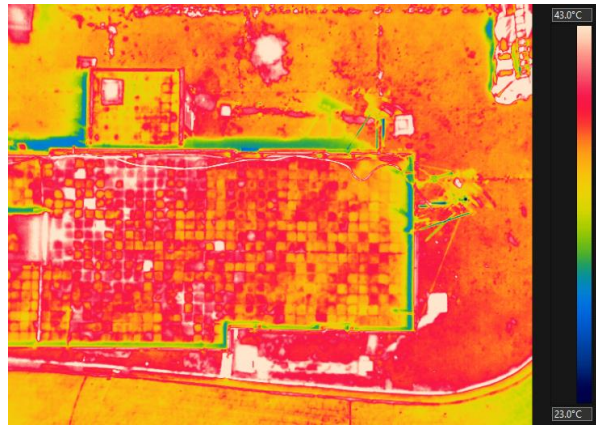


Figure 10. Thermal Image of Roof-top by Drone

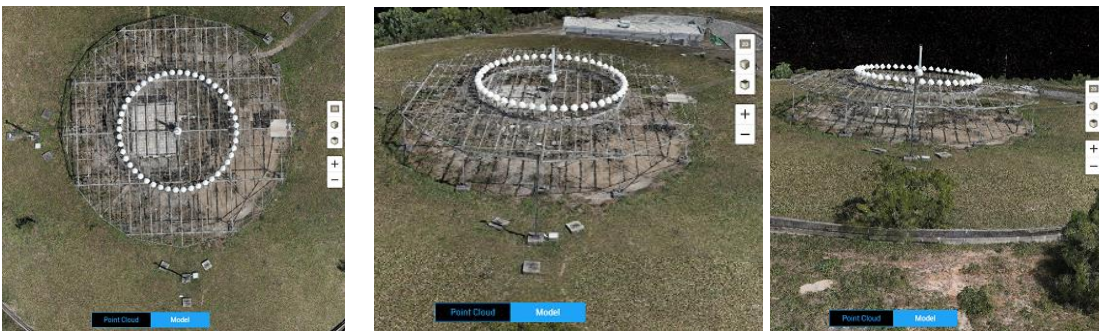


Figure 11. 3D Model of the Navigation Outstation Built by Drone Survey in Different Elevations

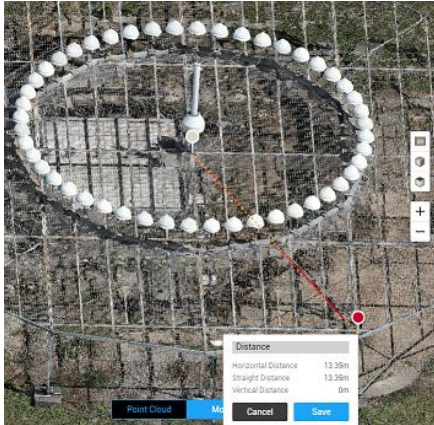


Figure 12. Distance Measurement in the 3D Model