

Topic of the Month December Spatial Disorientation



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Presented to: Salem Area Pilots
By: Thomas Gorski CFI
Date: December 6, 2014



This presentation was created by Thomas Gorski (503) 551-1700 for the FAASTeam Topic of the Month Seminar held in Salem, Oregon at Salem Air Center on December 6, 2014.

Welcome

- Restrooms
- Exits & Emergency Evacuation
- Sponsor Acknowledgment
- Interactive Presentation
- Seminar Recording
- Breaks



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Interactive presentation style: Ask relevant questions frequently. It is important to address your concerns and your questions.

Holding pattern for unanswered questions. We can learn much from each other. Questions and answers are very important, so frequent interaction is encouraged.

10 Min break.

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Outline

- **Presenter's Background**
- **Brief Overview of FAASTeam**
- **1st Hour Seminar Focus: Spatial Disorientation**
- **2nd Hour Audience Response Game**
(Based on FAA and AOPA Safety Brochures)

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Presenter's Background

- **1976 – US Army Avionics (Radar) Technician**
- **1984 – 2008 CFI & Charter C414A, LR-JET, CE-500**
- **2008 – 2013 Evergreen Airlines B-747-200, LCF, 400
Director of Flight Standards**
- **2013 – Present CFI, Contract Pilot, FAA Safety
Team Representative volunteer**

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Safety Seminars

FAASTeam Website
www.faasafety.gov

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Activities of the FAASTeam are organized and indexed through the Website
FAASAFETY.GOV

Faasafety.gov is a direct portal between the faa and the aviation community.

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Mission Statement

Improve the Nation's aviation accident rate
by conveying safety principles and practices
through training, outreach, and education;
while establishing partnerships
and encouraging the continual growth
of a positive safety culture
within the aviation community.

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Mission Statement:

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Relationship With Aviation Community

Individuals who makes a conscious effort to promote aviation safety and become part of the shift in safety culture:

Pilots – participate in WINGS - Pilot Proficiency Program

Mechanics – participate in AMT Awards Program

Everyone who attends FAASite Seminars

Thank You!

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Our relationship with the aviation community is made up of individuals who make an effort to promote aviation safety and become part of the shift in safety culture.

Members are:

Pilots - WINGS

Mechanics - AMT

Everyone who Attends Safety Seminars

On behalf of the FAA Safety Team I want to thank each one of you who are here today.

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Overview

- Physiology and limitations of human sight and balance mechanisms
- *Why not to fly by the Seat of your Pants*
- *Visual illusions*
- Best practices for preventing Spatial Disorientation

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In this presentation we'll talk about the limitations of sight and balance mechanisms. We will also show a two-part video produced by the Civil Aeromedical Institute. The first is titled: "*Why not to fly by the seat of your pants*" and the second part is titled "*Visual Illusions.*" The films will show typical disorientation and illusion events. The first video deals mostly with human physiology, and the second focuses on common visual illusions. Both presentations offer suggestions for managing disorientation. Each video runs for approximately 15 minutes.

After the videos we will have discussions about the best practices for preventing Spatial Disorientation.

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Statistics

- Between 5 to 10% of all general aviation accidents can be attributed to spatial disorientation
- 90% of which **are fatal**

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Between 5 to 10% of all general aviation accidents can be attributed to spatial disorientation. 90% of those accidents are fatal.

The physiology and dangers of spatial disorientation are taught during primary and instrument flight training, however, general aviation pilots still have misunderstandings about what it is and how to deal with it.

Accidents caused by Spatial Disorientation continue to claim the lives of too many pilots and passengers every year. Spatial disorientation is ranked among the most cited contributing factors to fatal aircraft accidents.

Number of Spatial Disorientation Accidents resulting in Fatalities



Source: ASF Accident Database

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From 1994 through 2003 Spatial Disorientation caused at least 202 accidents. One hundred eighty-four of them involved fatalities.

So, while spatial disorientation makes only a modest contribution to the overall accident rate in GA, it is responsible for a high percentage of its fatalities.

What is Spatial Disorientation?

- Spatial disorientation is the mistaken perception of one's position and motion relative to the earth.
 - Attempted VFR flight in IMC
 - Night VFR flight in VMC
 - Instrument flight in IMC

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Ask the question (**Click**)

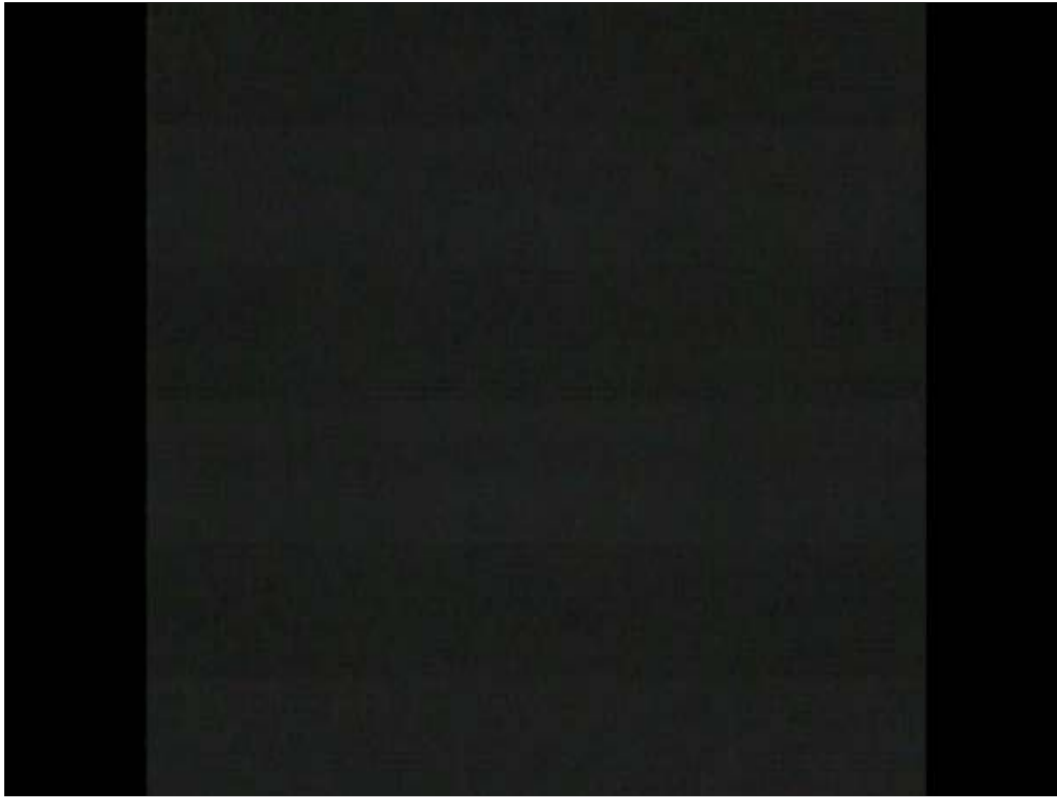
Spatial disorientation is the mistaken perception of one's position and motion relative to the earth.

Any condition that deprives the pilot of natural, visual references to maintain orientation, such as clouds, fog, haze, darkness, terrain or sky backgrounds with indistinct contrast (such as arctic whiteout or clear, moonless skies over water) can rapidly cause spatial disorientation.

Pilots can compensate by learning to fly by reference to their instruments.

Spatial disorientation accidents fall into three categories: (**Click**)

- Attempted VFR flight in IMC.
- Night VFR flight in VMC.
- Instrument flight in IMC.



Video Part 1 focuses on:

Vestibular system

And **Somatosensory (Proprioceptive)** system

Discussion

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In case there is little or no discussion point out that:

An instrument rating is no guarantee of survival when instrument conditions prevail. Spatial disorientation claimed the lives of 113 pilots and passengers in IMC during the last decade. Investigators found evidence of vacuum system and/or instrument failures in at least 24 of these accidents. It's important to remember spatial disorientation can overcome the most experienced pilots even in the absence of malfunctioning equipment.

However, the high percentage of accidents caused by mechanical failures indicates a widespread inability to fly the aircraft by partial panel.

Instrument rated pilots are required to be proficient in partial panel flying, and these statistics indicate why.

Sensory Systems

- **Visual system** – Our eyes, which sense position based on what we see
- **Vestibular system** – Organs in inner ear that sense position by the way we balance
- **Somatosensory (Proprioceptive) system** – Nerves, muscles, and joints; and hearing

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Our organic systems which at times may be responsible for Spatial Disorientation are:

Visual system – **Which sense position based on what we see.**

Vestibular system – **Organs found in the inner ear that sense position by the way we're balanced.**

Somatosensory (**Proprioceptive**) system – **Nerves in the skin, muscles, & joints, with hearing, sense our position based on Gravity, Feeling, and Sound.**

The Auditory System is cited separately when the word Proprioceptive is used. The auditory system is included when the word Somatosensory is used.

Let's take a look at the Video.

Vestibular Sensory Illusions

- Coriolis Illusion
- Inversion Illusion
- The Graveyard Spiral
- The Leans

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To an untrained pilot, these are what appear as limitations of the Vestibular Sensory System

Who in this room knows about what each of these are?

Coriolis Abrupt movements of the head can set the fluid in the semicircular canals moving in such a way as to create an overwhelming sensation of tumbling head over heels. The sensation can be so strong as to lead pilots to lose control of the aircraft. Looking down, as you might when searching for a chart in the cockpit, and then looking up can cause vertigo.

Inversion Illusion – An abrupt change from climb to straight-and-level flight can excessively stimulate the sensory organs for gravity and linear acceleration, creating the illusion of tumbling backwards.

The Graveyard Spiral – This is a high speed, tight descending turn entered as a result of a failure to detect rolling motion. Since any bank rate of less than two degrees per second is not felt, the wing may drop and the plane may begin a turn without the pilot realizing it. As the plane spirals downward and its descent accelerates, the pilot senses the descent but not the turn.

The Leans – This is the most common form of spatial disorientation. It results from a pilot's failure to detect angular, or banking, motion. If a bank is entered slowly, or is maintained long enough for fluid in the semicircular canals to stabilize, and the aircraft is quickly returned to straight and level, the motion of the fluid in the canal will give the sensation that the aircraft is banking in the opposite direction, and the pilot will have a tendency to bank the aircraft into an attitude erroneously perceived to be straight and level. The reason a pilot can be unaware of such a gradual turn is that human exposure to a rotational acceleration of 2 degrees per second or lower is below the detection threshold of the semicircular canals.

Visual Sensory Illusions

- **Autokinesis**
- **Confusing Ground and Star Light**
- **False Horizon**

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The next video goes into detail about Visual Sensory Limitations. Let's take a look at what are apparent limitations of the Visual Sensory System:

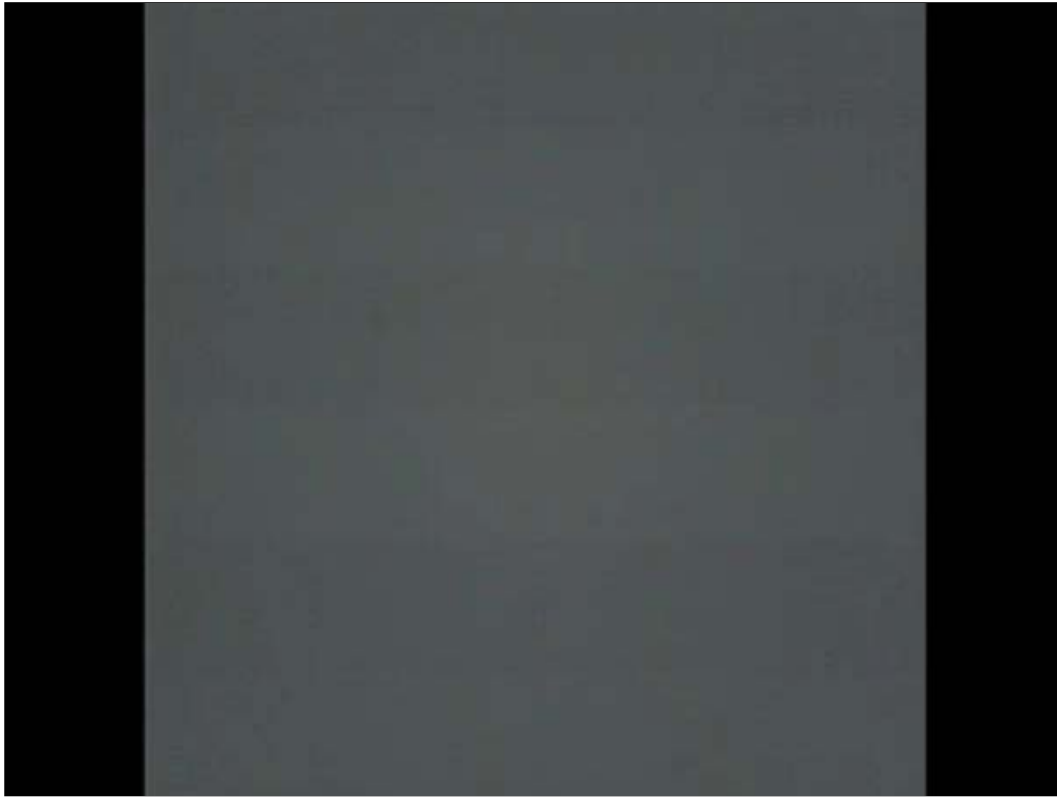
Does anyone not know what Autokinesis is?

Autokinesis – At night, a stationary dim light against a dark background will appear to move if a pilot visually fixates on the light for about six to 12 seconds. This can lead pilots to mistake the light for another aircraft, and to attempt to maneuver the aircraft to compensate for the perceived movement of the light.

Confusing Ground and Star Light – At night, In areas with sparse ground lighting, isolated lights can also be mistaken for stars, which can make the aircraft appear to be in a nose-high attitude or have one wing low. When overcast conditions block any view of stars, unlighted areas of the terrain can appear to be part of the sky.

False Horizon – When the only or most distinct visual reference is a cloud formation, it can be confused with the horizon or the ground. A sloping cloud deck that extends into a pilot's peripheral vision will appear to be horizontal. Likewise, a cloud bank below the aircraft that is not horizontal to the ground may appear to be horizontal. These illusions cause the pilot to fly the aircraft in a banked attitude.

To the untrained pilot these appear to be **limitations**, when actually they are **illusions**.



Video Part 2 focuses on:

Visual system – Our eyes, which sense position based on what we see

Discussion Best Practices

- Be committed to maintaining flexibility
- Consider options *before* the flight
- Evaluate options while en route
- Give yourself room to change your mind
- As soon as you start to feel uncomfortable, go to Plan B

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After any discussion (**click**)

Let's go over some best practices:

A commitment to maintaining flexibility

Consider options *before* the flight

Evaluate options while en route

Give yourself room to change your mind

As soon as you start to feel uncomfortable, go to Plan B

Practice

- **Flight in IMC or Hood with a Safety Pilot or Instructor**
- **Maintain night currency**
- **Practice flying partial panel**
- **Practice Recovery from Unusual Attitudes**
- **Use all available instruments even when operating under VMC**

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Take the opportunity to experience spatial disorientation illusions: (Barany chair, a Vertigon, a GYRO, or a Virtual Reality Spatial Disorientation Demonstrator.) Can also be experienced in a simulator, even with motion turned off!

- Before flying with less than 3 miles visibility, obtain training and maintain proficiency in airplane control by reference to instruments.
- If intending to fly at night, maintain night-flight currency. Include cross country and local operations at different airports.
- Practice flying partial panel with simulated inoperative Attitude and Heading indicators.
- Practice recovery from unusual attitudes under the hood.
- If only VFR qualified, do not attempt visual flight when there is a possibility of getting trapped in deteriorating weather.
- If you experience a vestibular illusion during flight, trust your instruments and disregard your sensory perceptions.



Discussion Question:
 What is going on in this picture?
 After discussion (**Click**)
 How are the above indications now different?
 Cover the Inoperative instruments (**Click**)

Review

- **Physiology and limitations of human sight and balance mechanisms**
- **Disorientation and illusions**
- **Best practices for preventing Spatial Disorientation & Operating Safely**



Questions?

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