MODERN AVIATION AND SPACE TECHNOLOGY

UDC 629.7(045)
DOI: 10.18372/2306-1472.85.15136

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THE CURRENT STATE OF DEVELOPMENT OF UNMANNED AERIAL SYSTEMS IN THE STRATOSPHERE

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Abstract
This paper considers the main goals and objectives that are solved with the help of Unmanned Aerial Vehicles. The classification of modern Unmanned Aerial Vehicles (UAVs) by weight, altitude and flight duration is shown. Basic advantages and disadvantages of the UAVs use in a stratosphere are analysed in comparison with piloted aircraft.

Keywords: Unmanned Aerial Vehicles, Unmanned Aerial Complexes, Unmanned Aerial Systems, Unmanned Aerial Vehicles goals and tasks

1. Introduction

One of prime examples of development of modern technologies is development of Unmanned Aerial Vehicles (UAVs).

Active development of UAVs has a row of implicit advantages. Absence of crew removes the risk of human losses onboard. Possibility of implementation of manoeuvres with an overload that exceeds physical possibilities of pilots, large duration and distance of flight removing fatigue of the crew. Ability to simultaneously conduct reconnaissance and lethal functions at tactical front in the strategic zone of opponent. Relatively small cost of UAV, small expenses on their exploitation and effectiveness in battle conditions of aerial vehicles. Nowadays, more wider spectrum of tasks is solved by UAVs that before traditionally was solved by piloted aircraft and helicopters. Therefore, in our country a necessity of development of UAV of class of maxi height and duration of flight is important, especially taking into account the tendencies of development of similar vehicles abroad.

2. The main part

The UAV - is an aircraft that flies and performs landing without a physical presence of pilot on-board. In international classification by the functional setting six categories of UAVs are distinguished:

- possibility of cheap realization of different tasks;
- surveillance and patrolling;
- reconnaissance of battle-field;
- logistic;
- scientific researches;
- civil applications [2].

All UAVs are divided as tactical UAVs by different take-off weight and endurance (Table) [5].

Table

UAVs classification

UAV Class	Take-off weight, kg	Endurance, km
Light Short Range Endurance	5-50	25-40 10-120
Light Medium Range Endurance	50-100	70-150 (250)
Medium Range Endurance	100-300	150-1000
Middle-weight	300-500	70-300
Heavy Medium Range Endurance	> 500	70-300
Heavy Long Endurance	> 1500	1500
Lethal	500	≈1500

Modern UAVs conditionally can be divided into several classes [2]:
- by mass: micro - (weighed less than 5 kg), mini- (less than 200 kg), midi- (less than 1000 kg) and maxi- UAVs (over 1000 kg);
- by duration of flight - vehicles with duration of flight less than 1 hour, 3 hours, 6 hours, 12 hours, 24 hours and so on;
- by the height of flight - aircrafts with practical limit to 1, 3, 9-12 kilometers, and also over 20 km.

Each of these classes is today presented by the wide spectrum of standards of different types. But if development and production mini- and (partly) midi UAVs presently is in strength practically to every country that has the aviation industry developed more or less (in particular, to many European countries, and also India, Pakistan, Iran, Iraq, Malaysia, Israel, Brazil), then most technically difficult мaxi- UAVs can produce only leaders of world aircraft construction. Most successes with this category were attained by Americans that created the unique by the parameters vehicle " Northrop-Grumman" RQ - 4a " Global Hawk ". Its working limit - 18-20 kilometers, duration of patrolling - 24 hours [6, p.21]. Airplanes usually fly in a stratosphere that is the second main layer of earthly atmosphere. Reasons, why they do it, are very practical and not difficult for understanding. Principal reason why that airplanes fly in a stratosphere consists in least amount of turbulence appears there. Except that, as a stratosphere is very dry, herein to the stratosphere less clouds, that assists more smooth flight on the whole. Certainly, there are very practical reasons, when airplanes fly in a stratosphere. Except less turbulence, this layer of atmosphere allows considerably to improve the economy of fuel. It is because on large heights, such as stratosphere is less windage.

In actual fact, windage in a stratosphere presents the half of the resistance educed on earth approximately, and it means that an airplane can retain speed of air at the less tuning of power, and not so much fuel is used. Smaller indexes of power always equal the best economy of fuel, that it is important for all airlines [5]. The analysis of development of the foreign programs in area of UAVs construction finds out a tendency to the increase of sizes of UAVs, mass of their payload, and also flight parameters.

Modification of "Hughes" - notedly added in sizes (a scope and length of fuselage grew). Aerodynamic properties of UAVs depend on length and wingspan [10]. As a result duration of flight increased to 36 hours, and limit is 21 km. In addition developments of UAVs of large duration of flight (from a few twenty-four hours, to a few months and even year - Vulture project) were done in the USA. In 2018 Airbus Perlan Mission II set the new world record of absolute height for a glider, climbing up to 23 202 meters. It is already the third record of Perlan. During the flight a glider collects weather and atmospheric data, and also information about exploitation on large heights[11]. Pilot-controlled glider by Jim Payne and Tim Gardner exceeded a mark in 22 475 meters - record of height of flight of famous reconnaissance airplane U – 2 of the USA Air Force, set by Jerry Hoyt on April, 17, 1989.

Unlike U - 2, equipped by an engine with traction more than 7 700 kg, Perlan 2 – engineless aircraft. A glider weighs in 680 kg and achieves record heights by means of rare stratospheric air flows, formed by mountain winds and arctic cyclones.

World records are bright confirmation of progress. Investigating insufficiently known part of atmosphere, Perlan helps to study the secrets of effective high-altitude flight, to learn to use the natural sources of carrying capacity, avoid turbulence and even to check up expediency of Mars research by means of aircrafts. For the producer of not only airplanes but also high-altitude UAVs, such as Zephyr, and also robotic rovers for Mars research, every flight of Perlan is investment in the future.

During one week the Perlan glider set, and then surpassed three times the world record of height on August, 26, 2018: pilots Jim Payneand Morgan Sandercock attained a height of 19 233 m, surpassing the previous record in a 16 459 m, set by a glider on Septembers, 3 in 2017; on August, 28, 2018 : Jim Payne and Miguel Iturmendi heaved up a glider on a height a 19 995 m; on Septembers, 2, 2018 : Jim Payne and Tim Gardner attained a height 23 202 m.

Airbus Perlan II continues flying seasons to the middle of September, while the streams of mountain air in the stratosphere of south semisphere do not begin to calm down. The number of flights depends on weather terms, explained in a company.

It follows notices about PHASA - 35, an UAV that works from sunny electric energy with the scope of wings at 35 m completed its first flight successfully. The flying tests organized by the British Defence Science and Technology Laboratory (DSTL) and the Australian Defence Science and Technology Group (DSTG) were conducted on Woomer RAAF landfield in South Australia. PHASA - 35 was projected, built and launched less than for two years within the framework of collaboration between BAE Systems and Prismatic Ltd.

The UAV is intended for flights in a stratosphere, at heights from invariant weather conditions and has higher limits than commercial air transportation. Who has large duration of flight and operates at a large height, PHASA - 35 feeds from sunny batteries a day and at night. Batteries with the long operation cycle and high-efficient sunny technologies can allow the airplane that works in a stratosphere, in the higher areas of atmosphere of Earth, to execute flights duration to one year. PHASA - 35 was developed for monitoring, supervision (including the exposure of forest fires and sea monitoring), communication and safety. In combination with other technologies and resources it will provide the soldiery and civil users of possibility, that presently existent airplanes and space vehicles does not have.

The tendency of the use of bigger number of satellites acquires in recent year. This tendency is conditioned first of all by an economy - more "heavy" vehicle is able longer to be in mid air, the increase of working height extends the area of supervision, and the use of more heavy and informing sensors provides the improvement of quality and completeness of the obtained information. Thus, for the decision of certain task the less dress UAV is needed, the total cost of their groupment goes down, the questions of exploitation are simplified. [5, p. 13-14].

In addition, the system from satellites has extremely high vulnerability. As an amount of satellites on the orbit is small, and a possible enemy exactly knows the location of every satellite on the orbit, then it will be no difficulties to him to destroy the group of satellite completely in a short period [3].

It is necessary to mention that the similar system of UAVs is effective exactly as a local, but not global system of positioning and supervision (in such case an amount of UAVs will be too large). It is especially important to underline considerably less vulnerability of UAVs in comparison to space satellite and possibility of instantaneous renewal of capacity of the system in case of death of any amounts of UAVs by their operative replacement that is impossible for the system working on space satellite [4].

There are other variants of the use of Unmanned Aerial System with a large height and duration of flight. In particular, such systems could control traffic on highways with high efficiency, greatly facilitating the work of the traffic police, as well as informing about the presence of "traffic jams". Presently similar project are done by the team of developments at the head with Karimov A.Kh. in the initiative order.

3. Conclusions

UAVs, undoubtedly, will acquire greater significance both in civil aviation and in air force. In the USA, France, Sweden, Great Britain and other countries works are already begun with creation of unmanned battle airplanes able to do lethal, and in a prospect - and "destructive" tasks.The row of analysts already calles a similar technique as the aviation of sixth generation. In accordance with existing in United States Air Force and United States Navy plans first serial battle UAV as UCAV and UCAV – N type, that presently already pass flying tests, must come on an armament in this decade. [4, p. 17-18].

If to look in a farther prospect, it becomes obvious, that with intensifying of power crisis (on the estimations of specialists, a world economy will use supplies of oil already in 30 years), the type of air force must change. Incineration annually of almost 2000 tons of fuel during normal exploitation in the conditions of peace-time only of one destroyer as F- 22 will become an impracticable dream to the middle of XXI of century. However, it follows to admit that works in area of pilotless aerotechics are done in our country mainly in the initiative order, with the minimum of state financing.

If we want to become the large aviation country, able to control the considerable proportion of world aviation market, volumes and rates of works for UAVs (first of all - in direction of creation of UAVs with a large height and duration of flight, and also for battle non-powered lithal device), in the future, then attention of the state must be concentrated in support of research and designer works of front-rank Scientific Research Institutes, engineering bureau, aviation institutes, etc.

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Сучасний стан розвитку безпілотних авіаційних систем в стратосфері

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У даній роботі розглянуті основні цілі та завдання, які вирішуються за допомогою безпілотних літальних апаратів (БПЛА). Показано класифікація сучасних БПЛА по масі, висоті і тривалості польоту. Проаналізовано основні переваги та недоліки використання БПЛА в стратосфері в порівнянні з пілотованими літальними апаратами (ПЛА).

Ключові слова: безпілотні літальні апарати (БПЛА), безпілотні авіаційні комплекси (БАК), безпілотні авіаційні системи (БАС), цілі і завдання БПЛА

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Современное состояние развития беспилотных авиационных систем в стратосфере

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В данной работе рассмотрены основные цели и задачи, решаемые с помощью беспилотных летательных аппаратов (БПЛА). Показана классификация современных БПЛА по массе, высоте и продолжительности полета. Проанализированы основные преимущества и недостатки использования БПЛА в стратосфере по сравнению с пилотируемыми летательными аппаратами (ПЛА).

Ключевые слова: беспилотные летательные аппараты (БПЛА), беспилотные авиационные комплексы (БАК), беспилотные авиационные системы (БАС), цели и задачи БПЛА

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