

THE DESIGN OF AN INNOVATIVE MODEL AIRCRAFT

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Abstract: *This article studies the continued development of both domestic and international commercial aviation in line with the evolution of sustainable technologies. The process involves a multitude of ideas represented by design iterations, where various features have been optimized and developed to arrive at the final iteration that constitutes all the improvements achieved along the way. The work will be completed with the 3D modeling of the final iteration of the innovative model aircraft. Air transport is an important element of the current globalization processes, it being open to new challenges and continuously adapting to the needs of its users, that is why the project reflects the dedication in favor of innovation and the development of new solutions in modern aviation.*

Key words: sustainable technologies, aviation, design, design iterations, improvements, innovation, 3D modeling, challenge.

1. INTRODUCTION

In the contemporaneity of technology and continuous innovation, the aeronautical field represents an area of research and development full of challenges and opportunities. This dissertation explores the evolution of aircraft and associated technologies, with an emphasis on recent innovations and potential transformations in the near future. In particular, the integration of VTOL (Vertical Takeoff and Landing) technology in a practical and applicable context is addressed and analyzed, with relevant examples and implications for industry.

The paper develops the depth of advanced technologies used in aeronautics, including innovative materials, efficient propulsion and advanced avionics systems. It will also look at the impact of automation innovations and the applicability of artificial intelligence on flight performance and safety.

Finally, the paper proposes the application of VTOL technology in a physical context by designing and building a model aircraft equipped with this capability.

This paper is an elaborate research, exploring the past, present and future of aeronautics, with the aim of contributing to the understanding of technological advances and how they may influence and transform the aeronautical industry in the coming decades.

The design of the wings and fuselage of fixed-wing aircraft, from the earliest versions to modern jet airliners, is directly inspired by the movement of large birds. However, with the success of fixed-wing aircraft, flapping-wing concepts have seen declining interest as a viable design option for air vehicles. During this time, the aerodynamics of bird wings remained at the study level, to answer questions regarding their aerodynamic performance. [1]

2. HISTORY OF AERONAUTICS

The notion of flight has its debut in the ancient times, when the flight of birds was such an interesting and controversial topic that people tried to penetrate this mystery and transform the flight of birds into flight for humans. [2]

2.1 The classic flight of airplanes types of air quality monitoring sensors

The principle of airplane flight is based on the principles of aerodynamics, which studies the behavior of air around moving objects. This principle is based on Newton's third law of action and reaction and the concept of differential air pressure. Newton's third law states: "When one body acts on another body with a force called action force, the second body also acts on the first body with a force called reaction of the same magnitude and direction, but of opposite meaning".

A central aspect of the principle of airplane flight is the generation of the pressure difference between the top and bottom of the wing. As the air passes over the wing, it takes a longer path over the top, causing a drop in pressure in this area. In contrast, pressure increases on the underside of the wing, resulting in a vertical upward force known as lift. [3]

The weight of an aircraft represents a gravitational force always directed towards the center of the Earth. This is directly proportional to the mass of the aircraft and influenced by its degree of loading. [3]

Traction, on the other hand, is generated by the aircraft's propulsion system. The amount of thrust depends on a number of factors related to the propulsion system, such as engine type, number of engines, engine command, speed and flight altitude. On some aircraft, the aircraft's two engines are placed under the wings and oriented parallel to the fuselage, causing thrust to act on the longitudinal centerline of the fuselage. [3]

Drag is an aerodynamic force that opposes the movement of a body through a fluid, in this case air. [3]



Figure1. The four forces acting on an airplane. [3]

2.2 Unconventional Flight

The first flying machine developed by Leonardo da Vinci, now known as the

"ornithopter", was an innovative project started in 1485. The concept of this device was inspired by the desire to imitate the natural flight of birds or bats. The ornithopter is distinguished by its impressive wingspan, measuring approximately 9.14 meters. [4]

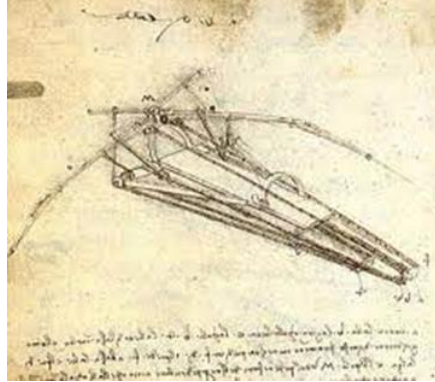


Figure2. Ornithopter flying car [5]

The second flying machine, often referred to as the air screw, is a fascinating creation attributed to Leonardo da Vinci. The term "aerial screw" or "air screw" suggests a screw-like object, while the term "helicopter" acknowledges its resemblance to modern helicopters. [4]

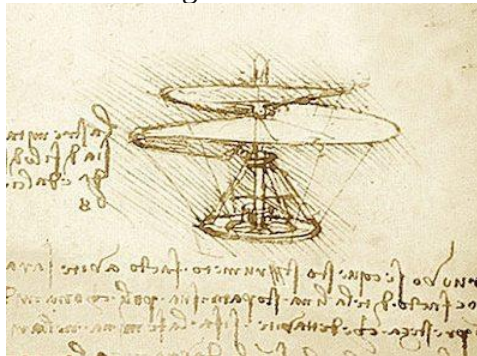


Figure3. "aerial screw"- aerial screw [5]

3. CONTEMPORARY MATERIALS

Currently, it can be seen that steel, aluminum and titanium alloys are widely used, however, the best from a technological point of view are composite materials such as glass fiber, various carbon fiber reinforced polymers, alveoli of quartz fiber reinforced plastic and more. The strength demonstrated by carbon fiber reinforced plastics is three times that of an aluminum alloy. However, CFRP also has disadvantages such as, over time, epoxy resin matrices can absorb moisture over a long period of time, which leads to reduced strength. [7]

4. TECHNOLOGIES OF THE FUTURE ESULTS

Driven by the desire to create faster, lighter, more fuel-efficient aircraft, the industry is continuously researching and developing next-generation materials. One of the most revolutionary technologies is three-dimensional (3D) printing, and what is developing recently is four-dimensional (4D) printing. These technologies have the potential to reshape the aircraft created by offering significant advantages when it comes to design flexibility, reduced costs and overall performance of the final product [8]. The latest breakthrough made by Airbus is a

new alloy called Scalmalloy developed specifically for the 3D printing process. This high performance alloy consists of Scandium, Aluminum and Magnesium. [8]

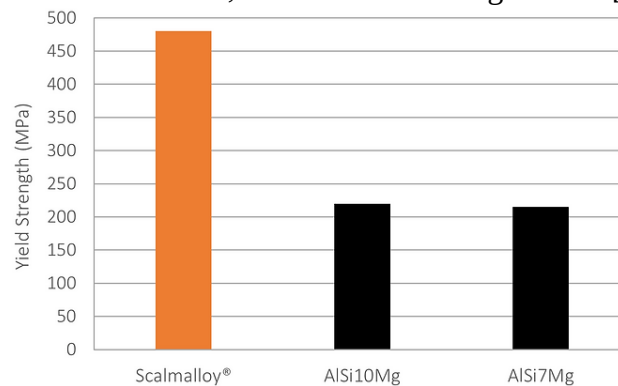


Figure4. The strength of Scalmalloy compared to other aluminum alloys. [9]

5. 3D MODELING

In order to follow the process of creating innovative aircraft models, several iterations will be created and after choosing the best model from the point of view of design, a series of tests will be carried out on the model thus proving that with the innovative design, one can also create a capable aircraft from all points of view.

A multitude of iterations were studied to refine the innovative aircraft designs to a technically functional, modern, visually and flight-optimized aircraft in terms of the materials used for its construction. The last iteration and the one chosen to be designed with Inventor software is present in figure 5.

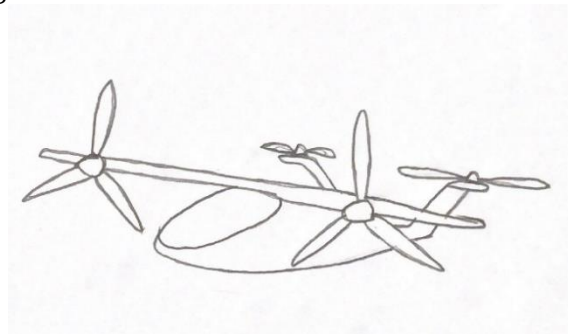


Figure5. Iteration of the 3D model to be developed and studied

The 3D model was designed using Autodesk Inventor software and it faithfully follows the last iteration presented, making it the most competent model in terms of technology, design, functionality and innovation.

The construction of the 3D model was started with the fuselage housing the cockpit, 8 additional seats and a horizontally arranged engine that serves as an aid to propel the aircraft [10]. After the construction of the fuselage followed the construction of the wing, generated from a NACA airfoil. A simple, straight wing was chosen which is functional, easy to build due to the existence of a single NACA airfoil arranged over the entire wing, cheap in terms of materials and which gives simplicity in design.

The classic vertical empennage received a new shape, becoming an oblique empennage, created with spaces where the propellers will be mounted.

Two small horizontal thrusters were created on the wing fulfilling the same role, helping the aircraft in propulsion, on which the propellers will also be mounted.

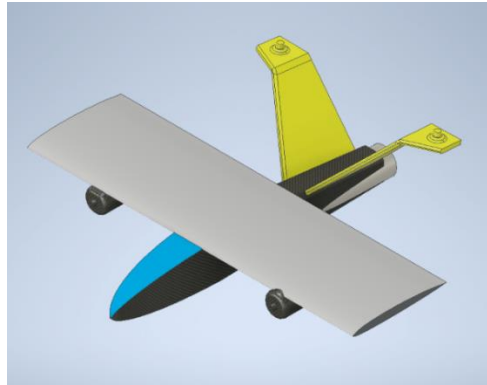


Fig.6. Innovative aircraft 3D model



Fig.7. Propeller

After the design of the aircraft, the construction of the propeller followed. It was built to be made from composite materials.

The assembly of the innovative aircraft equipped with a VTOL (vertical take-off and landing) system is shown in figure 8. This aircraft combines both the VTOL technology used with the help of the propellers located on the oblique wing and the horizontal flight functionality used with the help of the propeller located at the rear of the aircraft and propellers located on the wing.

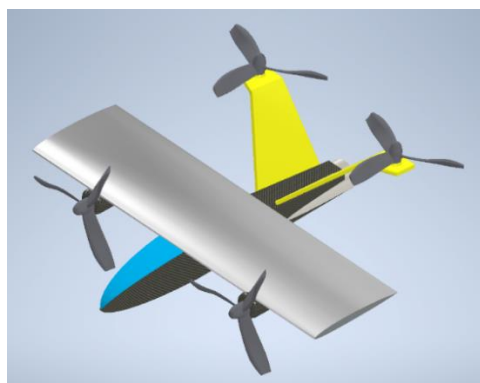


Fig.8. The ultimate innovative aircraft model

6. CONCLUSIONS

The work focused on the creation of an innovative aeromodel. The given design solution combines the aerodynamic efficiency of the prototype, the use of modern, light and cheap materials and the integration of modern technological options.

Throughout the work, numerous objectives were achieved, such as the success of optimizing the aerodynamic shape of the aircraft by introducing the vertical take-off and landing system. Another carefully studied objective is the choice of innovative materials to be as cheap and durable as possible. For the manufacture of the propellers, CFRP (carbon-fiber reinforced plastic) was used, for the manufacture of the wing, a composite material was also used, front of the fuselage of the prototype for which the new Scalmalloy material created for 3D printing technology was used, considerably reducing the costs of some classic materials while increasing flight performance.

For the realization of this aircraft model, a laborious and developed study on accessible and also efficient manufacturing methods was necessary for the eventual production of the aircraft model [11]. Also creativity merged with functionality to create a new aircraft model.

The prototype model aircraft will be proposed for future research to demonstrate the reliability of the design. Also, the model will be continuously improved and developed to reach the final version and to explore the possibility of integrating artificial intelligence for an eventual autonomous model. The paper proves that without new ideas there is no technological advance and that the aerospace field is worth exploring, testing and continuously innovating.

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