



MONITORING TAKEOFF PERFORMANCE

# ABNORMAL ACCELERATION EVENTS ON TAKEOFF

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NETJETS

# RISK AND HISTORICAL OCCURENCES

The EASA SIB 2016-01 (R1) discusses the “use of erroneous parameters at takeoff” as a contributing factor for safety occurrences.

Its references include the summary of several serious events involving insufficient acceleration on takeoff.

Exposure to this risk is hard to quantify and depends on the magnitude of the difference and how much “spare” runway was initially available.

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## Safety Information Bulletin Operations

SIB No.: 2016-02R1

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**Subject:** Use of Erroneous Parameters at Take-off

### Revision:

This SIB revises EASA SIB 2016-02 dated 16 February 2016.

### Ref. Publications:

- United States National Air & Space Administration (NASA) Study [NASA/TM-2012-216007](#) “Performance Data Errors in Air Carrier Operations: Causes and Countermeasures” dated June 2012.
- Australian Transport Safety Bureau Research and Analysis Report [AR-2009-052](#) “Take-off Performance Calculation and Entry Errors - A Global Perspective” dated 24 January 2011.
- Laboratory of Applied Anthropology, on behalf of Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile and Directorate General for Civil Aviation France [DOC AA 556/2008](#) “Use of erroneous parameters at take-off” dated May 2008.
- Commission Regulation (EU) [965/2012](#) dated 05 October 2012, annex V, subpart SPA.EFB.
- [European Operators Flight Data Monitoring forum \(EOFDMM\)](#):
  - Working Group A: “Review of Accident Precursors” and
  - Working Group B: “Guidance for the implementation of FDM precursors”.

### Applicability:

Competent authorities, operators, flight crews.

### Description:

The investigation reports and studies related to several accidents and serious incidents worldwide have highlighted the use of erroneous mass or take-off performance data as a safety issue of general concern and not specific to any aircraft type.

## DETECTION

- Some avionics already perform gross error checks. Airbus equips some aircraft with the Takeoff Monitoring (TOM) function, triggering a red ECAM warning “T.O. ACCELERATION DEGRADED” in case of insufficient acceleration on takeoff roll.
- Most aircraft cannot alert the crew, and the occurrences go unnoticed and unreported unless it is serious enough.

## GOAL AND ADDED VALUE

- An FDM event capable of detecting degraded acceleration on takeoff would be helpful to enhance the visibility on **data entry errors** and allow quantification of the actual probability and severity of these occurrences..
- Aircraft operators would then be able to assess risk and implement mitigation measures.
- Regulatory agencies would have data to substantiate new regulations on this matter.

## **HISTORICAL DEVELOPMENT AND CONTEXT**

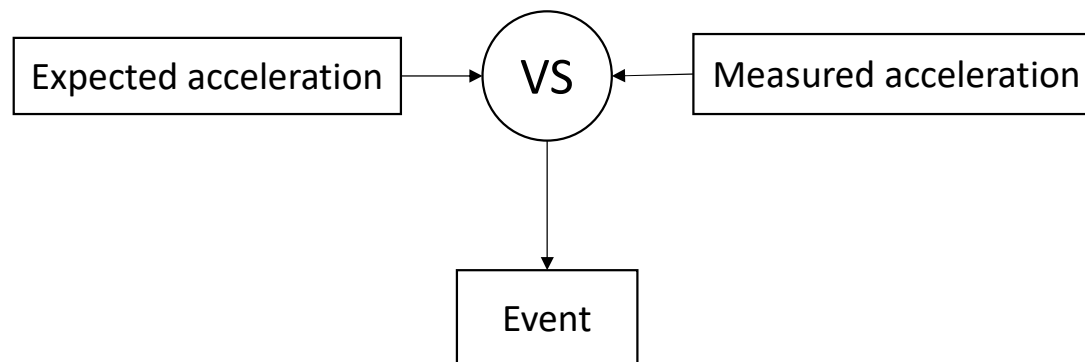
- A methodology for detecting slow acceleration on takeoff using FDM was presented for the first time at the EOFDM Conference in 2016.
- More guidance material and details have been added to the EOFDM WGB documentation.
- The implementation of this event is rather complex, leading to requests for clarification on EOFDM working groups

## **MORE INFORMATION**

- EASA EOFDM
- EASA EOFDM Conferences
- Proceedings of the 2016 conference: <https://tinyurl.com/53yna9ws>

## PRINCIPLE

- The “slow acceleration” event detects differences between the actual and the expected acceleration on the takeoff roll.
- Similar to the Airbus’ TOM function.

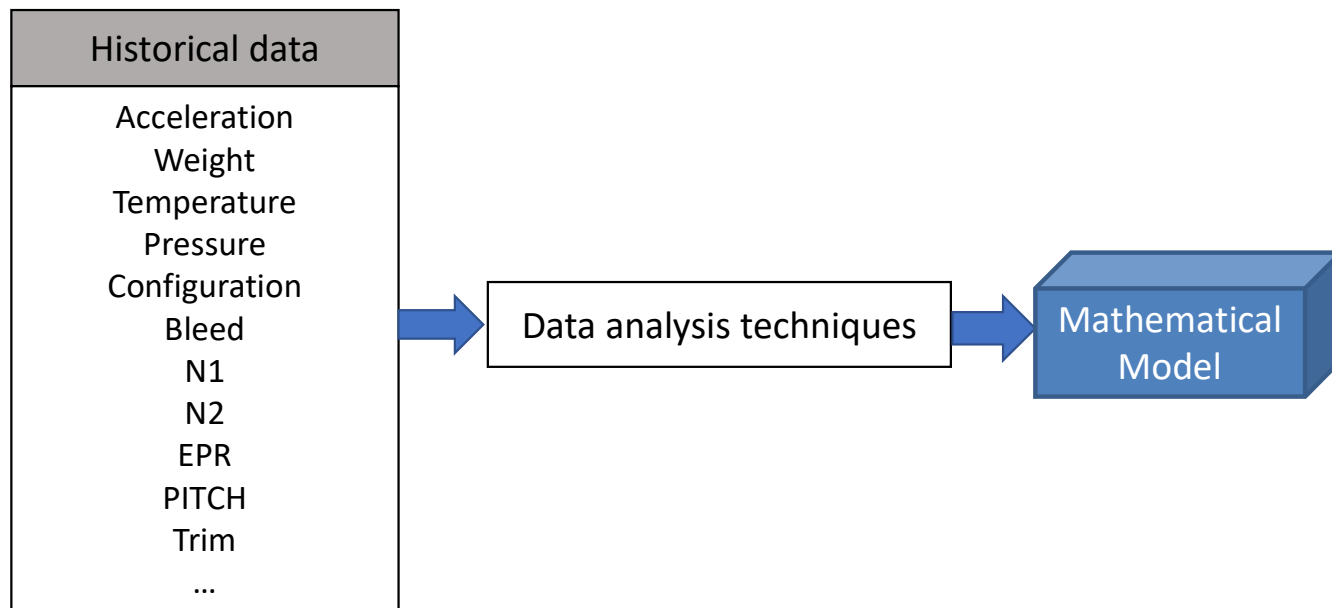


## DESIGN

The most challenging aspect of this methodology is the calculation of the expected acceleration – which is different for every flight and aircraft type.

The aircraft performance data available to operators is unsuitable for this particular application.

**A solution:** using historical FDM data to “reverse-engineer” a mathematical model for the expected acceleration on takeoff.



## IMPLEMENTATION

The model is valid for:

- An individual aircraft
- A group of aircraft of the same variant, i.e. aerodynamically similar and with the same engine configuration – subject to validation

The model will need to be reiterated upon changes in the aircraft (e.g new engines, new winglets)

The development of this event requires multi-disciplinary skills:

- Aircraft performance
- Flight data handling and processing
- Data science techniques

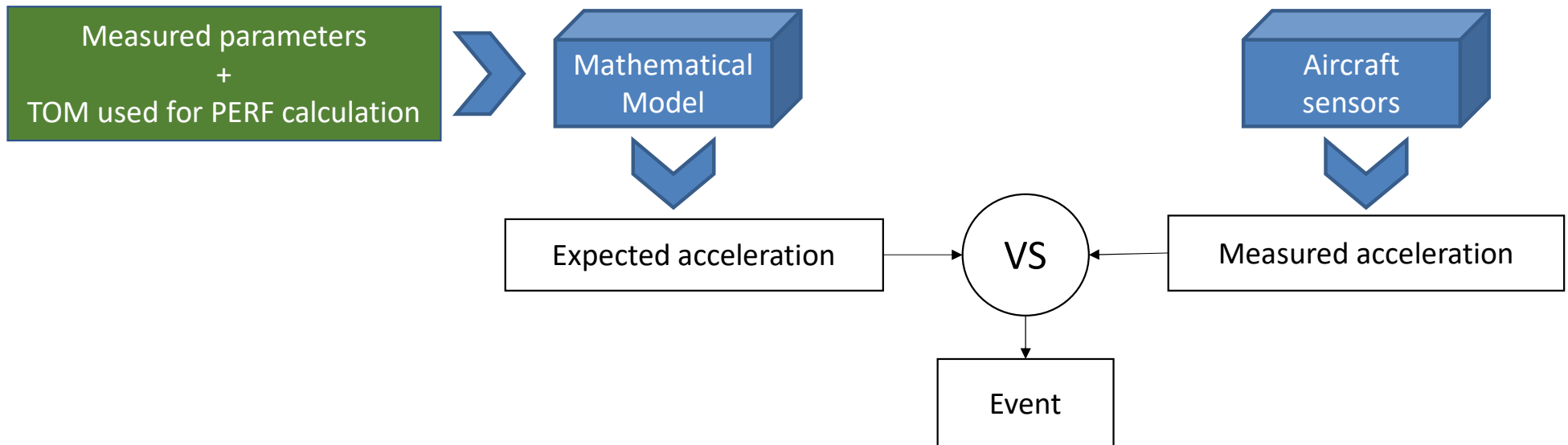
Depends on the capabilities/features of the FDM software:

- The mathematical model needs to be embedded in the routine analysis algorithms

More details on the presentation from 2016!

## DEPLOYMENT

For each flight captured with FDM data



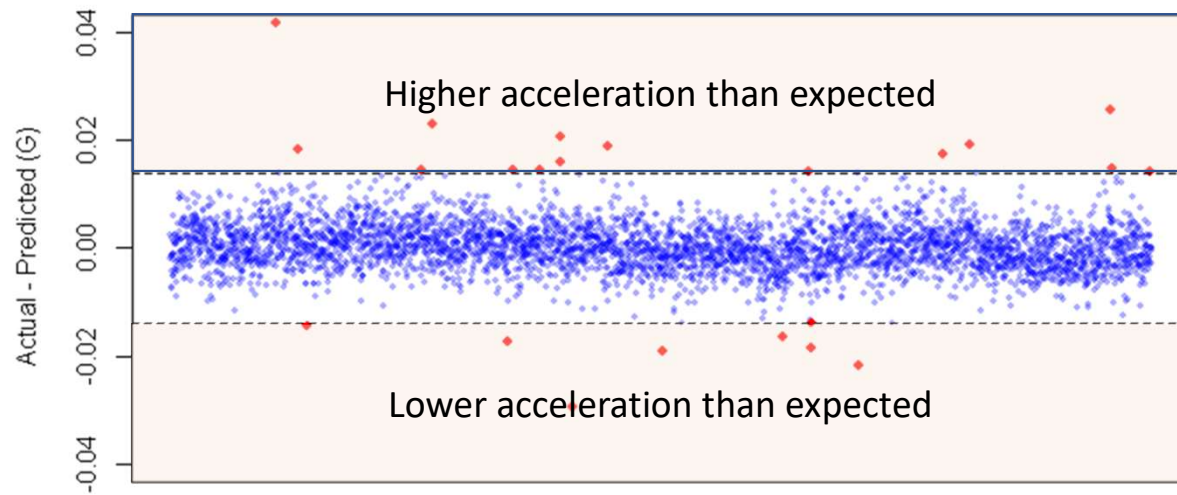


## RESULTS



WEIGHT	EPR	PALT	SAT	ACCEL	EXPECTED	DIFF
29165	1.55	-412	10.7	0.3432	0.3452	0.29%
27998	1.56	-32	18.1	0.3627	0.3655	0.78%
36635	1.56	-209	13.6	0.273	0.2684	-1.72%
33221	1.56	153	16.1	0.3015	0.298	-1.15%
28102	1.57	217	13.9	0.3677	0.3595	-2.27%
28484	1.56	165	22.1	0.3495	0.3575	2.24%

## EVENT ANALYSIS



Once this algorithm is in “production”, the events/outliers need to be validated and investigated.

An investigation often requires access to the load sheet and the flight plan for the corresponding flight, making it more time-consuming than most events.

The results will hopefully reveal root causes, perhaps linked to human factors or organizational issues. These findings should then be fed into the SMS as usual.

## SUMMARY

- Erroneous data entry inputs are contributing factors to serious incidents and accidents in the takeoff phase
- There is plenty of evidence of errors on TOM for takeoff performance from incident investigations
- Solutions for detecting the errors are not widespread, and the actual exposure to this risk is unknown
- We propose an algorithm that uses FDM data to detect the less severe events of erroneous mass inputs for takeoff performance calculations
- The algorithm is based on real-life performance and requires multi-disciplinary skills to build
- The event, if correctly implemented, will identify cases when the measured acceleration is different from what was expected
- The event ONLY tries to capture errors on the TOM data and is not designed to capture other contributing factors or errors related to the takeoff performance