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Dedicated to the 150th Anniversary and
The 1st Congress of World Engineers and
Riga Polytechnical Institute / RTU Alumni

DIGEST

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Micro-class Unmanned Aerial Vehicle Design Solutions

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Keywords **– Unmanned Aerial Systems, Micro-Class unmanned aerial vehicles, operations, UAS manufacture.**

I. Introduction

Design, manufacture and operation of micro-class unmanned aerial system (UAS) has to take into account several specific requirements, including condition of "flexible" manufacturing technology, reliable and safe exploitation, ecological safety etc.

II. Basic Requirements to UAS Design

The principal task of this research was a creation of an UAV construction corresponding to the following principal requirements [1]:

- possibility of implementing environment monitoring;
- implementation of the functions of strategic and nature conservation objects protection;
- possibility of determining the exact location of the target;
- possibility of detection and mapping of seats of fire and contaminated environmental zones;
- implementation of patrolling functions to solve the tasks of national armed forces and police;
- implementation of meteorological research, etc.

In addition, in the process of designing, a number of specific requirements are also taken into account, including:

- performance (the UAS ability to take-off and land in the conditions of no-runaway available, the simplicity of maintenance and repair, etc.);
- ecological safety requirements (non-contaminated environment, minimum noise level, etc.);
- effective steerability requirements (possibility of controlling the UAS both in manual and automatic mode using modern navigation systems and communication devices).

III. Design and Construction Specifics of UAS

Designed UAV is made according to classical scheme with electric type dragging propeller. Original construction of UAV is equipped with special capsules for working load (fig.1).

Fig. 1 Principle design of UAS.

In UAS construction different innovative materials are used – combination of polystyrene, tar-based composite and ultra light balsa-based materials.

Main UAS load-carrying construction is made from special extra strong carbon tubular members. Centre-section has partly working binding, which allows increasing durability and hardness of UAS construction and decreasing weight of primary load carrying members. UAS can execute environment monitoring, with high accuracy spot location of different objects and targets, map seats of fire and environmental pollution zones.

IV. Specifics of UAS Manufacturing

Modeling of main elements, as well as UAV construction generally has been performed using CAD technologies, specifically SolidWorks program.

Details and nodes are modeled taking into account manufacturability of UAV assembly. Objectives of lining up are fulfilled with a high precision level, optimal setup of UAV main elements and nodes composition are chosen. Possibility of computer modeling allowed creating optimal constructions of main elements and vehicle construction as such, given aerodynamic characteristics, as well as durability and weight.

In UAV details manufacture modern methods and technologies were applied, e.g.:

- milling cut at 3D milling-machine,
- sticking together details from composite materials according to beforehand prepared matrices;
- detail shaping from different expandable polystyrenes;
- hot shaping from plastic sheets,
- detail manufacture at 3-D Printer (see fig.2).

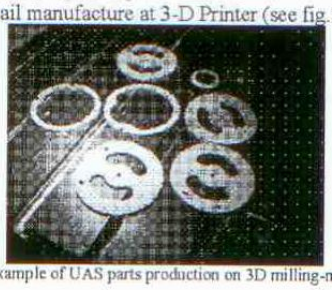

Fig.2 Example of UAS parts production on 3D milling-machine

V. Conclusions

UAV are designed considering possibilities to manufacture majority of its details on 3D milling-machine and *Computer-aided manufacturing* (*CAM*) technologies. This allowed not only optimizing manufacture process of details and nodes, but also increasing its constructability in further mass-production. Technological processes of different UAV details manufacture are designed taking into account specifics of details geometry, used materials, machinery equipment characteristics and production capacity.

VII. References

[1] Urbahs A., Urbaha M., Petrovs V., Jakovlevs A. Methods and Means of the Computer-Aided Design of Unmanned Aerial Vehicle Model // Proceedings of XIII International Conference on Intelligent Engineering Systems, ISBN: 978-1-4244-4111-2, Barbados, 2009. – p. 211-213.