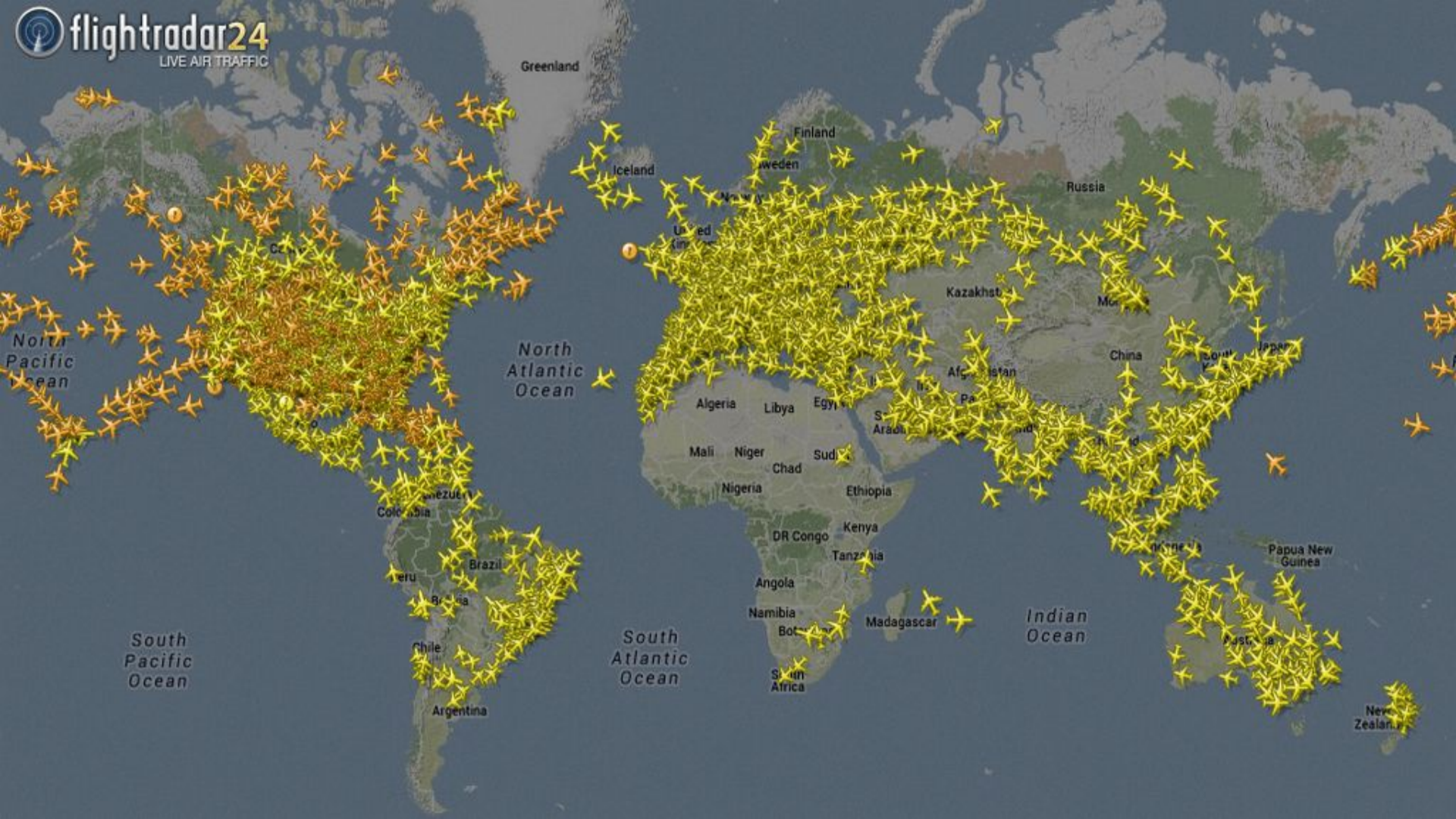
# Wireless Attacks on Aircraft Landing Systems

Alan Xiao, Cyrus Thompson, and Jenna Kaufman

“Every takeoff is optional. Every landing is mandatory.”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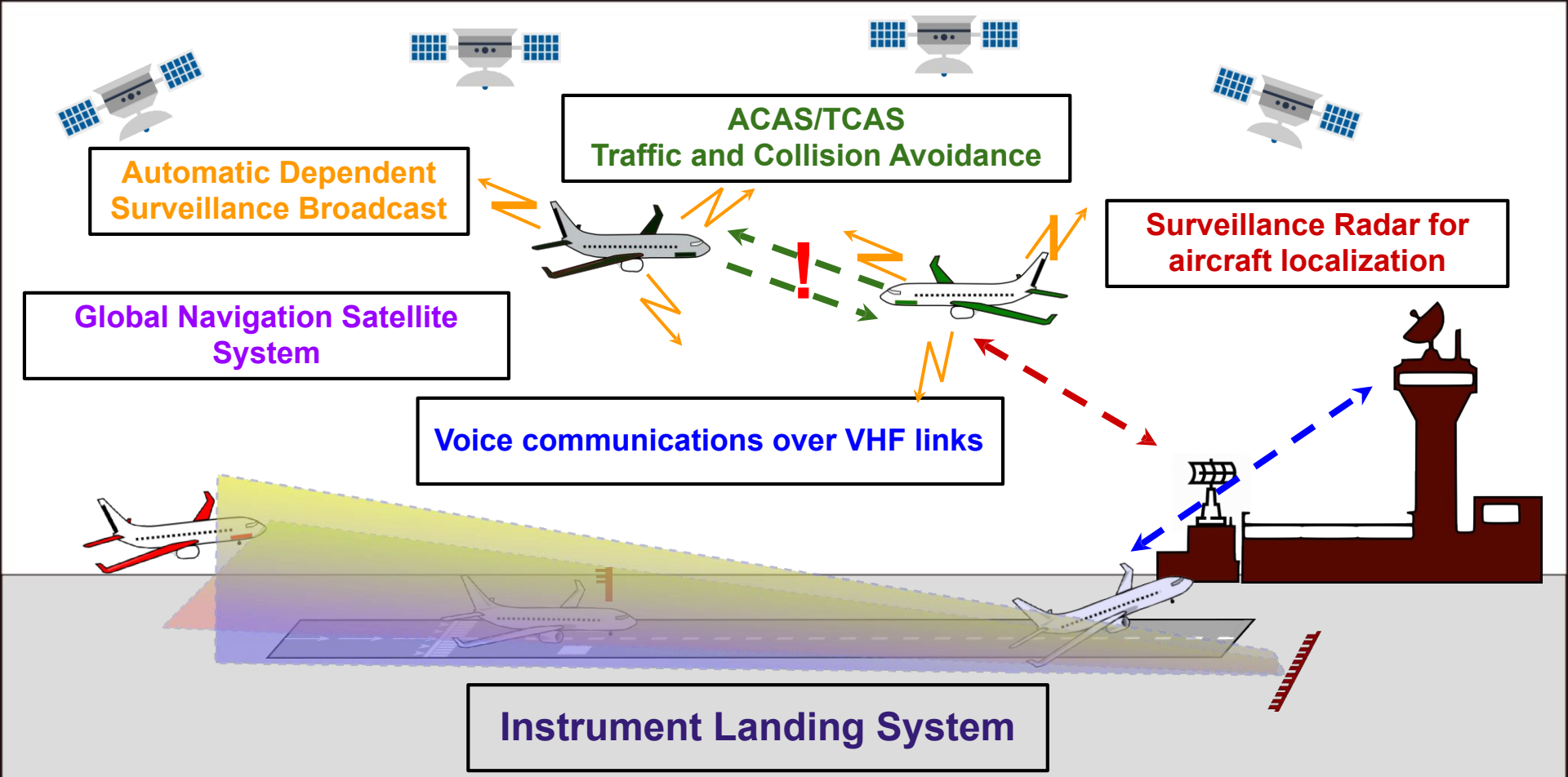
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Traffic and Collision Avoidance
Automatic Dependent Surveillance Broadcast
Surveillance Radar for aircraft localization
Global Navigation Satellite System
Voice communications over VHF links
Instrument Landing System


## Russian Tu-22M3 crash: Expert says instrument landing system to blame 'hard' landing

Jan 27, 2019 in Aviation, News

ENABLING NEXT-GENERATION AIRBORNE COMMUNICATIONS

## Realities and Challenges of NextGen Air Traffic Management: The Case of ADS-B

*Martin Strohmeier, Matthias Schäfer, Vincent Lenders, and Ivan Martinovic*

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ROAD TO NOWHERE —

A $225 GPS spoofer can send sat-nav-guided vehicles into oncoming traffic *

* Some restrictions apply.

DAN GOODIN - 7/18/2018, 7:30 AM

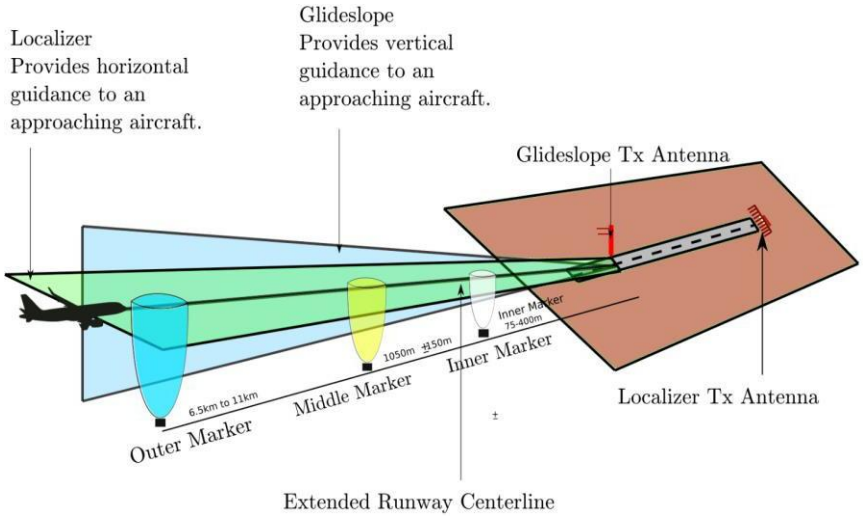
AIN

ADS-B Is Insecure and Easily Spoofed, Say Hackers

by Matt Thurber - September 3, 2012, 12:45 AM

# Aircraft Instrument Landing System (ILS)

- ILS helps aircraft land even in the most extreme weather scenarios
- According to Boeing, 59% of fatal accidents occur during the landing phase
- NASA indicated over 300 cases where ILS malfunctioned
- Landing systems have improved over the years, but are still susceptible to attack: and are perhaps even more dangerous



# Paper's Contributions

Demonstrates two types of attacks

- Overshadow attacks: attacker takes over entire signal
- Single-tone attacks: attacker just transmits one tone

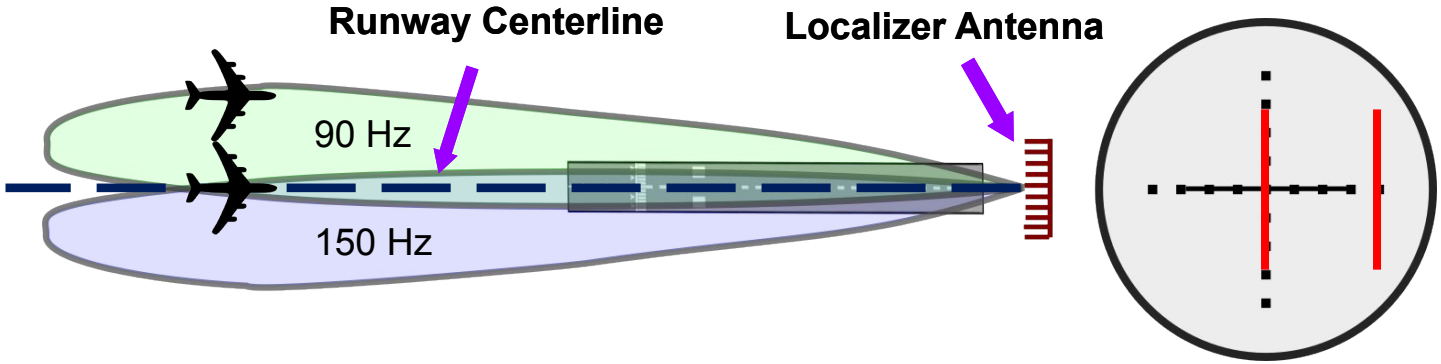
Developed an ILS imitation capable of sending false information to aircrafts

Demonstrated attacks on a FAA certified flight simulator

Discuss possible countermeasures against such attacks

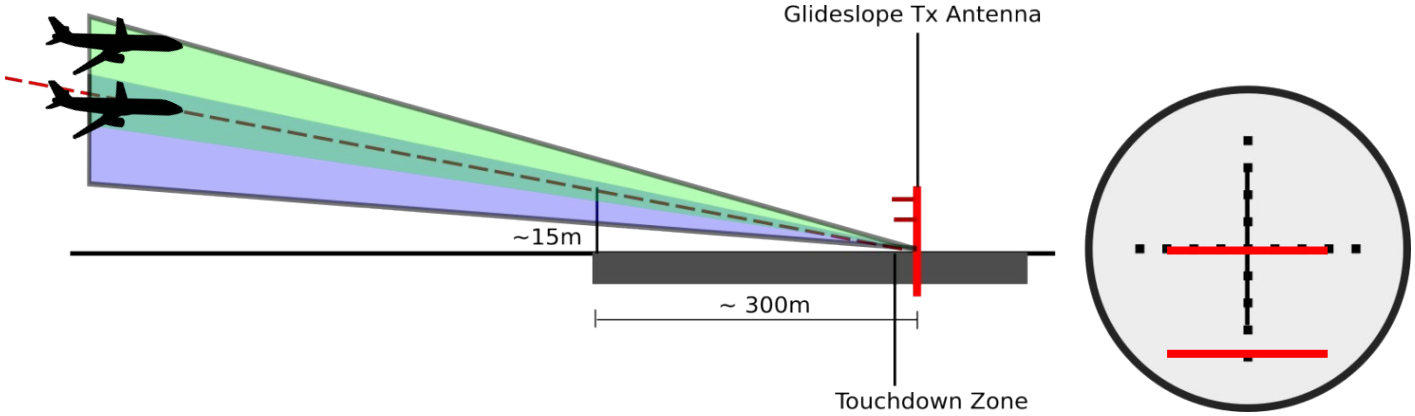
# Localizer

- Provides horizontal guidance for an aircraft
- Finds the aircraft's location with respect to the runway centerline
- Needle helps pilot align themselves

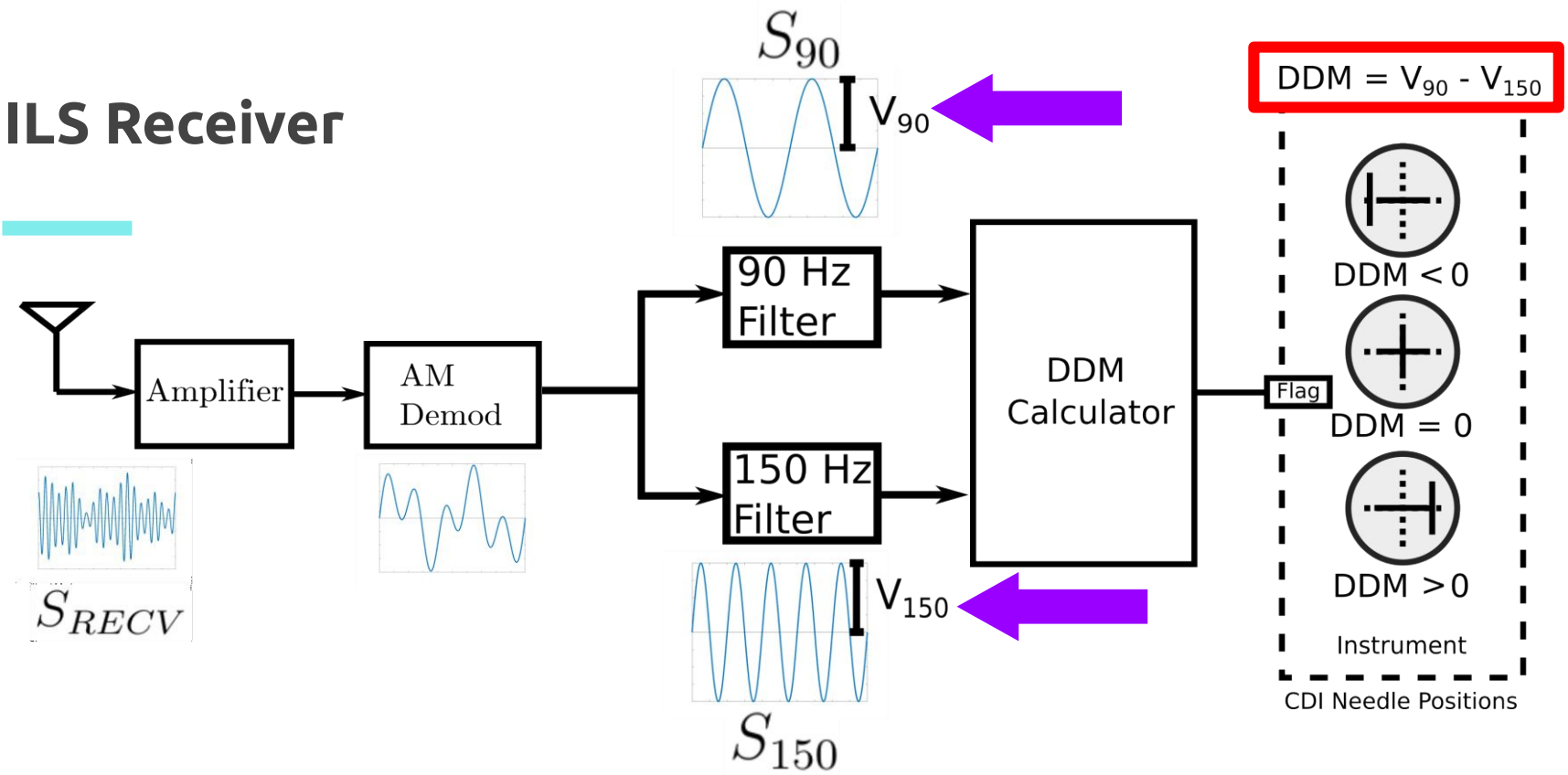


# Glidescope

- Provides vertical guidance for the aircraft
- Finds location based off of glidepath



# ILS Receiver



# OverShadow - Wireless Attacks

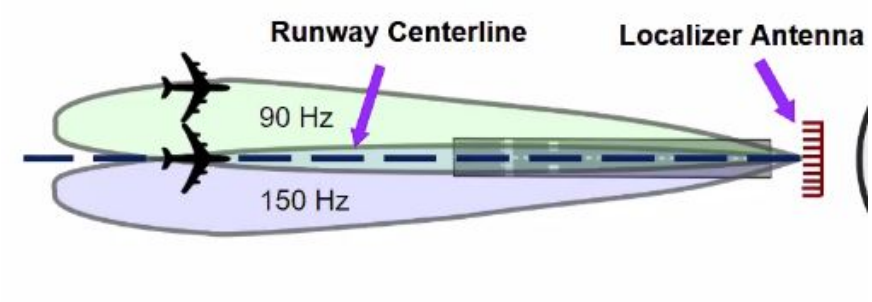
**Simply puts out a stronger signal**

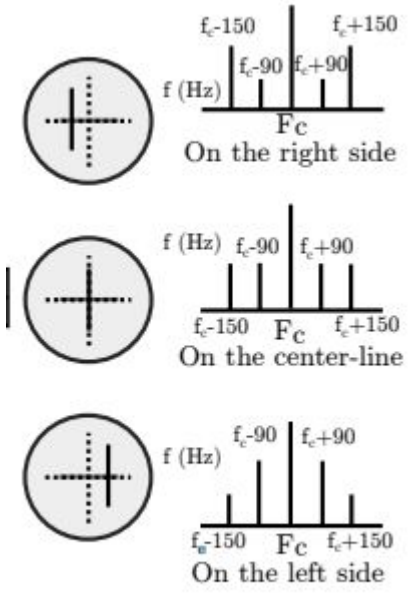
**Requires more power**

**Is less complicated**

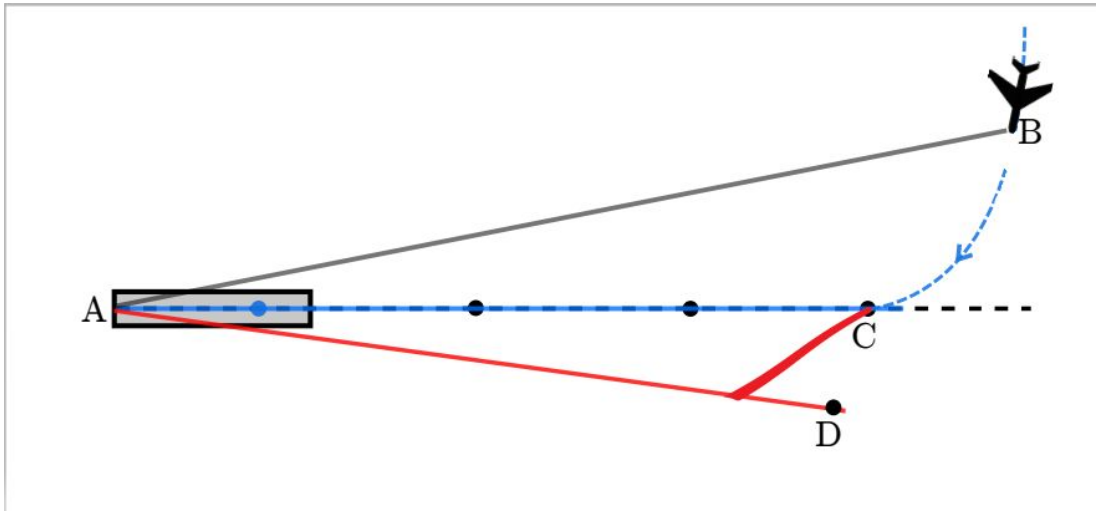
# Single-tone - Wireless Attack

- Attacks either the 90 Hz or 150 hz tone
- Requires Less Power
- More Complicated

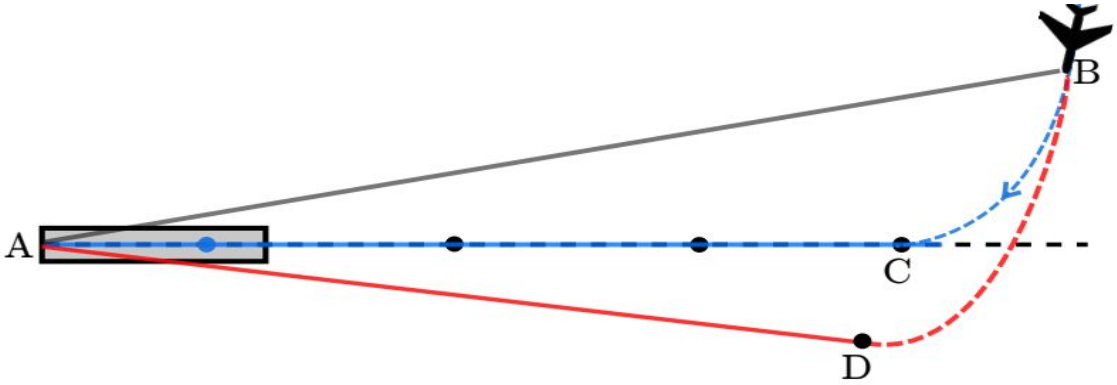


# Bad Approach



# Better Approach

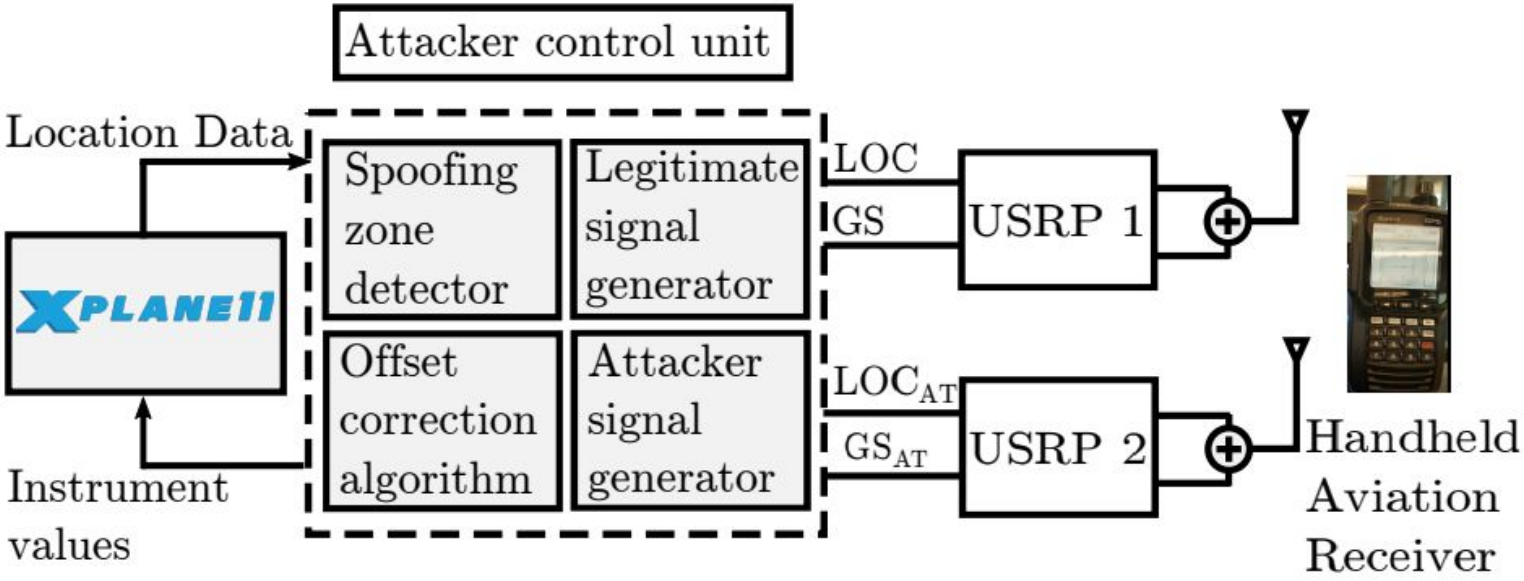


# How this was Done

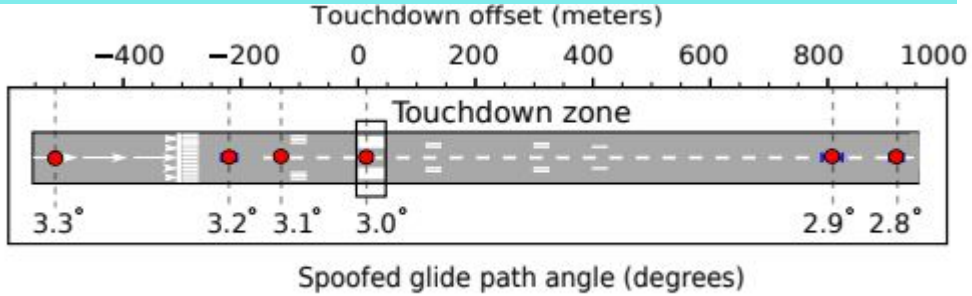
**Algorithm 1** Offset correction algorithm.

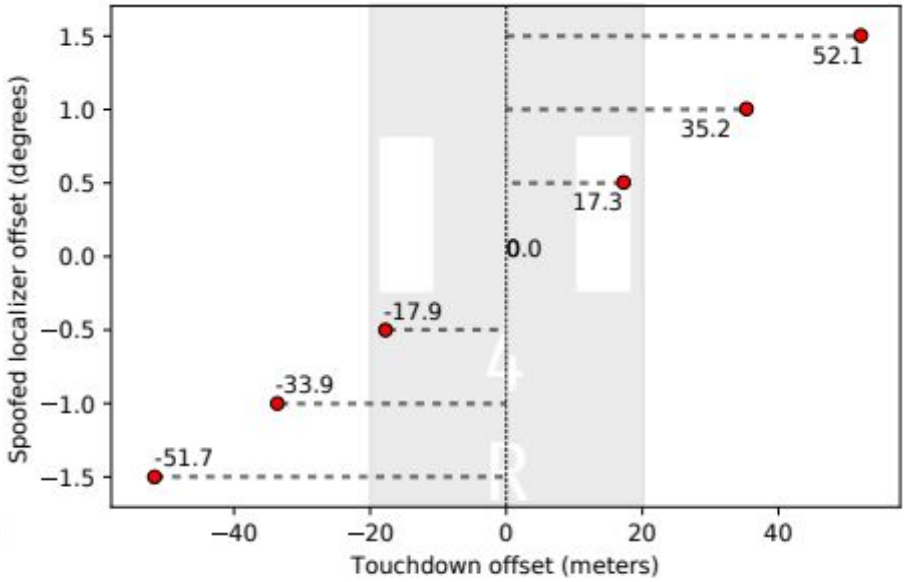
```
1:  procedure GETANGLEDIFFERENCE
2:      ∠DAC ← TargetedLocalizerOffset
3:      ∠BAC ← GetAngle(location)
4:      difference ← ∠DAC − ∠BAC
5:      return difference
6:  procedure CALCULATEDDM
7:      difference ← GetAngleDifference
8:      ddm ← (0.155 ∗ difference)/2.5
9:      AT90 ← 0.2 + (ddm)/2
10:     AT150 ← 0.2 − (ddm)/2
11:     ChangeAmplitude(AT90, AT150)
```

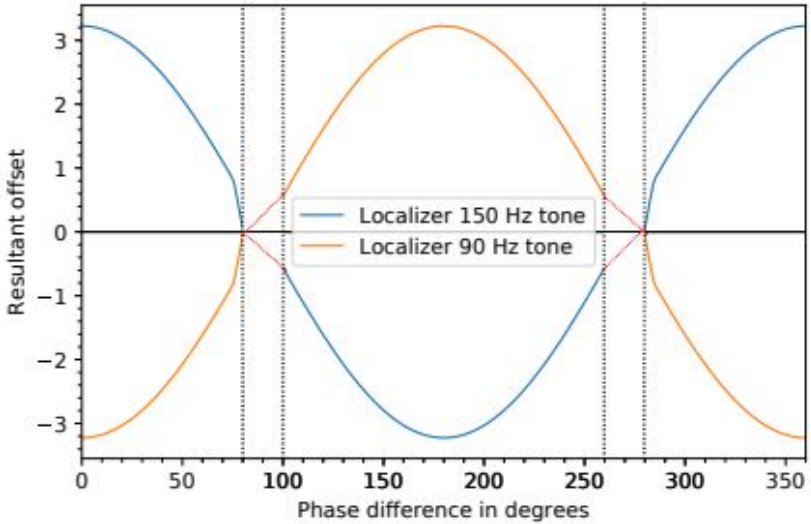
# Experimental Setup

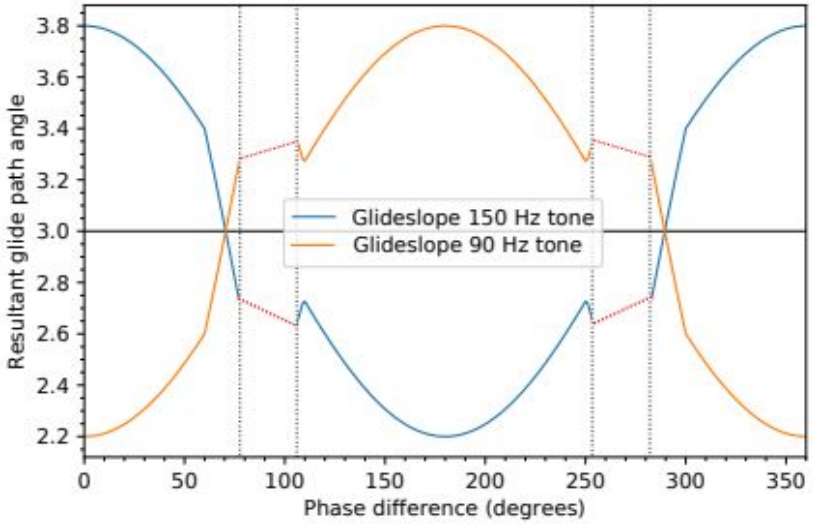


# Results
# OverShadow

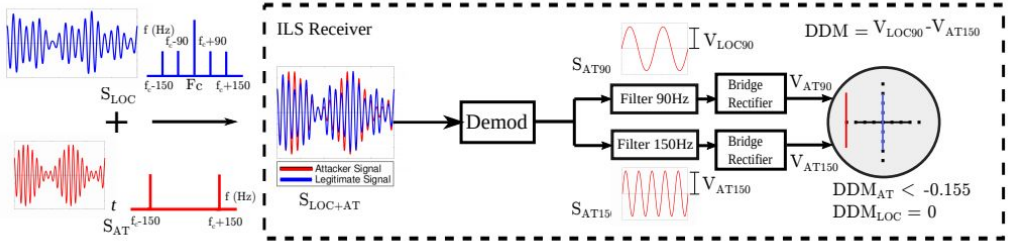





# Results Single-Tone



# Testing on a human pilot


- **OverShadow**
- **Single Tone**
- **Potential Denial of Service**

# Discussion

Location of Attacker

Height of Aborting Landing

Alternatives to ILS

Countermeasures

# Related Work



There has been a lot of research done on other aircraft systems, but none on the landing system.



Study of pilot response to glidescope attacks

- Easy to handle, wastes time and fuel
- Hard to deal with low visibility

# Conclusion

1. Attackers can take control of an aircraft's landing system
2. Hard for a pilot to notice, especially with low visibility
3. Current Security of Aircraft won't work on ILS

# Thanks!

# Works Cited

## Papers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[3] Flightradar24 AB. 2020. Flightradar24.com.
[4] Matthew Smith. 2020. A View from the Cockpit: Exploring Pilot Reactions to Attacks on Avionic Systems. University of Oxford, UK.


## Images


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Acknowledgements on inspiration of some slides to: Harshad Sathaye

# Video Demonstration