Introduction

Unmanned Combat Aerial Vehicles (UCAVs) are facing increased threats from the sophisticated enemy. They must be equipped with advanced flight control systems that can navigate complex environments and execute demanding maneuvers. The autonomous aerobatics system is one such example that demonstrates the capability of UCAVs to perform complex flight tasks.

Control Algorithm Methodology

A pilot is essentially a PID Controller. The author’s unique aviation experience as a Certified Flight Instructor and competition aerobatic pilot and instructor has helped to design and implement a Linear Algorithm that has been implemented in Autopilots with a quadrotor to the Valkyrie.

Custom Designed Airframe

The Valkyrie is a 3D printed fuselage with a combination of materials including aluminum, carbon fiber, and plywood. The wings are made of foam core composite material and the fuselage is built from 3D printed parts.

Flying the Slow Roll

- A slow roll is one of 3 fundamental maneuvers.
- 360° roll or no hesitation along the longitudinal axis while level, climbing, or descending.

Roll Criteria

- Roll rate must be constant throughout maneuver.
- Roll must be in a constant plane for the Center of Gravity Track (CGT).
- No change in direction of flight during maneuver.
- Accurate and crisp angle stops between elements during point rolls.
- Maintain axis in level or 45° climbing or descending flight.

Flight Testing, Data Collection, and Fly Off

- VF-1 Valkyrie: The Valkyrie is an excellent example of a slow roll and transition suite, excellent flight characteristics and ease of performance.
- Custom Designed Airframe: The Valkyrie features a 3D printed fuselage and wings made of foam core composite material, providing excellent flight characteristics.
- AERONAUTICAL FLYING: Operation of a UAV to perform aerobatic maneuvers requires a high degree of precision and control.
- FLIGHT TESTING: The Valkyrie is designed to perform 360° slow rolls and transition suites.
- DATA COLLECTION: The Valkyrie is equipped with sensors for data collection and analysis.
- FLY OFF: The Valkyrie is capable of performing aerobatic maneuvers in a controlled environment.

Aerobatic Context Box and Aces

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Autonomous Aerobatics: A Linear Algorithm and Implementation for a Slow Roll

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