Lab 7 - UAS safety & risk assessment

Introduction to Drone Technology

Group 8
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1 Concept of Operations Description

For nature conservation purposes a drone is needed to provide periodical sequences of aerial images of the shoreline at the island Mandø in the Wadden Sea, see figure 1, which is a sparsely populated area with a population of 40 [1]. The drone flight will be BVLOS, the pilot will be conducting the operation from a static position near the coast. All flights will be conducted under relatively low wind and no precipitation conditions.

The drone is a hexrotor with a diameter of 75 cm and a total weight of 4 kg. The altitude of flight will be 80 meters (262 feet) above MSL (mean sea level). A ground risk buffer of 50 meters (164 feet) is chosen.

Figure 1: Location of operations.

The area is a reserved drone zone (EK R38), and for this drone operation to take place in this area, permission from the appropriate air traffic services unit must be granted [2]. This are is also one of the noise sensitive natural areas in Denmark (BL 7-15), and special permission from the Danish Transport Construction and Housing Authority must also be granted, due to this flight being under 1000 meters [3].

2 Determination of the intrinsic UAS ground risk class (GRC)

As written in the ConOps in section 1, the drone has a diameter of 75 cm, and the operational scenario is BVLOS over a sparsely populated area. This gives a GRC of 3.

3 Final GRC determination

M1 — Strategic mitigations for ground risk - The UA will be equipped with strong LEDs providing higher visibility of the aircraft, to make people aware of its presence. This is a low robustness mitigation.

M2 — Effects of ground impact are reduced - The UA will be equipped with a parachute system to safely descent in case of system failure. This is a medium robustness mitigation.

M3 — An emergency response plan (ERP) is in place, the UAS operator is validated and effective There is no emegency plan in place, giving a robustness of none.

M1	low	-1
M2	medium	-1
M3	none	+1
Total	-	-1

Table 1: Sum of mitigation points

From table 1 it is shown that the sum of the points gained form mitigations are -1, which leads to a final GRC of 2.

4 Determination of the initial air risk class (ARC)

When determining the initial air risk class (ARC), certain categories need to be determined.

- At what altitude will the drone fly?
  - Above FL600 means ARC-b
  - Above 500ft. AGL but below FL600;
    - Mode-C veil, TMZ or controlled airspace means ARC-d
    - Uncontrolled airspace over urban or rural area means ARC-c
  - Below 500 ft. AGL
    - Mode-C Veil, TMZ, controlled airspace or uncontrolled airspace over urban area means ARC-C
    - Uncontrolled over rural areas it is ARC-b
- Is the airspace an airport/helicopter environment?
  - When drone in class B, C, or D Airspace it is ARC-d
  - When the drone is not in class B, C, or D Airspace it is ARC-c

The drone will operate at a restricted airspace along the shore of a small island in the Wadden sea. Even though the drone flies at the airport, when doing so the airspace will be shut down. This makes it an Atypical Airspace, meaning that the drone operates in ARC-a. But to rule out the other options as well, the drone will fly at 80 meters, with a maximum of 120 meters and will not operate in Mode-C Veil or TMZ.

5 Application of strategic mitigations to determine the residual ARC

No mitigations will be set in place.

6 TMPR and robustness levels

As described in section 1 this operation is BVLOS, requiring a DAA (Detect And Avoid) system. Due to the air risk being ARC-c, determined in section 4, the robustness level of the TMPR should be medium. To avoid traffic under BVLOS conditions, a system must be in place on the drone to help detect traffic, and perform traffic avoidance manoeuvres.

7 SAIL determination

From section 3 and 4 it is determined that the GRC is 2, and the ARC is c.

The SAIL score is then **IV**.

8 Identification of the operational safety objectives (OSOs)

OSO#02: UAS manufactured by competent and/or proven entity - A medium priority for SAIL IV. The UA chosen to carry out this operation is purchased from a trusted manufacturer of drones.

OSO#14: Operational procedures are defined, validated and adhered to - A high priority for SAIL IV. Operating procedures are documented and all personnel taking part in this operation will know and follow them.

OSO#23: Environmental conditions for safe operations are defined, measurable and adhered to - A medium priority for SAIL IV. Pre-flight section of the operational procedures states that a check of weather conditions and other environmental factors, are within safe and predetermined parameters for UA flight operations. Websites like `www.droneluftrum.dk` and `www.uavforecast.com` are used to measure these factors.

9 Adjacent area/airspace considerations

To reduce the risk of failure of the UA, there will be a redundancy of certain components, to make the UA more reliable. Multiple navigation systems should be on the drone, as well as electronics backup system such as emergency ESCs for motor control.

If failure is detected, either by component failure of breaking the geo-fence, a flight termination system (FTS) should be engaged. For this multi-rotor the parachute will be deployed.

For lost signal but no need for engaging FTS, the drone is designed to return to home autonomously.

10 Comprehensive safety portfolio

For the comprehensive portfolio, the purpose is to combine the knowledge from the preceding steps to conduct the portfolio with all mitigations and safety objectives. This includes documents listed in the Appendicies list below. At the same time, this step will also define additional requirements, that was not identified in he SORA steps. This could be things like environmental protection and identification of the relevant stakeholders.

Appendices

A. SORA Document
B. Operating Procedures
C. Contingency Procedures
D. Emergency Response Plan

11 Bibliography

[1] Dansk Ornitologisk Forening. Mandø. `https://www.dof.dk/oplev-fuglene/fuglesteder/jylland/mando`. Online; accessed 12 November 2021.

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[3] Danish Transport Construction and Housing Authority. Bestemmelser om flyvning over særligt støjfølsomme naturområder i danmark. `https://www.trafikstyrelsen.dk/da/-/media/TBST-DA/Luftfart/Lister/Lovstof/BL-7-serien/BL-7-15-om-flyvning-over-s%C3%A6rligt-st%C3%B8jf%C3%B8lsomme-naturomr%C3%A5der-i-Danmark.pdf`. Online; accessed 07 November 2021.