New Arctic air transportation with Hybrid electrical disc shaped Airship and body plane Aircraft innovation

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Abstract. The new Global International Air Transportation development as Logistic High Way via North Polar and Russia from Canada to China are focusing to the new Airship and Large Hall Aircraft (LHA) Ecology Electrical Concept of the Transpolar Hybrid Power Fleet by ICAO& IATA Regulation and Security along the Flight Routes with minimum Toxic & Noise to Climate and Passengers Safety. The paper analyzes the promising of Development Technologies of the Modern Hybrid Aero Systems as use the Solar Disc Shaped Airship (DSA) of Thermoplan LTA type by MAI Design and Production with EC Swiss, France and Germany cooperation. The estimation of the profitability of the Disk Shaped for the more Optimal Aerodynamic and Weight Efficiency in comparison with other view Forms for High Altitude Stratospheric & Orbital Complex as Astronomical Observatories and the implementation of International Aerospace Launches & Landings.

1. Introduction

The complex system analisis was based on the main advantages and experience of the past in the creation of the Airships Development in the World. The use of hybrid high-capacity Airship with aerostatic unloading for Ait Transport Operations that do not require mandatory airfield-based is more actually today and priority national strategies. In contrast to heavy transport aircraft for aerostatic Light-then-Air (LTA) weight restrictions in dimension are not limiting as the ‘Cube-to-Cube’ Physical Law positive principal.

That is why Prof. E. K. Tsiolkovsky at the same time focused on the development of rigid airships with hydrogen filling, which gave a "pop-up lift" according to the physical law of Archimedes. During the 30-40-ies years of the last century, the Cigar Geometry Shaped Airships have received the greatest breakthrough in its development in Russia and abroad. But the use of Hydrogen is better on the ‘Ejecting Up’ efficiency of the Gas, but explosive in contrast to the safe Helium, which led to the most famous death of Airships Directions, froze the further widespread use of this Aerostatic Ecological Green Technology.

2. Airship Conceptions of the New Arctic Innovation projects

The Moscow Aviation Institute (MAI) some years ago was developed and patented in Russia and Switzerland some new versions of DSA Thermoplan MAI Projects as innovative symmetrical Disc Shaped Geometry for Arctic and North Polar Regions Air Transportation Strategy Development. The Disc Shaped Structure is more efficiency with two gas cavities – for Helium and
Super Heated Air volumes. It is necessary to highlight the main advantages of this New Airship Concept Demonstrator for Ground and Flight Test as the Mid Version of the LTA Thermoplane ALA-40 (40 meters in Diameter of Tore): the Disc Geometry as perspective Aerodynamic Shape eliminates the constant adjustment in the direction of the crosswind which is an inevitable drawback for the weathering of the Non Symmetrical Geometry and Stress Tensometry Colour Pictures of the Cigar and Disc Shaped Airships Structure show on the Figure 1 [1], [2], [3]:

![Figure 1. Non Symmetrical and Disc Geometry visual Stress Tensometry Analysis](image1)

- the Shape of the Symmetrical Geometry Disk allows for the most lightweight design to use a uniform load distribution in the Structure and on the domes at the power Composite Tore with its Pre-Stress Methods (the principle of the spoke tension of the Bicycle wheel frame);
- the LTA use of a two-volume gas scheme, one volume for Helium filling (or Hydrogen with an unflammable additive) and the second volume – Super Heated Air with the selection and utilization of exhaust gases from the main trust of Gas Turbine Engines (GTE), which allows to create a profitable unbalanced DSA Scheme that does not require additional ballast and service filling Stations at the place of unloading the payload as view on the Figure 2 [4];

![Figure 2. Created Airship/ LTA project ALA Thermoplane MAI, Russia](image2)
3. Breakthrough potential of the new Arctic Solar Disc Airship

The Disc Shaped Thermoplane MAI project was the main initiative and breakthrough development of a new type of LTA in Russia and Germany, Australia, UK and USA for fast Economic Development and improving the efficiency of Heavy Air Transportations to the large Territories of Siberia, the Far East and the Arctic that are remote from negative factors of any Land-Rail-River Transport Highways.

In the early 2000s, a new project of LTA Lokomoskay as analogue of DSA LTA Thermoplane MAI in which the upper surface of the dome is more convex than the lower, which gives an increase in lift at high flight speeds. In 2010-ies there was a new project of Aerostatic Thermoballast Airship (ATLA) Atlant by Augur company, which is made in an Elliptical Geometry Form, which is included in the Skolkovo and long-term Russian National Program “Development of new Transport Corridors for the breakthrough development of Siberia, the Far East and the North of Russia.” But it should be noted that the Elliptical Airship Form of the weight efficiency is reduced due to increased loads on the longitudinal axis.

Disk Shaped LTA Thermoplane MAI can be used as a High Altitude Sky Platform for placing radio and optical telescopes in a cloudless and clean Stratosphere, and for Monitoring and Retransmission of Mobile communications 4G/ 5G, which is cheaper than the use of Space Satellite systems. The Aerosmena small firm which took as a basis the project LTA Thermoplane MAI is also aimed at the creation of small Disc Unmanned (UAV) Drones and the creation of the High Potential Sky systems as focus also by LTA Thermoplane MAI project to more efficiency Sky Start of AeroSpace Launches and Landings by use the new LTA Systems.

New Airship/LTA projects and design models

![Image](image-url)

Figure 3. Analysis of the different Geometry Type of Airship and Sky Drones

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The different Concepts of DSA Thermoplane MAI Innovation and Ecology Transportation project and 3D Modelling as show on the Figure 4 focusing to the main initiative and breakthrough Development of a new type of DSA in Russia for Economic Development and improving the efficiency of Aerospace Complex. In addition to transport tasks Disk-Shaped Airship Thermoplane MAI can be used to create a High Altitude Sky Platform for placing high-precision systems of the Radio-Optical Telescopes in a cloudless and clean Stratosphere and for High Altitude Monitoring and Telecommunications Systems (Retransmission) of the Internet and Global Mobile Communications, which is cheaper than the use any Orbital Satellite Systems.

**Development and 3D Modeling of Geometrically Similar Design of Disk Shaped LTA**

![Figure 4. Aerodynamic Tunnel Models for Experimental Research in MAI](image)

4. Large Long Hall Aircraft as the Body Plane shaped concepts

The new another very interesting New Delft University V-Body Wing Aircraft Ecology Project with more High Aerodynamic Efficiency in Flight and Passenger Saloon Comfort for EC Ecology Projection 2025-2030 which show at Figure 5 [6].

![Figure 5. The New Delft University FLYING-V Body Wing Aircraft Concept](image)
Large Aircraft [7], its decomposition according to the characteristic features and the identification of a critical factor for the Long-Haul Aircraft (LHA) innovation project. The whole issue, from the point of view of the 3D Volume-Weight-Drag Configuration, the optimal solution will be an Aircraft for which the external contour was obtained as a result of positioning of individual aggregates taking into account the criticality of the layout both with respect to the three axes of coordinates and in three planes, and for any arbitrary radius-vector, starting from the Dynamic Center of Mass of the Aircraft and optimal area position of Hybrid Engines for E-Aircraft Projections as the analogy new Boeing Body-Plane Concepts (BPC).

The New Integrate Aircraft Body-Wing Conceptions as focus to characteristic feature of the layout and "hard" dimensional constraints are possibility of carrying out spatial coupling of many units in the first iteration, which allows us to build layout from a certain virtual center. It is convenient to choose the origin of the associated coordinate system, which coincides with the real center of mass of the Large BPC Aircraft. Therefore, the layout problem is reduced to the location and interconnection of units in the layout space due to infrastructure constraints from the condition of bringing the Real Center of Mass (RCM) to the virtual mass center (VMC) and providing characteristic features for Aircraft Design MAI SW, as show on Figure 6, that satisfy both infrastructure requirements and others, for example, Aerodynamic-Weight-Drag Efficiency [8].

![Diagram](image)

**Figure 6. Influence of infrastructure restrictions on the LHA Geometric Shape**

The 3D image of the layout inside the Airspace Volume for the LHA, obtained from the results of the structural-parametric analysis of Airport terminal configurations, the Comp-Digital Method
of Aircraft Design parking and taking into account the Aircraft height limitations from the condition of PAX ability to the parking shelter Gate (23 m). Of course, in this case, the issues of antennas and equipment layout at the top of the surface are taken into account. The second level shows conditionally the range of permissible placement of passenger decks of the LHA. Their layout is determined by the dimensioning height (3.8 m), the length (20–25 m, and in prospect – 40–50 m) and the Limiting deviation angles in the vertical plane (10%) of the terminal slot hand-bridges. We make a comparative analysis of the Large Aircraft as the basis of the Flying Wing Scheme and the Normal Scheme. The data are given in Table 1.

| Aircraft | Usual scheme | "Wing" scheme | Absolute difference | Percentage difference |
|----------|--------------|---------------|---------------------|-----------------------|
| Iteration | $S_{vol}$ (m$^2$) | $V$ (m$^3$) | $S_{vol}$ (m$^2$) | $V$ (m$^3$) | $S_{vol}$ (m$^2$) | $V$ (m$^3$) | $dS_{vol}$ % | $dV$ % |
| 1 | 1412.7 | 2515 | 1315.8 | 2515 | 97.7 | 0 | -7 | 0 |
| 2 | 2493.8 | 3295.2 | 2576.3 | 3290.2 | 77.7 | 4 | 3 | 14 |
| 3 | 2916.5 | 3147.7 | 3147.7 | 3426.8 | 6.8 | 4 | -1 | 11 |
| 4 | 3181.9 | 3427.8 | 3427.8 | 3427.8 | 0 | 0 | -1 | 11 |

The passenger compartment of the LHA (Digital first iteration) was adopted. The second digital iteration is the wing and fuselage. Third iteration is the wing, fuselage and tail. And the fourth digital iteration is the whole composition of the Aircraft Systems, which corresponds to the complete washable surface (taking into account the Engine nacelles). The specific Volume per Passenger (average in all Cabins) was 2.485 m$^3$, which is 1.17 times worse than for the base Aircraft (as Normal Aerodynamic Shaped), but its 1.30 times better than for the Aircraft in the Lifting Wing Body Shaped, and 2-2.5% better than for the Aircraft with a Triplane Shaped with an articulated Wing. The developed Method of the Aircraft layout from the layout inside Airspace made it possible to obtain the Aircraft layout that meets all infrastructure requirements with Take-off Mass of 30–40 tons less than that of the Prototypes.

5. Conclusion

The new Ecology trends for a breakthrough use of new DSA LTA projects on the basis of modern Digital Design, AI and Additive Technologies, new Composite Materials structure and Adaptive Control Robo Systems in the next 10-15 years is extremely important for the vast territory of Russia and EC with the New Electrical Hybrid Aircrafts for up to 50 and 100 seats [9], [10]:

- any vertical take off and landing (VTOL) LTA in hard-to-reach places,
• large carrying capacity Air Transport “from Door-to Door” concepts as independence flight from the "rose" of winds,
• more cheaper of Production and Operation Low Cost over big land and seas,
• can flight any where and any day/night without landing (more electric LTA with big Solar Nano Film Battery cover) and easier to Operate and After Sales Services.

The Renovation Strategy with base on the patented in Russia and Switzerland the LTA Thermoplane MAI project could reflect the main Scientific interests of the National Research University - MAI the inclusion of Development and Modernization LTA Thermoplane MAI in the new AeroNet National Aerospace projects of NTI ‘Vision 2035’ which will strengthen the Economic Effect and feasibility of objectives to the National Strategy of ‘Connectedness Territories of Russia’ by MAI initiative 2019-2025.

The DSA Project is proposed for the practice competition of small search Airship & UAV Drones for Emergency Rescue Sky Services in the Russia Program "Odyssey 2020" for round-the-clock Sky Fast Monitoring of missing people in the any Forests or Mountains in Russia or other World Regions and Arctic. The 3D prototype DSA Plastic Model as MAI R&D Science Program in the Additive Technology LAB of the Engineering Graphics & Design Department is the more optimal 1:100 scale (or 1:10 for Drones Versions) to created and view presented on the Airshow Exposition.

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