

# Aerospace Europe Conference 2023

## Joint 10<sup>th</sup> EUCASS – 9<sup>th</sup> CEAS Conference

---

Abstract #XXX (to be filled by the organizers)

Preferred Topics: SUSTAV / STRMAT / FLOCON

Corresponding author: Sultan Alyammahi

e-mail of corresponding author: [A00051802@adpoly.ac.ae](mailto:A00051802@adpoly.ac.ae)

Type: Oral

Status of corresponding author: Student

For student corresponding author: student member of one of the following:

3AF / AAAR / AIAE / AIDAA / CzAeS / DGLR / FTF / NVvL / PSAA / RAeS / SVFW / EUROAVIA

---

### Title

## Moveable winglets on the wing of the aircraft

### Authors

Sultan Alyammahi<sup>1\*</sup>, Hamad Albalooshi<sup>2</sup>, Talal Alyaqubi<sup>3</sup>, Mohammed Alhammadi<sup>4</sup>, Mohammed Alhammadi<sup>5</sup>, Sheharyar Malik<sup>6</sup>

\* Corresponding author

<sup>1</sup> Bachelor student, ADPoly Al Ain, UAE, [A00051802@adpoly.ac.ae](mailto:A00051802@adpoly.ac.ae)

<sup>2</sup> Bachelor student, ADPoly Al Ain, UAE, [A00052145@adpoly.ac.ae](mailto:A00052145@adpoly.ac.ae)

<sup>3</sup> Bachelor student, ADPoly Al Ain, UAE, [A00052010@adpoly.ac.ae](mailto:A00052010@adpoly.ac.ae)

<sup>4</sup> Bachelor student, ADPoly Al Ain, UAE, [A00057948@adpoly.ac.ae](mailto:A00057948@adpoly.ac.ae)

<sup>5</sup> Bachelor student, ADPoly Al Ain, UAE, [A00057792@adpoly.ac.ae](mailto:A00057792@adpoly.ac.ae)

<sup>6</sup> Assistant Professor, ADPoly Al Ain, UAE, [sheharyar.malik@adpoly.ac.ae](mailto:sheharyar.malik@adpoly.ac.ae)

### Abstract

This paper presents an idea of moveable winglets and its effect on the flight. With the aviation industry becoming major contributor in the transportation industry. Much of the fuel consumption is shared by the aviation industry. Whether the aircraft is a cargo or passenger aircraft, saving fuel and increasing the range is what all aircraft designers are after. Since last few decades, there have been several design changes have been implemented that differ from the initial design of the aircraft. These changes are implemented due to the recommended safety features and to improve the aerodynamic performance to reduce the fuel consumption. The changes include implementing the aerodynamic fuselage shape and wing shape, making the surface smoother for laminar flow, retractable landing gears configuration for the drag reduction [1]. More recently, the concept of active control has been introduced which improves the aerodynamic performance over the surface by active changing the shape of the structure. One prominent example in this regard is the morphing cambered wing [2]. The design is yet to be implemented by industry and approved by the governing bodies but it holds the potential to reduce the drag. Winglets are also found in new aircrafts, they are used on large aircrafts to reduce the drag. The winglets are semi-vertical extensions the wing at the wingtips of an aircraft. Winglets are small airfoils that reduce the aerodynamic drag that develops at the wingtips as the airplane moves through the air. They reduce the drag by overcoming the lift-induced drag on the wing tip [1]. The lift induced drag is due to vortices originating due to difference in pressure distribution between the upper and lower surface of the wing. This pressure differential also influences the flow on the span of the wing as well as it escalates the flow separation on the wing surface thus inducing stall at low angle of attacks and higher stall speeds [3]. The lift induced drag contributes more towards total drag at low speed and high angle of attack i.e. during the takeoff and landing phase. However, as the speed increase during cruise, the contribution of the lift induced drag considerably decreases [4]. In such a scenario the winglets are not effective as they were at low speed and high angle of attacks. So, the idea is to convert the winglets in to the part of the wing at high speed and low angle of attack. This will not only increase the lift on the wing due to increase in the span of the wing but also it will reduce the lift-induced drag by increasing the span of the wing [5]. In this paper a design of the winglets will be presented which can be aligned with the wing during the cruise flight. A flexible spar will be developed for this purpose. The spar will be moved with the help of the tendons attached with servo motor. The servo motor will be driven by the Arduino controller. The design of the spar, winglets is generated by the

help of the freely commercially available software BLENDER. The effect of the morphing winglets will be presented in this paper.

## References

- 1) Aviation Handbooks & Manuals, Federal Aviation Administration. Available at: [https://www.faa.gov/regulations\\_policies/handbooks\\_manuals/aviation](https://www.faa.gov/regulations_policies/handbooks_manuals/aviation) (Accessed: February 1, 2023).
- 2) S. Malik, E. Elaggan, and Peter Dawson, "Design, Analysis and Fabrication of Morphing Airfoil," AIAA SciTech Forum 2021.
- 3) Winglets, [https://www.nasa.gov/pdf/89234main\\_TF-2004-15-DFRC.pdf](https://www.nasa.gov/pdf/89234main_TF-2004-15-DFRC.pdf) (Accessed: February 1, 2023).
- 4) Dunbar, B., NASA Dryden Technology Facts - Winglets, NASA. NASA.
- 5) This is how winglets work (no date) Online Flight Training Courses and CFI Tools. Available at: <https://www.boldmethod.com/learn-to-fly/aerodynamics/how-winglets-reduce-drag-and-how-wingtip-vortices-form/#:~:text=Winglets%20Are%20Wings%20That%20Generate%20Forward%20Lift&text=But%2C%20wingtip%20vortices%20change%20the,bending%20the%20relative%20wind%20inward> (Accessed: February 1, 2023).