Basic Mathematical Operating Principles

The figure below shows the axial directions relative to aircraft travel

A diagram of a plane

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where LW = Left wing, RW = Right wing, k is a correction factor. Gust factor is a magnitude of the change in fuel sloshing in the left wing vs right wing times a correction factor. Gust factor has a relationship to stability and whether an unstable attitude was due to a turbulence/external factors or aircraft control.

stability is related to the fuel sloshing and wing acceleration () (in all 3 axial directions) at various airspeeds.

stability is related to the acceleration difference between the left and right wings through the integral of acceleration being airspeed and differences in airspeed between the left and right wings leading to a spin.

stability is related to angle of attack which is determined by the angle of attack sensor.

(s is side, l is location) Stability also has a relationship to the fuel sloshing coefficient for senders in opposite locations on each wing (i.e., if the inboard sender on the left wing experiences a drastic fuel rise and the outboard sender on the right wing experiences a similar affect then the roll stability will change if yaw and pitch are not detected).

The stability in roll, pitch and yaw will be a factor of the first stability equation and that of the corresponding Relationship 4, 5 or 6 for yaw, pitch and roll, respectively. Stability will be a unitless value comparable to a score. The stability value (score) will determine if the aircraft is stable enough. The stability score may be displayed to the pilot either broken down by motion (yaw, pitch and roll) or a combination of all 3. Additionally, the angle of attack will be supplied to the pilot to provide them additional information such as an impending stall.

The overarching concept is to provide the pilot with information regarding stability relative to yaw, pitch and roll as well as angle of attack so that the overall stability of the aircraft can be determined by exploiting the information and relationships present between fuel sloshing (as determined by the fuel senders), airspeed, load factor (as determined by the accelerometers onboard the fuel senders and angle of attack sensor) and angle of attack (as determined by the angle of attack sensor).

The graph below shows a situation in which the load factor has not changed, however, following acceleration of the right wing and deceleration of the left wing, the aircraft is approaching a state where one wing is much faster than the other leading to spin. The speed difference at which a spin occurs will also be influenced by the angle of attack although that is not depicted here. A diagram of a diagram

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In the graph below, the load factor on the aircraft has changed substantially (i.e., steep bank – not shown or aggressive climb - shown) while the aircraft speed remains unchanged. Therefore, the aircraft stability decreases due to the increased load factor. A diagram of a plane

Description automatically generated

The plot below shows system tracking of angle of attack, load factor and airspeed.A diagram of a diagram

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System Communication

A diagram of a flowchart

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