Yaw Characteristics of a Powered Flying Wing of a Novel Design and Manufacture

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The drag characteristics of an aircraft are heavily influenced by the lift distribution along the span of its wing. A bell-shaped lift distribution results in induced thrust instead of induced drag at the wingtips, which confers two notable benefits upon an aircraft: (1) Proverse yaw and (2) intrinsic yaw stability. A powered flying wing with a bell-shaped lift distribution was designed iteratively with the aid of the XFLR5 software. It was then constructed from foam using a novel technique that closely approximates the complex geometry of a non-linearly-twisted wing with multiple linearly-twisted sections that are far easier to manufacture. The experimental aircraft was then remotely piloted and flown in predetermined patterns designed to evaluate its yaw characteristics. The flight characteristics of the experimental aircraft were evaluated using data captured by an onboard smart phone running a gyroscope app and correlated with videos of the flights made from the ground. The experimental aircraft, which has no vertical surfaces, demonstrated a consistent positive correlation between the direction of its roll and the direction of its yaw during a turn, indicating proverse yaw. It also demonstrated the ability to continuously correct for small yaw disturbances during flight, indicating intrinsic yaw stability. The novel process for manufacturing a wing with a bell-shaped lift distribution was validated by the fact that the experimental aircraft performed exactly as expected.

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