
Module-7

Lecture-34

Phugoid effect and dutch roll motion

Flight demonstration of Phugoid effect

The phugoid is a constant angle of attack but varying pitch angle exchange of airspeed and altitude.

- It can be excited by an elevator pulse (a short, sharp deflection followed by a return to the centered position) resulting in a pitch increase with no change in trim from cruise condition.
- As speed decays, the nose will drop below the horizon.
- Speed will increase, and the nose will climb above the horizon.
- Periods can vary from under 30 seconds for light aircraft to minute for larger aircraft.
- Micro light aircraft typically shows a Phugoid period of 15-25 seconds, and it has been suggested that birds and model airplane shows convergence between the Phugoid and short period modes.
- Too forward location of *cg* results in worse Phugoid.
- Watch <https://www.youtube.com/watch?v=9pQnNh-0pdg>

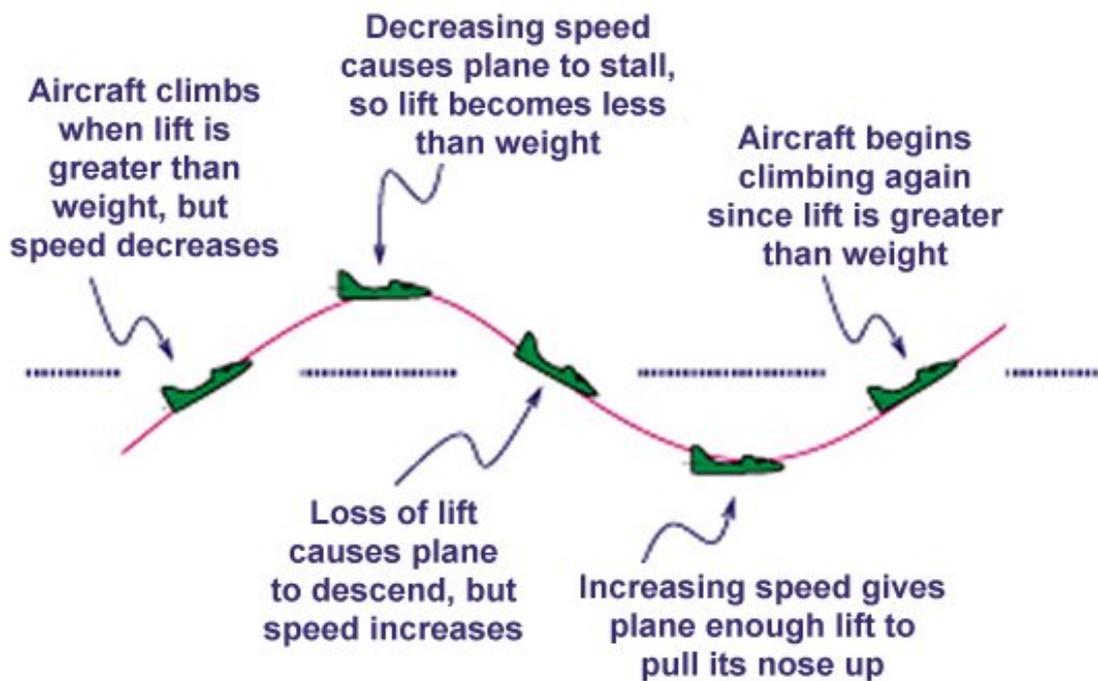


Figure 1: Schematic representation of Phugoid effect

Flight demonstration of dutch roll effect

- Dutch roll is a type of aircraft motion, consisting of an out-of-phase combination of “tail-wagging” and rocking from side to side.
- This yaw-roll coupling is one of the basic flight dynamics modes (others include Phugoid, short period and spiral divergence).
- This motion is normally well damped. Dutch roll modes can experience a degradation in damping, decrease in airspeed and increase in altitude.
- Dutch roll stability can be artificially increased by the installation of a yaw damper.
- Wings placed well above the center of mass, sweep-back (swept wings) and dihedral wings tends to increase the roll restoring force, and therefore increase the Dutch roll tendencies this is why high-winged aircraft often are slightly anhedral, and transport category swept wing aircraft are equipped with yaw dampers.
- *Dutch roll is a messy combination of rolling, slipping and yawing. Like pedaling a bicycle backwards.*
- Watch <https://www.youtube.com/watch?v=k0BbAFzXrRg>

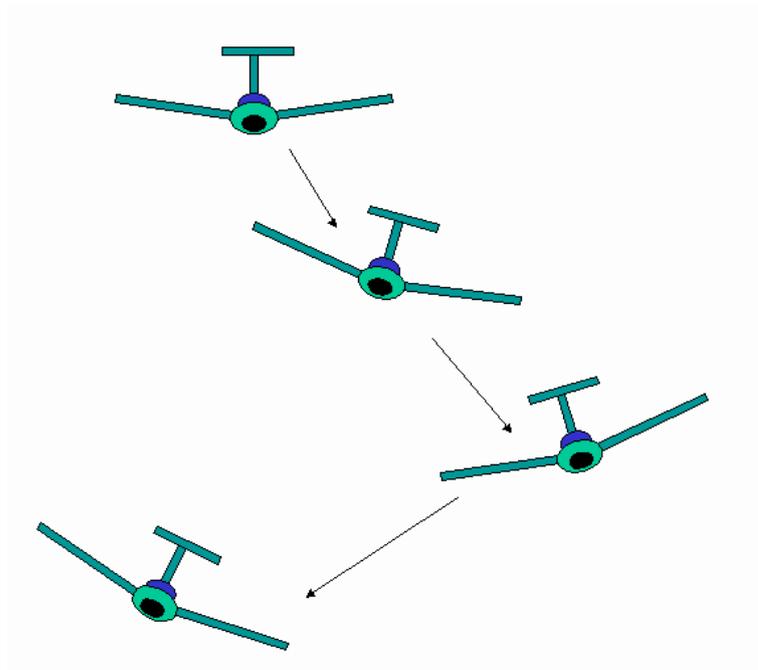


Figure 2: Schematic representation of dutch roll