A Wing Is Enough: An Improved Flying Wing Based on a Bell-Shaped Lift Distribution

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Flying wings offer an enormous potential to reduce drag and weight. Unfortunately, flying wings are significantly more critical in terms of flight stability than aircraft with tail assemblies. In many cases, flying wings are so unstable that they are only able to fly with the support of complex computer systems. The objective of the project was to design and test a flying wing based on the concept of the bell-shaped lift distribution developed by the Horten brothers in the 1930s. A swept-wing configuration together with this unique lift distribution ensures an aerodynamic stabilization comparable to conventional tail assemblies. The target was to achieve flight characteristics comparable to those of conventional airplanes even without any electronic stabilization systems. To test and analyse the concept, an interdisciplinary approach was chosen to examine the concept both theoretically and practically using a self-designed remote-controlled and flight-capable model. To measure the complex movements even in a small model I developed some of my own telemetry and video analyses to perform a qualitative and quantitative examination of the flight characteristics in a wide variety of flight situations. Furthermore, a specially designed system for controlling about the yaw axis (flaps extended in opposite direction on one side of the aircraft) was implemented using self-adapted software and tested in practice. The goal of smooth and safe flight characteristics, even without electronic stabilisation, was achieved in full. The flight behaviour is completely comparable to that of conventional airplanes and the drag is noticeably lower.

Awards Won:

Intel ISEF Best of Category Award of $5,000

Society of Experimental Test Pilots: First Award of $1,500