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Abstract

This paper presents an analysis of the modelling and simulation of aircraft autorotation, a significant safety concern, especially for highly manoeuvrable aircraft such as advanced trainers, combat, and aerobatic planes. Autorotation is an uncontrolled rotation of the aircraft around its longitudinal axis, independent of aileron deflection, often occurring at high angles of attack when boundary layer separation happens earlier on one wing than on the other. This phenomenon, also known as a "snap roll," can be initiated and terminated by the pilot, but its progression remains beyond control.

The paper discusses two methods for analysing inertial coupling between the angular velocities of the aircraft. The first method, based on a mathematical model with fewer simplifying assumptions, allows for an approximate determination of the unstable regions of aircraft motion. The second method, though employing more simplifications, provides more accurate determination of damping coefficients for rolling and yawing motions, enabling a more precise assessment of stability.

A comparison of both methods show that while differences in the calculated eigenfrequencies are minor, the second method offers unequivocal indications regarding the aircraft's stability.

The simulation results and theoretical analysis underscore the necessity of accounting for inertial coupling effects in aircraft design, particularly for highly manoeuvrable aircraft.

Keywords: flight mechanics, spin, autorotative roll, snap roll