Proverse Yaw Characteristics of a Powered Blended Wing Body Aircraft of a Novel Design and Manufacture

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Most modern aircraft have an elliptical lift distribution (ELD) that results in induced drag across its entire wingspan. Induced drag leads to adverse yaw, the undesirable tendency for an aircraft to yaw in the direction opposite of its roll, necessitating structures (such as rudders) for yaw control. In contrast, the bell-shaped lift distribution (BSLD) results in induced thrust instead of induced drag at the wingtips, which confers two notable benefits: Proverse yaw, the opposite of adverse yaw, and increased yaw stability. A powered blended wing body (BWB) aircraft with a BSLD was designed and constructed using a novel technique that closely approximates the geometry of a non-linearly-twisted wing with multiple linearly-twisted sections that are easier to manufacture. The aircraft was flown to evaluate its yaw characteristics. Flight data were captured by an onboard smartphone running a gyroscope app and correlated with videos of the flights made from the ground. As a control, a commercially-available model aircraft with an ELD was flown before and after its vertical stabilizers were removed. The experimental aircraft consistently demonstrated proverse yaw and yaw stability in flight despite the lack of added structures for yaw control. In contrast, the control aircraft demonstrated adverse yaw during turns and was uncontrollable after its vertical stabilizers were removed. The novel simplified process for manufacturing a wing with a BSLD was validated by the fact that the experimental aircraft performed exactly as expected. This is the first time proverse yaw has been demonstrated in a physical BWB aircraft.

Awards Won:
Second Award of $2,000