

# Enhanced Flight Vision Systems in Commercial Aviation

IASS 2019  
Captain Michael Gillen, Ph.D.  
November, 2019



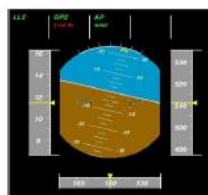
# Evolution of Flight Deck



*FAA Focus Area*



Aircraft Attitude



Attitude & Performance  
On Glass MFD



Flight Info on HUD



Flight Info on HUD With  
Sensor/Database Image

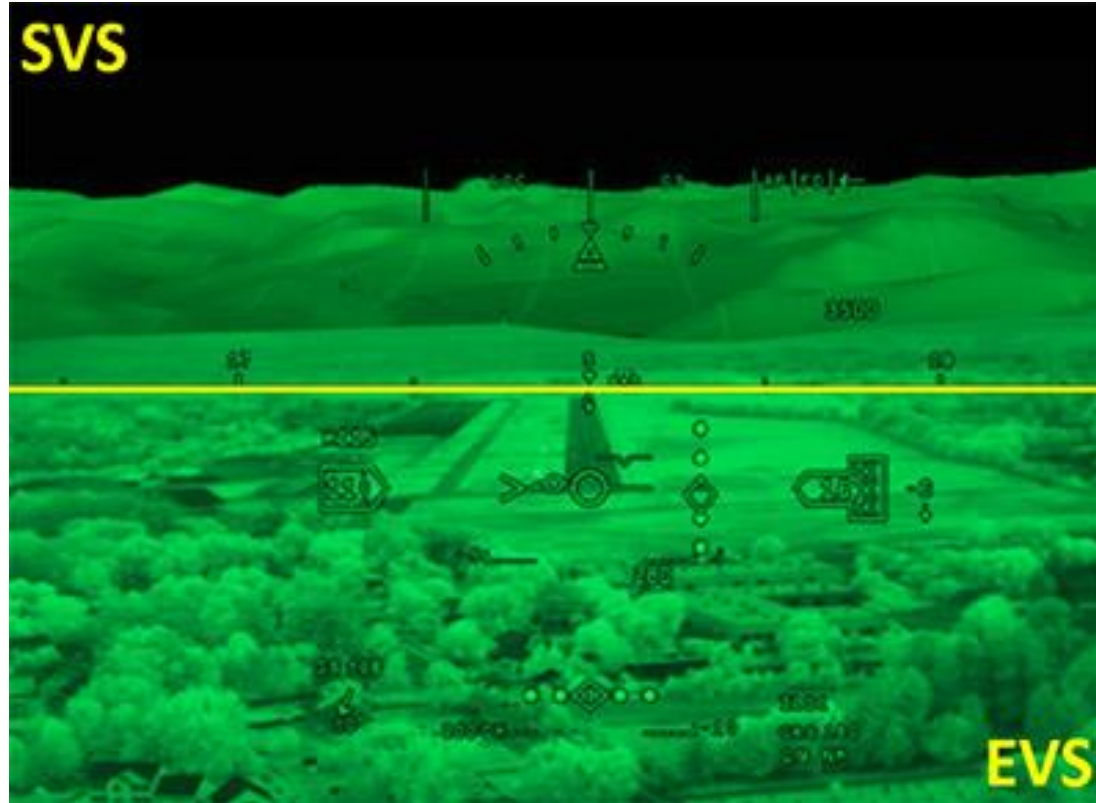


Gulfstream G550  
Boeing 787

# What is EFVS

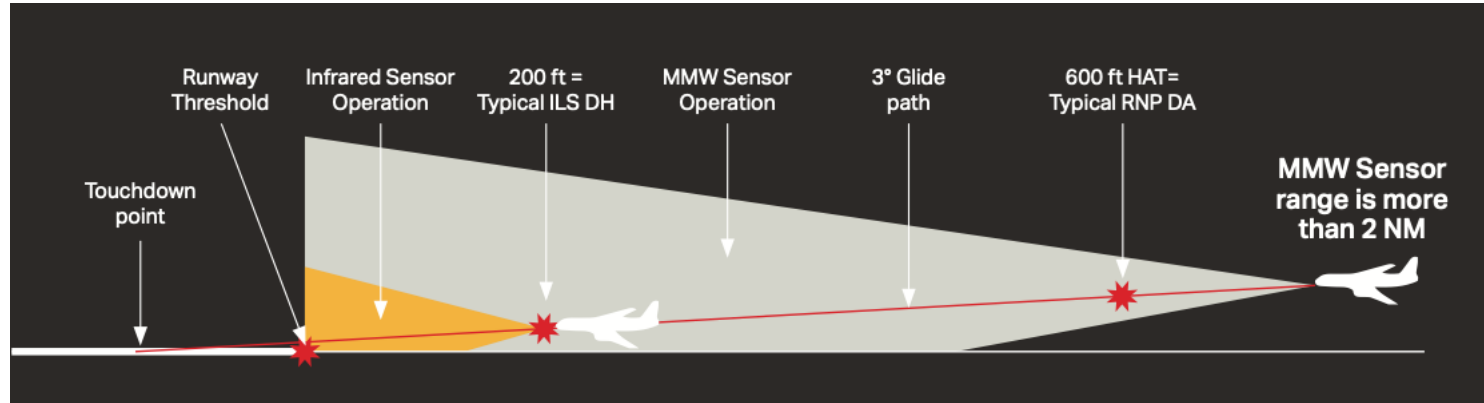


# SVS and EVS Comparison





# EFVS Equipment



# Visual Advantage



- Flight test videos were evaluated at three different altitudes (decision altitude, 100 feet radar altitude, and touchdown) to determine the visual advantage afforded to the pilot using the EFVS/Forward-Looking InfraRed (FLIR) imagery compared to natural vision.
- Results indicate the EFVS provided a visual advantage of two to three times over that of the out-the-window (OTW) view.
- The EFVS allowed pilots to view the runway environment, specifically runway lights, before they would be able to OTW with natural vision.

# Operational Advantages



# New Part 121 EFVS Operations – Regulations

- Permits operators to use an Enhanced Flight Vision System (EFVS) in lieu of natural vision
- Continue descending from 100 feet above the touchdown zone elevation to the runway and land
- Dispatch, Release, or Takeoff under IFR with less than CAT I weather
- Initiate and continue an approach when destination airport weather is below authorized visibility minimums



**Enhanced Flight Vision System (EFVS) in lieu of natural vision**



# Equivalent Visual Operations – Adaptive Technology

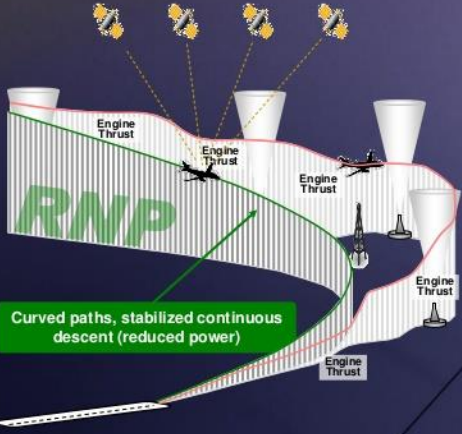
- Is reliable, all weather operation
- Enables dispatch in low visibility by rule
- Approach and landing, by rule, without delay
- All Runways are now lower than CATIII equivalent
- Any approach with Vertical guidance is permitted to landing and rollout, without natural vision
- Takeoff on runways with no guidance or centerline lights provided by EFVS
- Elimination Takeoff Alternates
- EFVS Is Strategic in value to all aspects of our operations for maintaining schedule and expansion to new airports with limited infrastructure
- Maintains schedule reliability
- Low training initial and recurrent



Regains lost capacity due to weather

# NextGen Enhancements

RNP provides precise, stabilized flight path to runway




The diagram illustrates an RNP (Required Navigation Performance) flight path. It shows a curved, stabilized continuous descent profile. The path is defined by a green line, and the area between the path and the runway is shaded with vertical lines. The path is stabilized by engine thrust, as indicated by the 'Engine Thrust' labels and arrows. The path is also stabilized by engine thrust, as indicated by the 'Engine Thrust' labels and arrows. The path is also stabilized by engine thrust, as indicated by the 'Engine Thrust' labels and arrows. The path is also stabilized by engine thrust, as indicated by the 'Engine Thrust' labels and arrows.

**RNP**

Curved paths, stabilized continuous descent (reduced power)

**Fly within containment corridor**



The diagram shows a 3D perspective of a containment corridor. A white aircraft is flying within a transparent, rectangular corridor. The corridor is defined by vertical lines and has a green floor. The aircraft is flying towards the horizon, and the corridor narrows as it approaches the runway.

**Benefits**

- **Safer** more stabilized approach
- **Access** to terrain challenged airports
- **Saves time and fuel**, optimized routing
- **Reduced emissions and noise**

Copyright © 2015 Boeing. All rights reserved. ACE | 6



# Established on RNP (EoR)

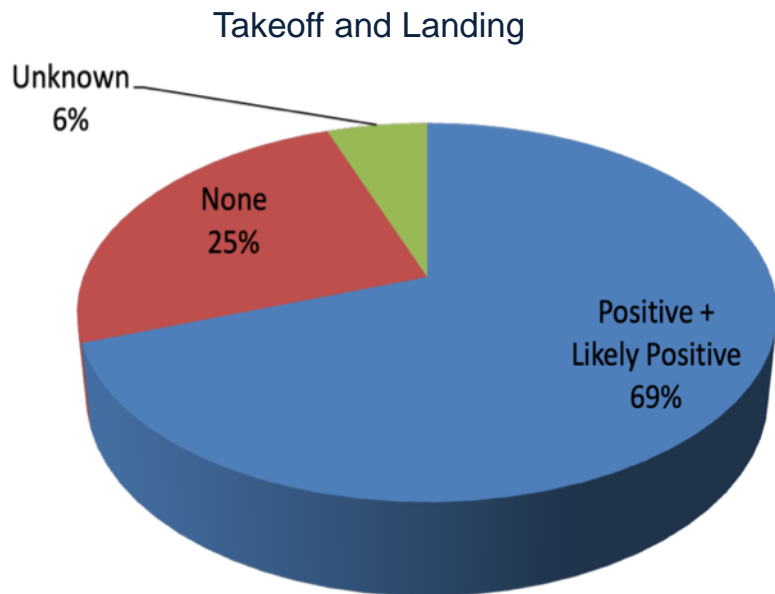


# Safety Advantages

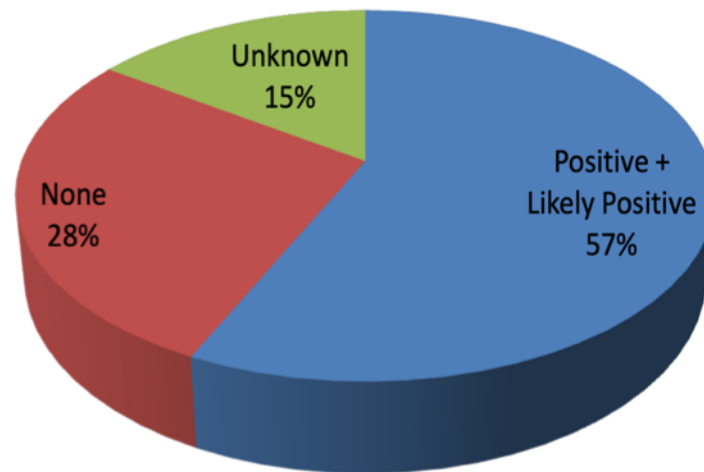


# Flight Safety Foundation – Safety Benefits of HGS Technology

 HGS would have highly likely or likely affected



Inflight Loss of Control – 123 Accidents





# Top Safety Risks Mitigated by EFVS

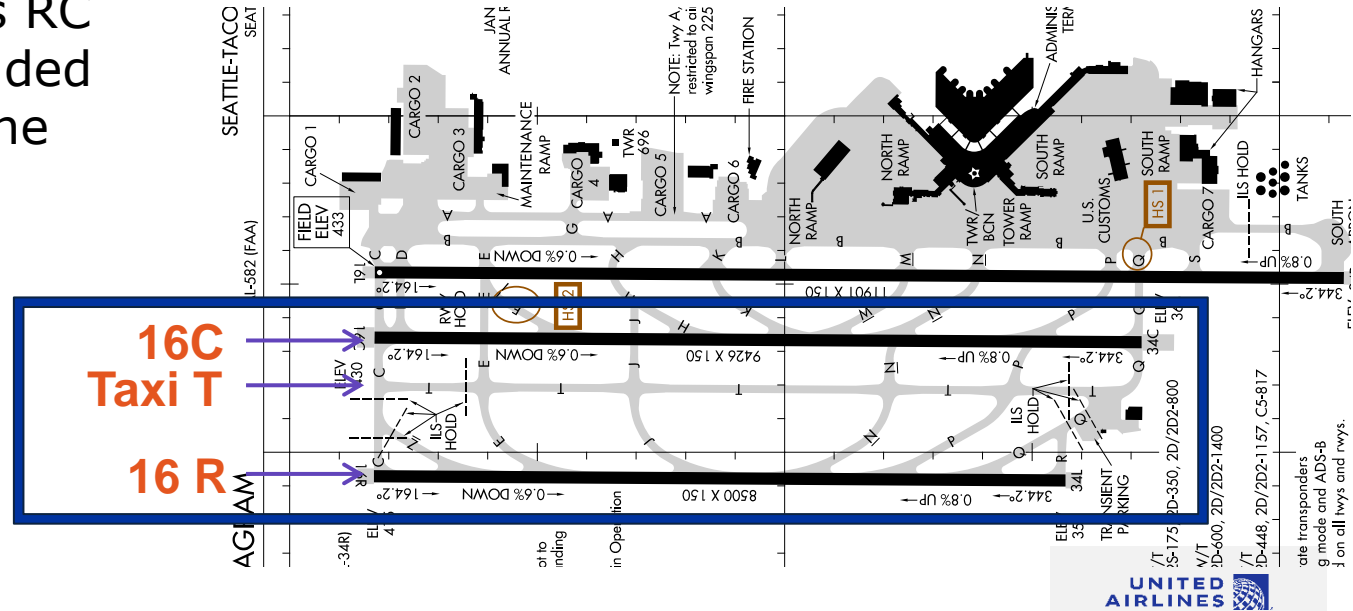
- Misconfiguration on Takeoff
- Controlled Flight into Terrain - EGPWS events
- System Component failures (non-powerplant)
- High altitude stalls – improper response (between 20,000-30,000 feet)
- High rates of descent
- Wrong surface movements
- Use of Flight Level Change (FLCH) below 1000 feet



## Synthetic Vision – Seattle Misaligned Approach

A number of incidents have occurred at Seattle (KSEA) where pilots confused Taxiway Tango with Rwy 16C and 16R to which they were cleared, and landed on the taxiway instead.

Next slide shows RC  
"Synthetic Extended  
Centerline" for the  
selected landing  
runway.



# Landing Runway 16L, Aligned to Taxiway

*Synthetic Vision*



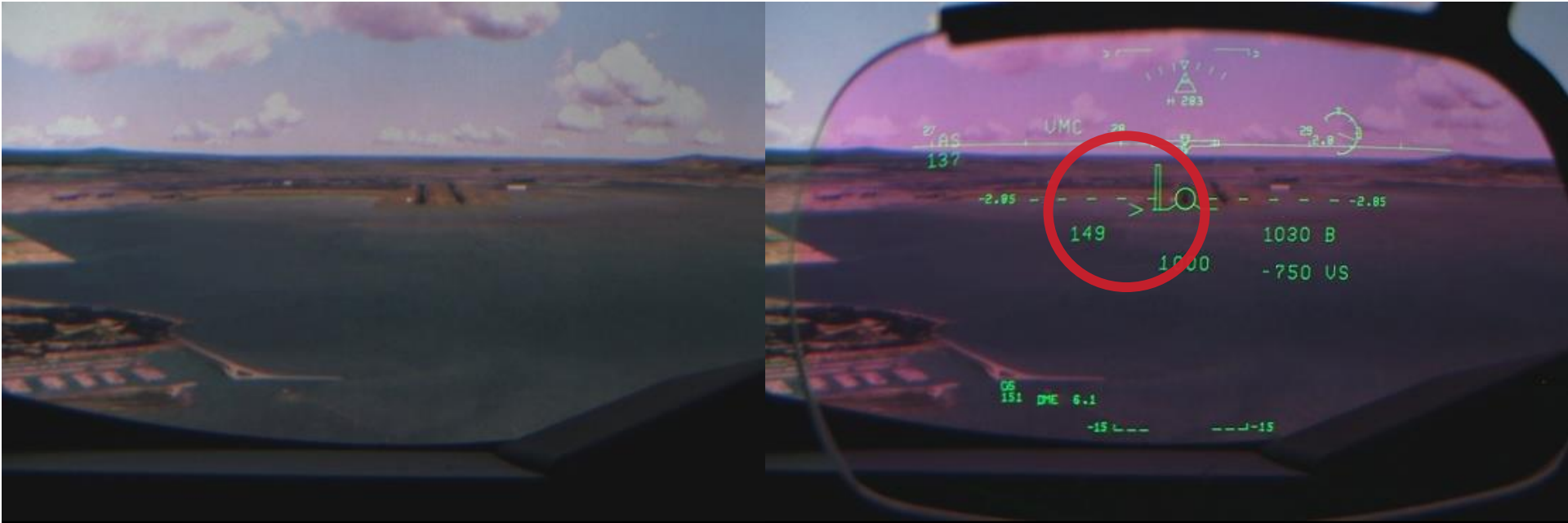
1000' AGL



500' AGL

# Unstabilized Visual Approach – at 1000'

*San Francisco (SFO)*



# Unstabilized Visual Approach – at 200'

*San Francisco (SFO)*





# Unstabilized Visual Approach – at 25'

*San Francisco (SFO)*



# CONCLUSIONS

## Enhanced Flight Vision Systems

- The EFVS sensor performance must be demonstrated to establish eligibility for operational credit
- The EFVS sensor performance should be quantified as an advantage the EFVS (sensor) provides over natural vision in the lowest *reported* visibility that the EFVS is to be authorized
- The EFVS sensor performance should be demonstrated by a manufacturer
- The FAA AEG must be engaged in the evaluation of demonstrated performance.
- Data from EFVS operations conducted during certification should be recorded to assist flight departments in determining eligibility for operational credit. (IAP, VIS, Assessment)
- Documented performance should be easily accessible to individual operators and regulators seeking operational credit

72nd annual

INTERNATIONAL AIR SAFETY SUMMIT

**IASS** 2019

Mike Gillen  
[mike.gillen@united.com](mailto:mike.gillen@united.com)

Questions?

