Relevance of CPS R&D to NTSB Issues for Advancing Transportation Safety

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NTSB

- **Independent Agency - Reports to Congress & President**
- **Small Agency - 400 employees, 5 Board Members Appointed by President and Approved by Senate. Only Chairman has Administrative Responsibilities**
- **Investigates Aviation, Rail, Highway, Marine and Pipeline/Hazmat Accidents- Determines Probable Cause**
- **Issues Safety Recommendations**
- **Provides for Victims' Families Support**
- **Adjudicates Appeals by Airmen & Mariners on USDOT License Actions**

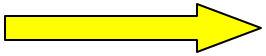
Key Issues in Assessing Probable Cause of Accidents

- **Initiation Mechanism – Failure is a Process**
- **Pre versus Post Crash Damage and Failure**
- **Loadings – Expected or Unexpected**
- **Pre-Crash Condition of Structure and Systems**
- **Actions of Operator and Control/Propulsion Systems**

Total Safety Requires an Approach that Fully Couples All Stages

MOST TRANSPORTATION ACCIDENTS ARE CAUSED BY MAINTENANCE AND INSPECTION ERRORS OR OPERATOR ERROR

But Commercial Transport Aircraft, Automobiles, Trucks and Other Vehicles are Designed to be Safe within a Defined Operational Envelope



Structural/System Operational Characteristics and Failure Mechanisms OUTSIDE of this ENVELOPE are Typically NOT WELL UNDERSTOOD

Research Challenge: What Enhances Safety?

Accidents and Failures are Processes: We do not need to prevent them to enhance safety. Example from automotive safety development

- **Electronic Stability Control helps to prevent accidents or reduce their severity**
- **Airbags help to prevent injuries during last stage of accidents**

Taken together they deal with the first and last stage of an automotive accident process – *CAN WE FILL IN THE SPECTRUM*

American Flight 587

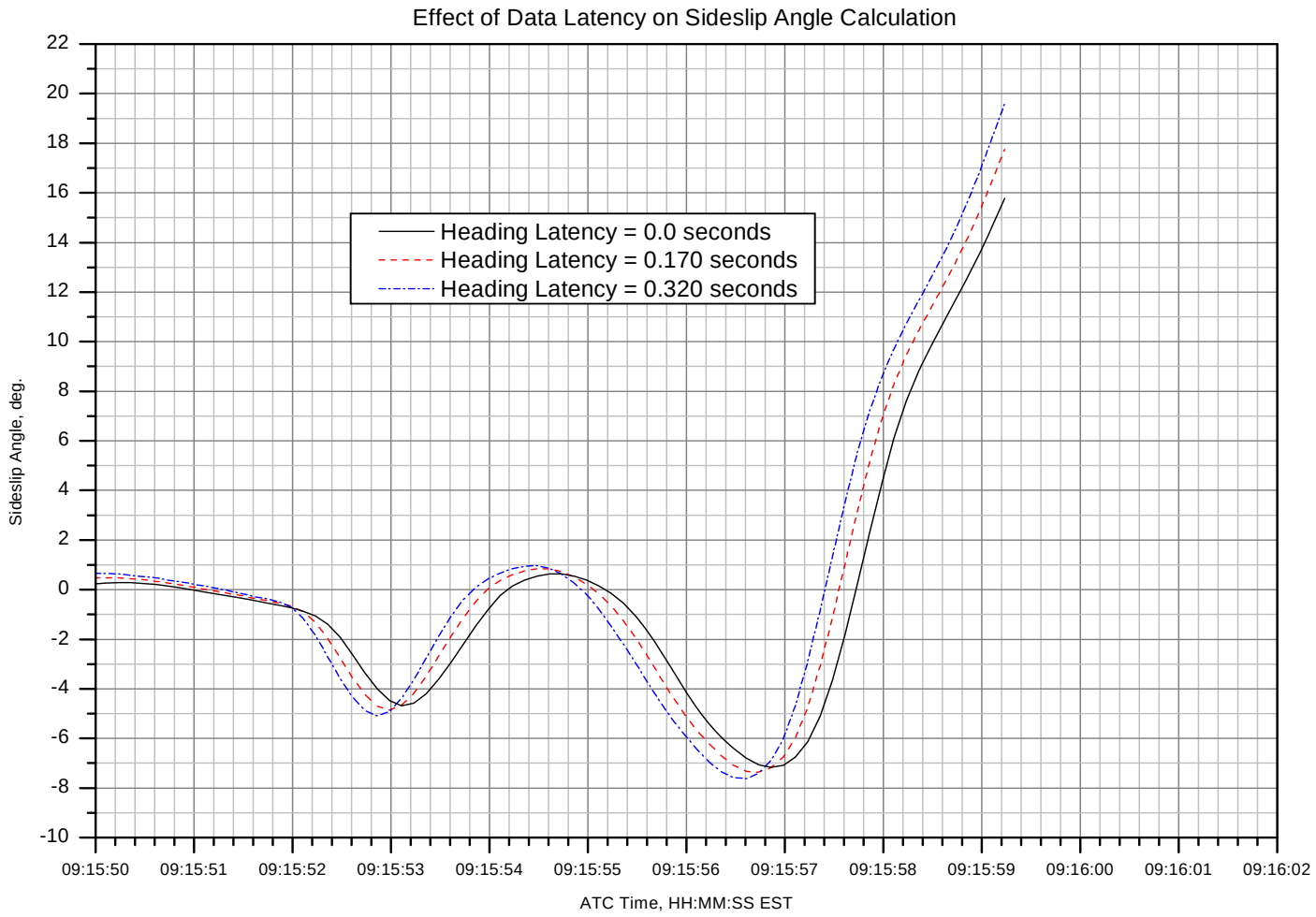
NTSB CONCERNS ON FLIGHT DATA RECORDERS

- **Number of parameters and volume of data varies among aircraft**
  - **Minimum of 22 to 2000+ parameters**
  - **25 to 100+ hours of data**

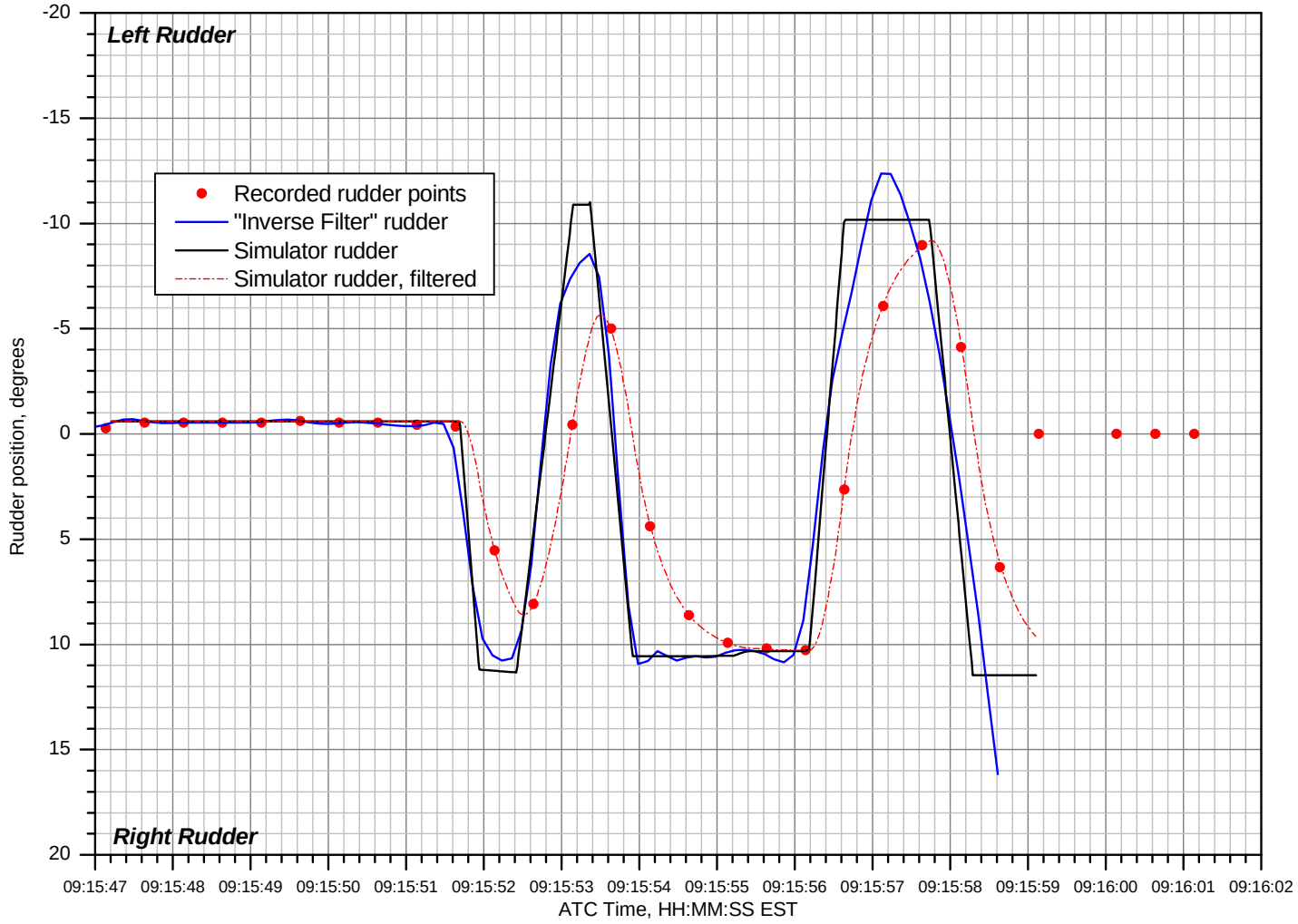
- **Parameters are sampled at different rates**
  - **Altitude, Airspeed, Euler Angles = 1 sample per second**
  - **Flight Control Surfaces = 2 samples per second**
  - **Longitudinal, Lateral Load Factors = 4 samples per second**
  - **Normal Load Factor = 8 samples per second**

- **Sample times are associated with the position of recorded data in the binary data structure**

- **New recorder architectures can introduce "latency" in some parameters (a time delay between sensor and recorder)**


Effect of Data Latency on Sideslip Angle Calculation
Heading Latency = 0.0 seconds
Heading Latency = 0.170 seconds
Heading Latency = 0.320 seconds
Sideslip Angle, deg.
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
09:15:50
09:15:51
09:15:52
09:15:53
09:15:54
09:15:55
09:15:56
09:15:57
09:15:58
09:15:59
09:16:00
09:16:01
09:16:02
ATC Time, HH:MM:SS EST

Effect of Filtering and Sampling Rate



ISSUES & CHALLENGES IDENTIFIED FROM AMERICAN AIRLINES FLIGHT 587

Strategies for dealing with incomplete and uncertain data. Techniques for fusion of data and simulations to determine "best" values for missing data - Do not know actual configuration of aircraft at assumed time of failure

- **Because the failure occurred outside of the certificated safe flight regime, loads module is highly inaccurate - Do not have confidence in load prediction at assumed time of failure**

Can Future Aircraft Simultaneously Fly in the Physical and Virtual Domains and Monitor Flight Data to Detect Dangerous Conditions

NTSB
MOST WANTED LIST
Transportation Safety Improvements

Actions Needed by Federal Agencies

AVIATION

The Federal Aviation Administration should:

- **Improve Safety of Emergency Medical Services Flights**
  - Conduct all flights with medical personnel on board in accordance with commuter aircraft regulations.
  - Develop and implement flight risk evaluation programs.
  - Require formalized dispatch and flight-following procedures including up-to-date weather information.
  - Install terrain awareness and warning systems on aircraft.
- **Improve Runway Safety**
  - Give immediate warnings of probable collisions/incursions directly to cockpit flight crews.
  - Require specific air traffic control clearance for each runway crossing.
  - Install cockpit moving map displays or automatic systems to alert pilots of attempted takeoffs from taxiways or wrong runways.
  - Require landing distance assessment with an adequate safety margin.
- **Reduce Dangers to Aircraft Flying in Icing Conditions**
  - Use current research on freezing rain and large water droplets to revise the way aircraft are designed and approved for flight in icing conditions.
  - Apply revised icing requirements to currently certificated aircraft.
  - Require that airplanes with pneumatic deice boots activate boots as soon as the airplane enters icing conditions.
- **Improve Crew Resource Management**
  - Require commuter and on-demand air taxi flight crews to receive crew resource management training.

HIGHWAY

The Federal Motor Carrier Safety Administration should:

Require On-board Electronic Recorders

- Require all interstate commercial vehicle carriers to use electronic on-board recorders to collect data on both driver hours of operation and accident conditions.

Improve Safety of Motor Carrier Operations

- Prevent motor carriers from operating if they put vehicles with mechanical problems on the road or unqualified drivers behind the wheel.

Prevent Medically Unqualified Drivers from Operating Commercial Vehicles

- Establish a comprehensive medical oversight program for interstate commercial drivers.
- Ensure that medical examiners are qualified.
- Track all medical certificate applications.
- Enhance oversight and enforcement of invalid certificates
- Provide mechanisms for reporting medical conditions.

The National Highway Traffic Safety Administration should:

Prevent Collisions by Using Enhanced Vehicle Safety Technology

- Require adaptive cruise control and collision warning system standards for all new passenger and commercial vehicles.