MODERN AVIATION TECHNOLOGIES

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UNMANNED AIR VEHICLE FLIGHTS WITHIN AIRSPACE

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Recent years have shown a rapid increase in air traffic. Unmanned Air Vehicles will deteriorate this situation. For this reason, Air Traffic Management should be adopt Unmanned Air Vehicles, than Unmanned Air Vehicles flights within Controlled Airspace, Uncontrolled Airspace and Special Use Airspace.

Introduction

Air traffic is continuously growing in the all the world. To keep this transportation element as effective as needed, adequate research and technological development efforts have to be made in Air Traffic Management (ATM), mainly related to assistance tools and improved operational management. A lot of different projects [1; 2; 3] and theoretic models [4] are created to reduce and avoid ATM inefficiencies, delays and safety risks.

A new challenge, Unmanned Air Vehicles (UAV), already approaches and it will change this situation in the near future and will introduce new aspects and dependencies to the current situation. The growth of UAV industry is greatly dependent on how the entire range of technical, airworthiness, operational and regulatory issues related to UAV integration in airspace will be solved [5].

Airspace integration aspects are crucial for the growth of UAV operations and call for the application of the same rules.

Controlled Airspace

For air traffic management purposes, in controlled airspace only a subset of the total range of UAV types are intended to be operated in the airspace strata currently used by the major manned commercial aircraft.

UAVs operating at very low altitudes and above 60 000 feet could be subject to a dedicated set of ATM procedural and airspace provisions. Therefore, ATM of UAVs will need to focus on those UAVs required to share controlled airspace with manned operating aircraft or those rising or descending in controlled airspace to or from very high altitudes of performance. The configurations and operating characteristics of these aircraft as compared to the range of manned aircraft operating within the same airspace will influence the possibility to permit operations of UAVs outside the common airspace.

Appliance of the stringent requirements to operations in controlled airspace means that UAVs performance in uncontrolled airspace will also face equally challenging problems requiring solutions in the form of procedures and technical compliance measures specific to that operational environment.

The main principles of airspace use for UAV are:

– equivalent level of compliance;

– will not increase risk to existing operators;

– transparent Air Traffic Control (ATC) compatibility;

– operation compatibility, collision avoidance, right of way, weather.

Of course, these principles are valid in controlled and uncontrolled airspace.

Controlled airspace is an airspace of defined dimensions within which air traffic control services are provided in accordance with the airspace classification. Controlled airspace is a general term covering Air Traffic Service (ATS) airspace Classes A, B, C, D, E. This airspace is in the primary responsibility of ATM, however, not all traffic in this airspace is under positive radar control. In controlled airspace IFR-flights and VFR-flights are possible, collision avoidance is in the responsibility of ATC (IFR) and the aircrews (VFR). UAVs have to be informed accordingly about other UAV flights.

Initially operations within the controlled airspace depend on applied flight rules (IFR or VFR) and on the weather conditions (IMC or VMC) as well. Basically, there are two possible meteorological conditions which can occur:

– Instrument Meteorological Conditions (IMC) – meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minima specified for visual meteorological conditions;

– Visual Meteorological Conditions (VMC) – meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, equal to or better than specified minima.

VMC prevails if certain values for visibility and cloud ceiling are given, respectively if a certain distance to clouds, both lateral and vertical, can be maintained. Whereas IMC prevails, any of the values mentioned above are not given or can not be maintained. These two meteorological conditions are based on the human eyesight. Thus, they are not applicable for the control of the UAV itself, but they are decisive with respect to the other traffic. UAVs operate entirely independently from these meteorological conditions.

"There are two basic kinds of flight rules:

– Instrumental Flight Rules (IFR);

– Visual Flight Rules (VFR).

Flights can be conducted under one or mixture of these flight rules. Flights under VFR (VFR-flights) have to be conducted in VMC that means that separation and collision avoidance are mostly based on "see and avoid". Flights under IFR (IFR-flights) may be conducted either under VMC or IMC. In IMC the collision avoidance is primarily based on other means than "see and avoid". At the first approach, UAVs shall be operated in an environment in which at least some other traffic operators operate according to VFR rules, mainly based on "see and avoid" [6, p. 101].

UAV operations within the controlled airspace for further considerations are separated into the following parts:

1) operation in the Terminal Control Area (TMA);

2) operation En-route;

3) operation in high Altitude.

The Terminal Control Area is the controlled airspace, within which aircraft can take off from an airport and climb the first portion of their en-route altitude (to be coordinated into the enroot traffic flow) completely under control of the appropriate ATC units. To a large extent, parts of this area offer UAV possibility to climb without encountering uncontrolled traffic under VFR to flight levels, where generally unknown air traffic does not exist.

The en-route portion of controlled airspace is divided into lower and upper controlled airspace. [6, p. 43].

The high altitude part of controlled airspace does not belong to civil manned aircraft, because they can not operate at such altitude and this part of airspace takes place above the established air route system.

Uncontrolled Airspace

Uncontrolled airspace is a small portion of airspace. Generally, traffic in this airspace is not related to ATM-authorities and therefore it is mostly unknown to ATC. All flights are supposed to be VFR-flights and collision avoidance is in the responsibility of the aircrews. UAVs have to be informed accordingly, i.e. by NOTAM (Notice To Airmen).

"Since IFR flights are prohibited within this airspace, in uncontrolled airspace commonly used by other traffic operators UAVs operations are not expected at the nearest future. So, the following brief considerations are preliminary only.

The UAV, flying in uncontrolled airspace, should have at least adequate "sense and avoid" possibility, with a Human Machine Interface (HMI) adequate for the special situation of the remotely piloted vehicle. For an autonomous flight all separation related functions must be fully automated.

Flights of UAV in uncontrolled airspace are not relevant for ATC, however, many concerns with respect to ATM exist.

UAV may fly from controlled into uncontrolled airspace under ATM control or military control, and vice versa. Therefore, the UAV have to be or coordinated and cleared into controlled airspace.

UAV flying in uncontrolled airspace may unintentionally, by error or in case of emergency enter the controlled airspace, when climbing, descending or laterally deviating. This may pose a more serious threat than manned aircraft entering controlled airspace unintentionally because ATC has less possibilities to address UAV. However, measures can be taken for remedy, for example:

– all operators of UAV have to listen to ATC emergency frequency calls received by UAV;

– all operators have to file a UAV-flight plan for any flight;

– all operators have to switch transponder" [6, p. 45].

UAV operations in Airspace

The procedure contained herein applies specifically to UAV operations outside reserved airspace and includes procedures required to govern UAV take off, climb, descent and landing.

The procedures apply specifically to those UAVs that can be monitored and controlled during the real-time from an air vehicle control station. Nothing herein is meant to preclude operation of a UAV in programmed flight mode, provided that UAV performance and designated ATC communication circuits are continuously monitored by the UAV crew, and that the UAV system and crew are capable of immediately taking active control of the UAV.

UAVs operations within the national airspace shall be equipped with a Secondary Surveillance radar (SSR) transponder. The pilot in command shall have the capability to change the SSR code and squawk identification when required. All requests for flight deviations shall be made under the proce-

dures established by the appropriate ATS authorities. The UAV pilot-in Command shall initiate and maintain two-way communication with the appropriate ATC authorities for the duration of any flight. UAVs operation outside the reserved airspace shall be continuously monitored for adherence to the flight plan approved by the pilot in command. The pilot in command shall make reports on all positions and other required reports to the appropriate ATC unit. ATC shall continuously monitor the flight path of the UAV through SSR and radar. UAVs shall not operate in area without adequate ATC radar/SSR coverage unless equipped with an operable Automatic Dependent Surveillance (ADS) system, unless approved by ATC for special operation. Each UAV flight should have some means of informing (giving information to) ATC controllers that the flight is unmanned. Each UAV should be properly equipped to be able to inform ATC controllers that the flight is unmanned.

Conclusions

The impact of UAV operations on Air Traffic Management, problem and conflict areas between UAVs and other related traffic operators shall be clearly identified in order to develop adequate air traffic management procedures providing initial environment to integrate these vehicles into ATM.

The facilitation to the integration of UAVs into the civil airspace will require effective classification / categorisation scheme. Such scheme shall be global in the future.

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Безпілотні літальні апарати в космосі

Показано, що польоти літальних апаратів можуть збільшити інтенсивність повітряних сполучень. Запропоновано запровадити службу керівництва повітряним рухом безпілотних літальних апаратів, яка буде дозволяти польоти в контрольованому, неконтрольованому і спеціальному повітряному просторі.

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Беспилотные полеты летательных аппаратов в космосе

Показано, что полеты беспилотных летательных аппаратов могут резко увеличить интенсивность воздушных сообщений. Предложено учредить службу управления воздушным движением беспилотных летательных аппаратов, которая будет разрешать полеты в контролируемом, неконтролируемом и специальном воздушном пространстве.