

Aerospace Engineering Thesis Defense

Destabilized Aircraft Response: the Implications of Pilot Trim Error

School for Engineering of Matter, Transport and Energy

Mathew Delisle

Advisor: Dr. Timothy Takahashi

abstract

This paper uses a typical aircraft aerodynamic model and propulsion data, representing a configuration similar to the A320, to perform trade studies to understand the weight and configuration effects of “out-of-trim” flight during takeoff, cruise, approach, and bailed landing. It is found that flying an aircraft slightly above the angle of attack or pitch angle required for a trimmed, stabilized flight will cause the aircraft to lose speed rapidly. This effect is most noticeable for lighter aircraft and when one engine is rendered inoperative. In the event of an engine failure, if the pilot does not pitch the nose of the aircraft down quickly, speed losses are significant and potentially lead to stalling the aircraft. Even when the risk of stalling the aircraft is small, the implications on aircraft climb performance, obstacle clearance, and acceleration distances can still become problematic if the aircraft is not flown properly. When the aircraft is slightly above the trimmed angle of attack, the response is shown to closely follow the classical phugoid response where the aircraft will trade speed and altitude in an oscillatory manner. However, when the pitch angle is slightly above the trimmed condition, the aircraft does not show this phugoid pattern but instead just loses speed until it reaches a new stabilized trajectory, never having speed and altitude oscillate. In this event, the way a pilot should respond to both events is different and may cause confusion in the cockpit.

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