

The first officer flying the Atlas Air B-767 which crashed near Huston airport may have experienced a nose up sensation of up to 80 degrees nose up before he put the aircraft to a dive. The “apparent” pitch angle that the co-pilot might have “felt” that the airplane was at based solely on vestibular/kinesthetic (body’s balance system in the ear canal) perception from loads acting in the co-pilot’s body coordinate system

On February 23, 2019, at 1239 central standard time, Atlas Air flight 3591, a Boeing 767-375BCF, N1217A, entered a rapid descent from 6,000 ft and impacted a marshy bay area about 40 miles southeast of George Bush Intercontinental Airport (KIAH), Houston, Texas. The two pilots and one non-revenue jump seat pilot were fatally injured. The airplane was destroyed and highly fragmented.

The chain of events was probably triggered by an inadvertent activation of the go-around mode which commanded maximum thrust from the engines and a rapid acceleration. The acceleration may have been perceived as a pitch up. To counter the apparent pitch up, the first officer may have pushed the nose down into a steep dive.

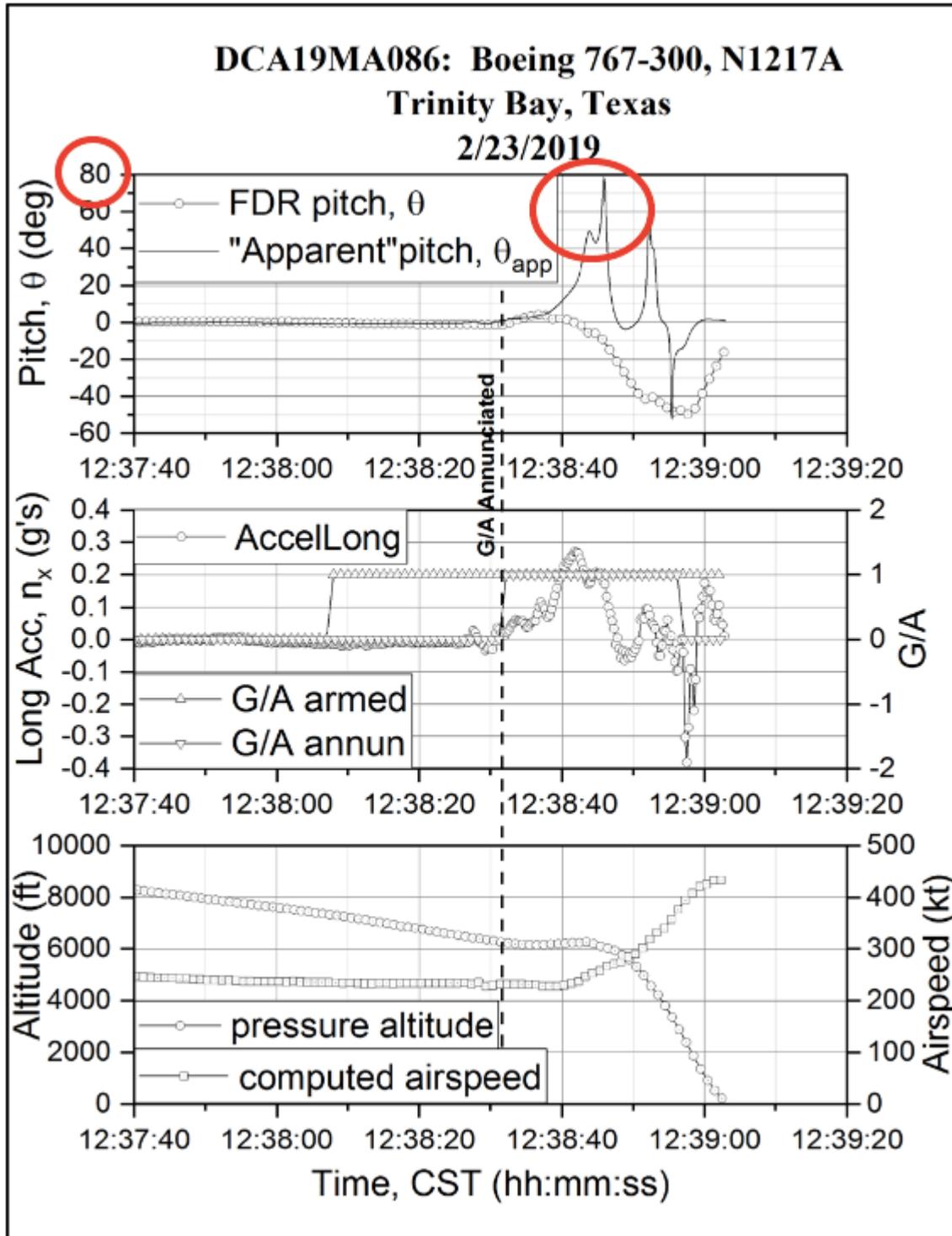


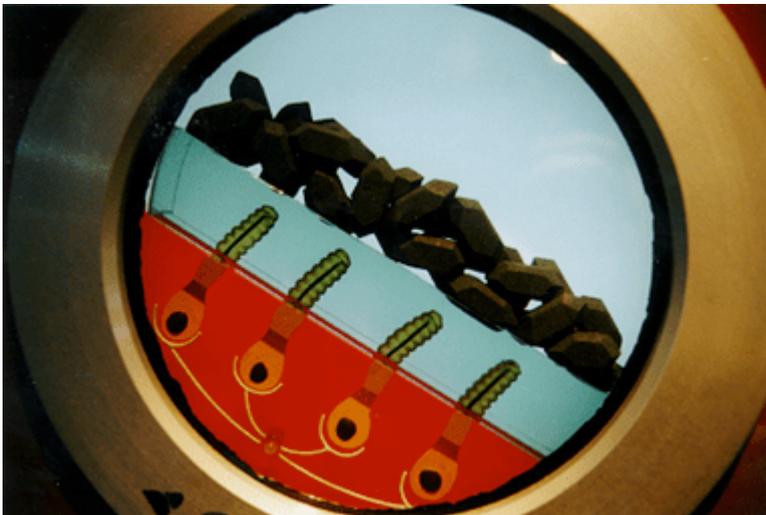
Figure 8: Computed "Apparent Pitch" and Longitudinal Acceleration from FDR

Apparent pitch

Somatogyral illusion

SI is a false sensation of rotation or absence of rotation. Any discrepancy between the actual and perceived rate of self-rotation. It originates in the inability of the semicircular canals to register accurately prolonged rotation (> 30 s).

OTOLYTH ORGAN

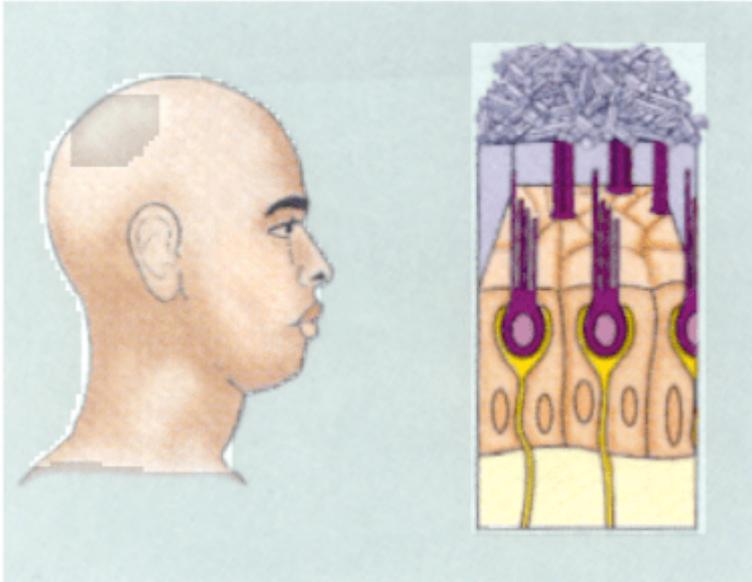


Otolith Organ

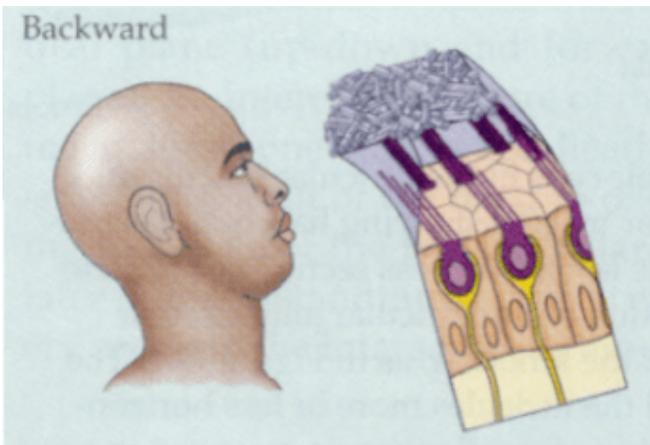
The otoliths consist of calcium carbonate 'stones' embedded in a gelatinous substance. When the head moves, the inertia or weight of the stones bends the hair cells and thus activates nerve cells, sending a signal to the brain proportional to the amount of head movement.

INNER EAR

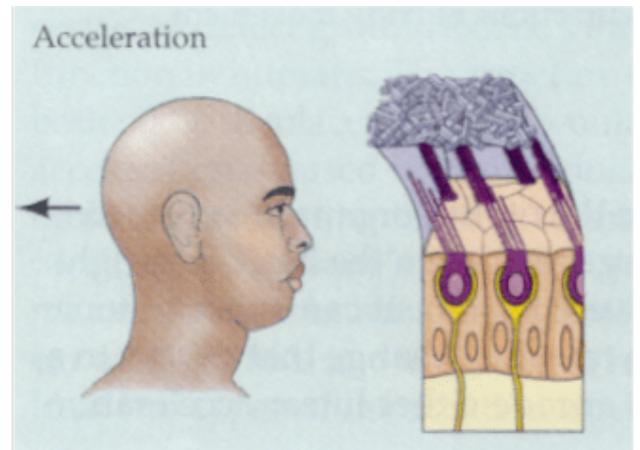
Upright

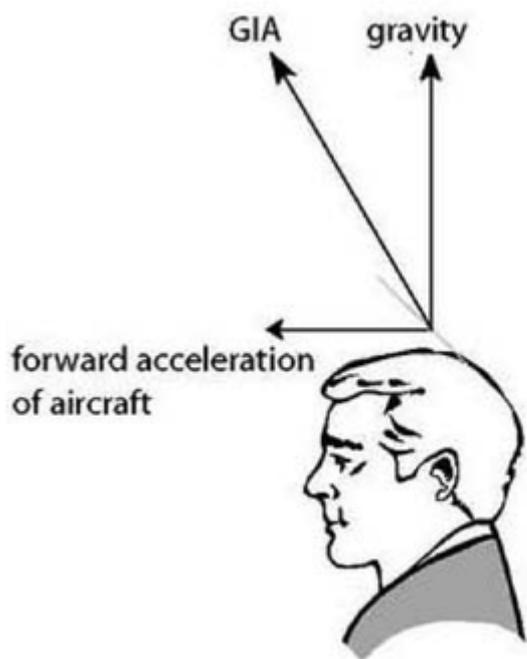


Upright position



Backward tilt = Forward acceleration

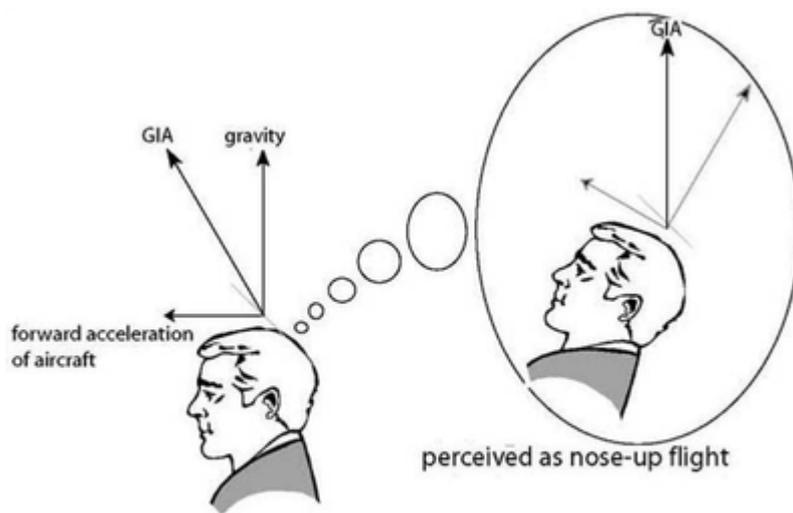




AIRCRAFT CARRIER TAKE-OFF

Gravito inertial acceleration

The gravito-inertial acceleration (GIA) is the vector sum of the vector of gravitational acceleration (upward) and all other linear accelerations acting on the head.



AIRCRAFT CARRIER TAKE-OFF

LA somatogravic illusion is a false sensation of body tilt that results from perceiving as vertical the direction of non-vertical gravito-inertial acceleration or force.

Prevention

- **Prioritize the workload; first, fly the aircraft, then do everything else**
- **Build up experience controlling the aircraft in an environment of conflicting orientation cues**
- **Avoid disorientation by making frequent instrument cross-checks, even when the autopilot is on**
- **Match the instrument readings with your internal mental representation of the flight path**
- **Recover from disorientation by**
- **Making the instruments read right, regardless of your sensation**
- **Don't trust your built-in equilibrium organs, particularly in low-visibility conditions**
- **In moments of stress, make decisions based on the instruments; don't fall**

back on your instinct or perceptions

SHORT CALCULATION

- 1 knot = 0.514 m/s Acceleration after takeoff:
- 30 kts/10s = 1.54 m/s²
- 1 G = 9.81 m/s²
- à acceleration = 0.16 G
- GIA = $\sqrt{1^2 + 0.16^2} = 1.01$ G
- Inclination = $\text{Arc Tan}(0.16/1) = 9$ degrees
- Nose-up impression of 9 degrees

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