Pitch

StratoAvis System is an independent design team dedicated to the application of biomimetic high-performance UAV solutions. We provide fix-winged solutions with lightweight and reliable designs based upon inspirations from high-speed birds, surpassing the performance of the most competitive models in the market with unprecedented adaptability, allowing takeoff and service from anywhere, in any conditions. The StratoAvis is one of the best solutions for mid and low-end survey-related market, providing industry level solutions at significantly lower costs, revolutionizing UAV design with utmost reduction in complexity.

Team

Our team is formed as a group of friends holding different specialties and interests but commonly willing to utilize technology to change the world. We have conceived of this innovation from to our mutual interest in observation of the nature - the exceptional flying capabilities of falcons.

The team roles are:

Hanyue Shen: CEO and General Engineer;

Xueyi Shen: Product Manager;

Yehao Wang: CMO and Structure Engineer;

Miya Wang: Content and Art Director;

Floria: Material Engineer and Artist.

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Our engineering crew is proficient in design and analysis skills required to professionally design UAVs, while being connected to related institutions and experts who can provide assistance in validation and experiments. The content and marketing crew is experienced in both engineering and social and environmental sciences, and hence able to formulate application plans for our product. Our artists are experienced in planar designs and website designs, helping us to professionally present our materials.

Opportunity

Since the manufacturing technologies and materials of small and lightweight UAVs are heavily restricted by their sizes and price, overloading and fracture [1][2] are severe problems that restrict the performance of UAVs, as their aeroelastic responses ban them from taking high aerodynamic loadings. For example, common consumer level UAVs are generally capable of only less than 28 m/s [3]. Comparing to birds, human UAVs have lower VNEs with the same wing loading and even stiffer materials [4][5][6][7]. Although military drones can dash at higher speeds, their aluminum hulls and structures are extremely expensive and unacceptable for most civilian uses. With these considerations, there is room for improvement in drone designing in order to either increase the maneuverability of UAVs or decrease the structural weight, both as a result of improved response to aerodynamic loading. The improved aeroelastic effects, combined with acceptable aerodynamic efficiency, will benefit the operators by decreasing their needs for larger and heavier UAVs and their costs, as well as decreasing the manufacturing technology required for small UAVs, allowing more rapid and uncostly production.

Innovation

The StratoAvis System provides a bird-like system solution based on aerodynamic and aeroelastic optimizations. One major trait of our products is a bird-like wing.

Other than conventional straight wings or segmented wings, StratoAvis system takes a parametric approach to resemble the wing geometry of a fast-cruising peregrine falcon. It uses a forward sweeping inner wing segment combined with a backward swept wing. Not only is its wingspan reduced, the design also incorporates massive aerodynamic and aeroelastic advantage. Moreover, the mid segment of the wing is thickened, rather than conventional tapered wing with decreasing chord lengths, which is justified by observations on fast-flying avian creatures.

The M shaped geometry and thickened mid-wing chord distribution contributes to the decrease in aeroelastic bending, pitching, and fluttering due to loading. Due to differences in effective force action points between the aerodynamic lift and the gravity, bending moment and torsion moment will be created and the wing will bend upwards and be twisted when experiencing lift force. A backward wing tends to pitching downward, and the forward wing pitches upward. The increased mid-wing chord concentrates the stress towards the central sections rather than the root section, and decreases the total stress experienced when the lift coefficient is constant as well as the bending displacement, as analyzed with structural simulations in the preliminary research, the specifics of which and brief tables are given in Appendix I – Research Paper (Hanyue Shen). The M shape then cancels the mid-wing stress by countering torsion moments at the tip of the forward swept section (the turning point) with the downward torsion moment produced by the outer section, hence decreasing the aeroelastic twisting and bending even further. Results indicate that the bending is decreased by over 5%, the stress by over 8.8%, and the highly loaded area by over 20%, with an aerodynamic efficiency of over 19 (lift-drag ratio) at 19 m/s – a number which is larger than that of B-737, a successful commercial airliner of similar aspect ratio.

The full layout of the StratoAvis UAV incorporates a fluent BWB design, providing a large fuselage containment while reducing the extra parasitic drag. The tail of the aircraft uses a pair of inverted stabilizers to adjust the balancing, while mimicking similar configurations on that of a bird. These traits allow the UAV design to best exploit its aerodynamic and payload capabilities.

The system engineering of the UAV utilizes the advanced concept of modular construction. Being a multipurpose design, the StratoAvis product is intended for very different tasks which require different takeoff and control methods. For this reason, the most recent design produced by the team, S-712-TR and S-713 (see Appendix I – S-713 Technical Handbook), are capable of utilizing different appendages, such a fixed wing, tiltrotor, VTOL, or floating barrels; for purposes such as fire mitigation, the hanging position is also capable of holding appendages such as fire mitigation missiles. Like conventional VTOLs, the fuselage is still capable of holding payloads such as gimbal cameras.

The modular wing design as well as simple inner structure contributes to simplicity in manufacturing and fixing, along with the possibility of replacing with newer or more advanced modules when needed. For example, the outer wing segment can be replaced with solar modules to enhance the flight duration, or with unique designs for validation purposes. Hence, with such a modular design, the StratoAvis is capable of accommodating to complicated tasks as no other small UAVs can.

In summary, the StratoAvis provides a unique modular solution based on extensive research and optimization on high-speed wing layout and other advantageous design traits, allowing for extreme performance and adaptability.

Validation

Industry-level validation is carried out by the StratoAvis team to ensure the quality of the product in different aspects.

In the initial design phase, the product has been iterated with data from Symula virtual wind tunnel platform for double-validation of aerodynamic data. At the mid design phase, two wind tunnel experiments are carried out for the purpose of simulation data validation and comparison experiment.

The larger wind tunnel experiment is carried out in Shanghai Automobile Wind Testing Center, a laboratory under Tongji University. It is chosen for its capability of fast wind speed testing with a larger testing segment size, capable of containing up-to-scale model of the design. However, since it is a testing device designed for automobiles, it does not return lift and moment data as wind tunnels for aircrafts do. Therefore, the measurement is in terms of 14 distributed pressure sensors and a pair of laser displacement sensors for the aerodynamic and aeroelastic data collection. The eventual results processed indicate industry-level fitness with the simulated data, and proves that previous theoretical and CFD works are valid.

The second experiment is carried out with a homemade desktop wind tunnel constructed in the offline facility of the team. Two SLA full wing models with 1:53 scale are placed in the open testing segment to directly compare the aeroelastic responses of the designed wing and a conventional delta wing with controlled variables. Displacement data is captured by high frame rate camera and analyzed using graphical tools on computer. Experiment has returned that the designed wing reduces the fluttering amplitude and frequency by over 20%.

For more information concerning the data and results, please see Appendix I – Research Paper (Hanyue Shen) and https://www.StratoAvis.design/wtdata

To evaluate the structural design of the product, the StratoAvis team has also manufactured four S-712-750 in order for evaluation of connection designs and manufacturing. For example, the team evaluated on how the 3D printing manufactures the winglet and changes the sinusoidal winglet in early S-712 versions into a straight wing fence in S-712’s publicized versions. With discussions concerning the weaknesses present on the design, the team actively make changes to the draft to produce improved versions of the S-712 and the S-713 more recently.

Market

Our customer base is mainly concentrated in four different categories. First, we serve corporate entities that use drones for a variety of tasks, including aerial surveying, monitoring, and service delivery. Secondly, we serve hobbyists who are keen to use drones for recreational purposes. Third, our customers include the government and defense sectors, which use drones for special missions such as surveillance and security. Finally, we work with the agriculture sector to help farmers in crop monitoring, irrigation management and pesticide spraying.

What matters most to our customers is durability, efficiency and cost effectiveness, all of which are perfectly aligned with the attributes of our StratoAvis products.

Due to technological advancements and their diverse applications, the unmanned aerial vehicle (UAV) market has seen substantial growth. Current estimates place the global market in the multi-billion dollar realm [8], and this trajectory suggests continued expansion, making it an economically viable project.

In some cases, a dichotomy has emerged between buyer and payer. For example, a business may procure drones for use by employees (the buyer), while the company assumes financial responsibility (the payer). In contrast, government procurement (the buyer) often relies on taxpayer funds (the payer) to make the acquisition.

In the drone industry, the industry ecosystem includes manufacturers, regulators, distributors, end users and service providers. Collaboration between these entities is critical to fostering innovation, ensuring compliance and market penetration. As a manufacturer, our team offers our customers more affordable drones. At the same time, as a service provider, we provide maintenance, repair and training services to our customers.

Competition

Our UAV will be primarily competing with similar small or individual design teams, as well as a few UAV companies that target low-cost segments of the market, such as MakeFlyEasy (MFE). These manufacturers are capable of using foam or carbon fiber materials to produce uncostly UAV systems with industrial payloads, and although they are not producers of scale, they will be competing with our solutions in online platforms as well as industrial groups. The positioning of the StratoAvis system is to target a slightly higher-end market then these solutions, but not as high as targeted segments of firms such as AheadX. This allows us to avoid competing with dominating groups with monopoly power and extremely developed manufacturing technology and experiences, but making us a competitive product compared to lower-end solutions such as those provided by MFE.

Comparatively, while the manufacturing of StratoAvis systems products is significantly less costly than most products with compound material hulls (for example, FoxTech’s carbon fiber solutions), it is not advantageous in cost compared to mass-produced foam solutions (such as MFE’s Striver) though it is not in disadvantage either. However, compared to these solutions, the performance of the StratoAvis is far beyond the market curve – in fact, the performance is at state-of-the-art level (see the end of page <https://www.StratoAvis.design>, where are marketing curve is produced with data from AeroEnvironment’s [11] solutions).

A disadvantage is that as the team is not of scale as of now, the production capability is relatively slow (while it could be accelerated given due investment), and the team is not capable yet of providing much services such as test flights and training, while other producers can. This shortage will be mitigated as the size of the team grows with possible incoming investments and revenue.

Goto Market

StratoAvis primarily attracts the customers by leveraging psychological approaches and th principles of Pareto’s Law. That is, letting the customers believe that purchasing our drones will bring substantial revenues and competitive advantages that our drones offer to businesses, out shining competitors with superior usability, stability, and affordability. In this case, we can let them believe that this cost-effective design and significantly reduces fire hazards, enhancing safety and value.

The pilot customers are local university research teams eager to test out relevant fields of research. For instance, providing the product to FDU research teams. If they confirm that this is a good design, then this would act as a potential advertisement boost to our product.

The market would be served through strategic partnerships and relationship marketing, that is, by cultivating major companies and establishing ourselves as the preferred long-term drone supplier for major companies, meeting their ongoing demands.

Business Model

Our company’s revenue streams are generated through selling, leasing the products, or the licensing of patented technologies (Technology transfer). For instance, other than selling the product itself, we can allow other companies to have license in producing our unique tailless design that facilitates drones to fly in high-altitude with enhanced lift and stability. In particular, by offering production licenses and leases, StratoAvis can also extend the market influence beyond mere monetary measurements. Other than that, assembling the product will also be a revenue source as we can generate $499 gross profit from it.

The pricing for each unit (a prototype), would be around $4999 RMB o $1499 RMB depending on the product. As of now, the three available prototypes are, S-712 FW, S-712-1000, S-701-M, with each having a market price of $2950, $1499, $4499. On the other hand, their costs for manufacturing and other production related costs are each $2000, $1070 and $3800. This would indicate their overall gross revenue to be $950, $429, and $699, approximately half to a fifth of the overall retail prices as pure revenue for future investments.

The design is utilized to maximize pure financial returns and sustainable expansions in the long term, which leads to StratoAvis seizing all market potentials. More information is available in Appendix II – SA BP V3.0.

Fundraising

The StratoAvis team has gone beyond most of the development stages and current needs on fundings are related to prototyping and manufacturing infrastructure. The team is currently hoping for at least $10,000 for the initial prototyping, with unit cost at $3100 (see Appendix II), which will be utilized for manufacturing demonstration models of the designed products and undergo tests such as flight profile confirmation and overloading tests.

No additional funding is required for 3D printing method of. However, for further development, carbon fiber models are considered and such production requires approximately $9000 for molding.

We will look for investors who have experience in the drone industry, who will not only give us financial aids, and also potential customer and cooperation sources. Currently, negotiations are underway with MiraclePlus, a Chinese investing group fitting such description.