Data4Safety

Partnership for Data Driven Aviation Safety Analysis

Supported by EASA

GUIDANCE FOR IDENTIFYING UNSTABLE APPROACH WITH FLIGHT DATA

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Rev 00

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ACKNOWLEDGEMENTS

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PHOTOCREDITS

The purpose of this document is to share the main aspects and lessons learnt during the development of the Unstable Approach detection algorithm

Objectives of the document

1. Provide a complete characterisation of the logic for detection of Unstable Approach events, the analysis window and their severity classification based on FDM data

2. Present the different criteria and thresholds that the identification of instabilities encompasses, so as to guide industry practitioners on its implementation

3. Convey a set of assumptions, considerations and lessons learnt, arising out of the work performed during the definition of Unstable Approach detection algorithm, aiming to assist industry practitioners when conducting safety analysis in this area

Acronyms

A/C	Aircraft
ASR	EASA Annual Safety Review
CE	Consequential Event
DAP	Data Analytics Provider
D4S	Data4Safety
DH	Decision Height
DS	Directed Study
EASA	European Union Aviation Safety Agency
FDM	Flight Data Monitoring
FH	Flight Hours
FL	Flight Level
GA	Go-Around

GPS	Global Positioning System
HAT	Height Above Touchdown
IATA	International Air Transport Association
ILS	Instrument Landing System
N1	Engine 1 rotational speed of low speed spool
PoC	Proof of Concept
SH	Stabilization Height
SL	Severity Level
TAWS	Terrain Avoidance and Warning System
TD	Touchdown
UA	Unstable Approach
V_{ref}	Reference speed

Definitions

Approaches with instability	Any approach with an instability condition triggered within the analysis window as per the instability criteria.
Destabilization Height	Height at which any approach firstly encounters an instability (instability condition is triggered).
Instability condition / trigger	Aircraft parameter deviations from a specific nominal thresholds and within a minimum number of seconds, considered to be inducing instability.
Stabilization Height	Height at which any approach with an instability is fully stabilized, meaning the lowest height at which any instability criteria is no longer triggered.
Unstable Approach	Any approach with the minimum required instability conditions triggered within the analysis window (1000ft – 0ft) as per the instability criteria and height band.

CONTENT

SECTION

1

This document captures part of the work performed in the 2nd Directed Study developed under the D4S programme, focused on Unstable Approaches

Context of the document

Data4Safety is a data collection and analysis programme that supports the goal of ensuring the highest common level of safety and environmental protection for the European aviation system. To this end, the programme collects data from multiple sources (including safety reports, flight data, surveillance data, and weather data) and utilises big data techniques to process it, extracting insights on the location and nature of risks, and on the performance of safety actions.

The programme, coordinated by EASA, is organised around safety partners from the European Aviation Community: airlines, manufacturers, ANSPs, NAAs, pilots, etc. As voluntary members of the programme they provide the necessary data and expertise for the programme to achieve its stated goals.

The Proof of Concept (PoC) phase of the D4S programme was launched at technical level in June 2016. Among the main outcomes expected from this phase, the Programme is delivering a set of Use Cases that will support the demonstration of the D4S concept.

Since the start of the programme, the aviation industry has underwent significant change in a very short timeframe (e.g. COVID-19 crisis). In order to underline the value of D4S in this rapidly changing environment, the Steering Board decided to address a safety topic of special concern through a Directed Study. This Directed Study had the objective of providing insights to better understand the context of Unstable Approaches, the prevalence of some associated risks as well as the impact of Go-Arounds as mitigation barriers to consequential events.

To enable the analysis of Unstable Approaches, it is first essential to define a common understanding of the set of parameters that constitute 'instability'

What do we understand by 'Unstable Approach'?

There is a general understanding at industry level concerning what could be considered as an Unstable Approach. It is commonly understood as: *"an undesired state by which an aircraft arrives at the RWY threshold too high, too fast, out of alignment with the runway centre-line or incorrectly configured in a way that is not prepared to land".*

However, there are many variables that might be considered within the industry to identify such undesired aircraft state, given the wide variety of aircraft types and operational environments at different airports. As a result, different methodologies and criteria have been developed in the industry which, although they are the same in essence, differ in terms of particular parameters and thresholds analysed.

Commonly, instability conditions to be analysed include:

- Approach speed above / below the desired reference speed
- Vertical speed too high
- Aircraft misconfiguration (landing gear or flaps)
- Engine thrust level
- Approach path deviations

Picture: EASA

A standardised criteria to identify ‘Unstable Approaches’ is defined at D4S level, as a result of close cooperation between participating FDM and data experts

Defining a standardised criteria for identification of ‘Unstable Approaches’

While specific criteria might work from an organisational perspective, a common criteria is required for the analysis of data at industry-wide level, as general as possible, to drive conclusions that were relevant and coherent with each operational environment and aircraft type.

To that end, a multidisciplinary approach, through collaboration and communication between all industry members participating in the D4S, was applied to develop a standardised criteria to identify Unstable Approaches based on FDM data.

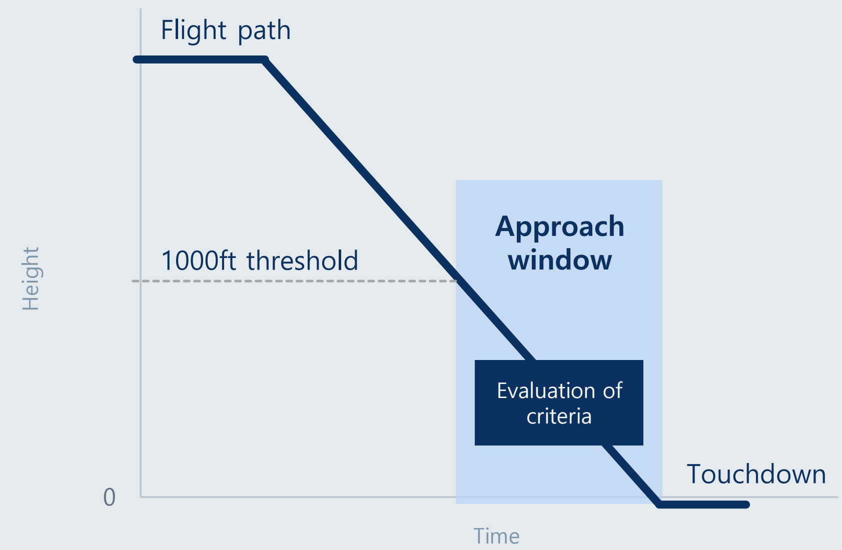
Figure 1: Illustrative figures for identification of Unstable Approach analysis window and instability criteria assessed

Within the **approach window (<1000ft)**, the following set of instability criteria (triggers) are evaluated:

- Fast descent
- Low thrust
- High/Low airspeed
- TAWS alerts
- Late flap or gear extension
- Unstable attitude (pitch, roll)
- High/Low glideslope deviation
- High/Low localizer deviation

Each criterion is evaluated at different height bands and thresholds in order to classify it into a severity level. Two bands are differentiated above/below 500ft

An approach is considered **unstable when a minimum number of criteria are met.** Three criteria must be met above 500ft while only one instability condition triggers the identification of UA below that threshold.



The presented UA detection algorithm is not to be understood as the only valid definition, but as a UA metric that has been tested on a large number of aeroplanes and could be used as a start, as it has the advantage of not being aircraft-type specific. Therefore, operators should not hesitate to try different threshold values when found more relevant for their fleet. Furthermore, the algorithm has been validated only with turbojet aeroplanes with a MCTOM of over 27,000 KG, not with turboprop or business jet aeroplanes.

SECTION

2

The pool of FDM and data experts within the D4S programme defined and developed a standardised algorithm for detection of Unstable Approaches

‘4’ steps for the definition of the Unstable Approach algorithm

1 A methodology and algorithm were developed, capable of harmoniously identify Unstable Approach events on FDM data for multiple operators and aircraft types, based on the combination of 12 different operational criteria

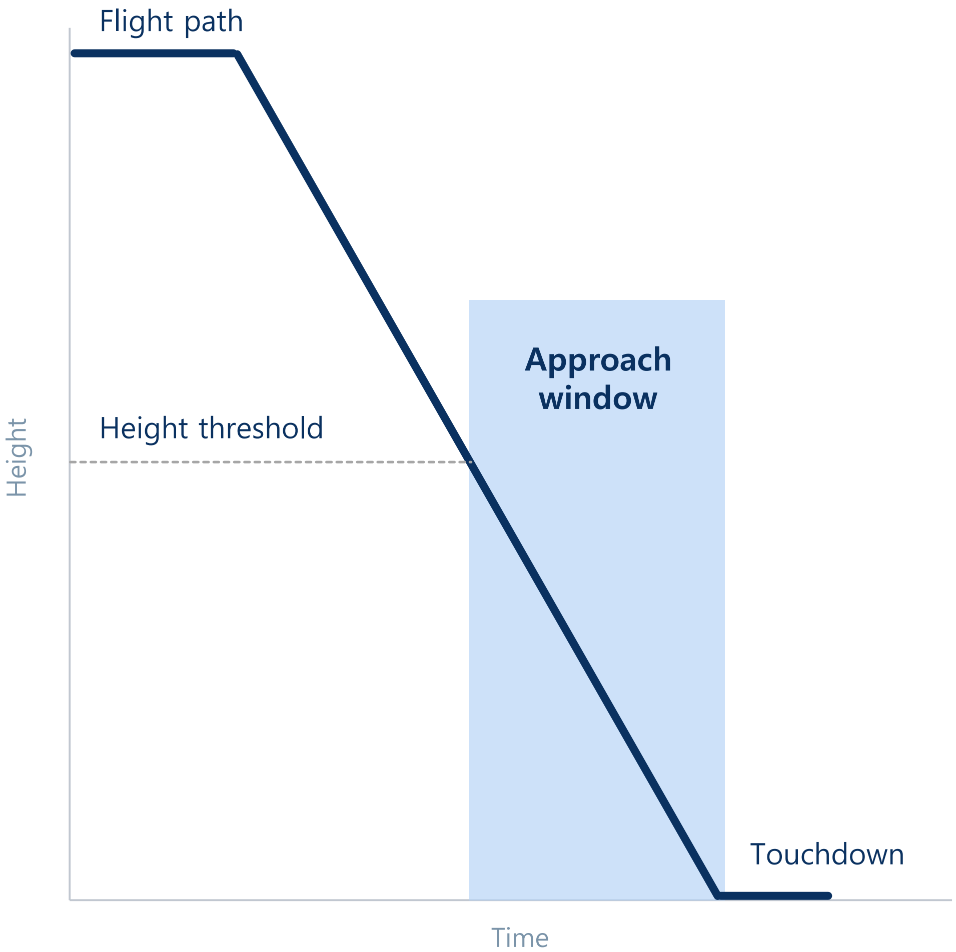
2 Multiple iterations of refinement, validation, results discussion with experts and data quality analysis were conducted to ensure that Unstable Approaches detection results were reliable. As part of this process, conditions for the identification of instabilities during approach were reviewed and modified when deemed necessary. The consistency of its definition was tested by using a data sample covering around 1.4 million flights from 8 different aircraft models

3 By encountering several data quality issues throughout the analysis of FDM data in the context of the Unstable Approaches definition, relevant insights were extracted on how to deal with flight parameters and the criteria for instabilities detection during approaches

4 Once the Unstable Approach methodology and algorithm is thoroughly defined and validated, the identification of those events is ready to be used on the development of specific and in-depth analysis

The Unstable Approach algorithm intends to identify those cases where the approach was not stabilized or was destabilized shortly before landing

Overview of the Unstable Approach identification logic



- Within the approach window, the following set of **criteria** are evaluated:

High/Low airspeed	Fast descent	Low thrust
TAWS alerts	Late flap or gear extension	Unstable attitude (pitch, roll)
High/Low glideslope deviation	High/Low localizer deviation	

- Each criterion is evaluated at different height bands and thresholds in order to classify it into a **severity level**

- An approach is considered unstable when a minimum **number of criteria** are met

A total of 12 criteria are set to be evaluated in parallel and for each approach, within different height ranges and, in some cases, with multiple thresholds

Detailed 'instability' criteria and thresholds for Unstable Approach detection

	Instability conditions	1st threshold	2nd threshold	Height range
Energy management	High airspeed	>(Vref + 20kt) [3s]	>(Vref + 35kt) [3s]	1000ft to 50ft
Energy management	Low airspeed	<(Vref – 5kt) [3s]	<(Vref – 10kt) [3s]	1000ft to 50ft
Energy management	Fast descent (vertical speed)	<-1200fpm [5s]	<-1500fpm [3s]	1000ft to 50ft
Energy management	Low thrust (N1)	Fleet specific (1st percentile) [10s]		1000ft to 50ft
Energy management	TAWS alerts	Modes 1 (Alert & Warning), 2 (Alert & Warning), 4 (Terrain)		1000ft to 0ft
Aircraft handling and configuration	Late flap extension	Any change > 2 degrees or 1 notch		1000ft to 0ft
Aircraft handling and configuration	Late gear extension	Any deployment or not deployed		1000ft to 0ft

	Instability conditions	1st threshold	2nd threshold	Height range
Aircraft handling and configuration	High pitch attitude	>10º and <-3º [3s]	>15º and <-10º [3s]	1000ft to 50ft
Aircraft handling and configuration	High roll attitude	>15º and <-15º [3s]	>30º and <-30º [3s]	1000ft to 50ft
Aircraft path management	High glideslope deviation	>1 dot [5s]	>2 dots [5s]	1000ft to 500ft
Aircraft path management	Low glideslope deviation	<-1 dot [5s]	<-2 dots [5s]	1000ft to 500ft
Aircraft path management	Excessive localizer deviation	>1 dot (left or right) [5s]	>1.5 dots (left or right) [5s]	1000ft to 500ft

A four-level severity classification is also proposed to categorise criteria based on both the height at which they occurred and the severity of the occurrence

Unstable Approach identification and severity classification

Unstable Approach identification

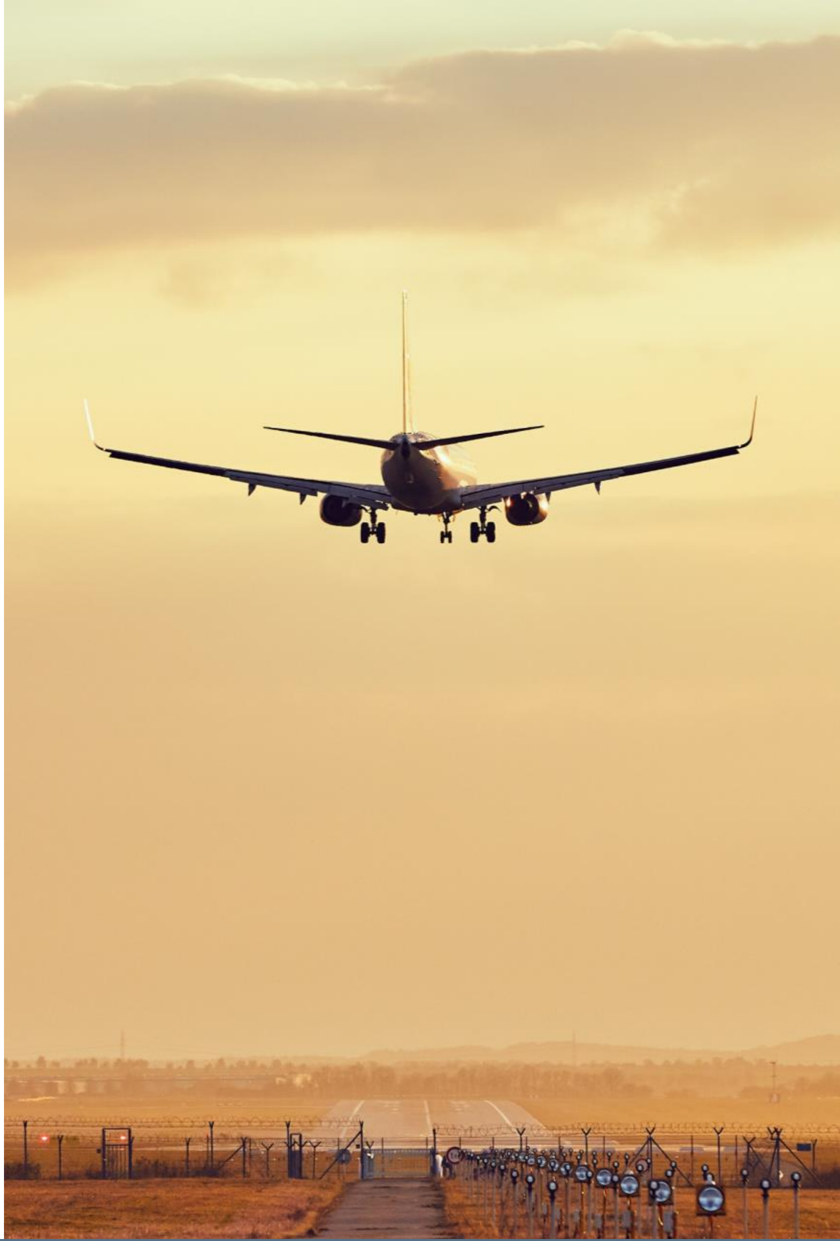
- For an approach to be classified as Unstable, there must be:
  - At least **3 distinct criteria** triggered **at severity level 1 or 2A**; OR
  - At least **1 criterion** triggered **at severity level 2B or 3**
- An approach is classified as the **highest severity level** of its criteria
  - For example, if an event has two criteria triggered at SL1 but one at SL2A, the UA is ultimately classified as SL2A

For those criteria that only have one threshold (e.g. *Low Thrust* or *Late Flap Extension*), SL2A and SL3 are used for each height band

SECTION

3

Lessons learnt from the implementation of the Unstable Approach FDM logic provide valuable insights for industry practitioners



Throughout various iterations and validations over the Unstable Approach detection methodology – under the D4S programme – some relevant outcomes and lessons learnt can be generally applied in the definition of detection algorithms for organizations' FDM programmes and/or safety analysis

Figure 2: D4S Unstable Approach detection criteria and thresholds

Instability conditions		1st threshold	2nd threshold	Height range
Energy management	High airspeed	>(Vref + 20kt) [3s]	>(Vref + 35kt) [3s]	1000ft to 50ft
	Low airspeed	<(Vref – 5kt) [3s]	<(Vref – 10kt) [3s]	
	Fast descent (vertical speed)	<-1200fpm [5s]	<-1500fpm [3s]	
	Low thrust (N1)	Fleet specific (1st percentile) [10s]		
	TAWS alerts	Modes 1 (Alert & Warning), 2 (Alert & Warning), 4 (Terrain)		1000ft to 0ft
Aircraft handling and configuration	Late flap extension	Any change > 2 degrees or 1 notch		
	Late gear extension	Any deployment or not deployed		

Instability conditions		1st threshold	2nd threshold	Height range
Aircraft handling and configuration	High pitch attitude	>10° and <-3° [3s]	>15° and <-10° [3s]	1000ft to 50ft
	High roll attitude	>15° and <-15° [3s]	>30° and <-30° [3s]	
Aircraft path management	High glideslope deviation	>1 dot [5s]	>2 dots [5s]	1000ft to 500ft
	Low glideslope deviation	<-1 dot [5s]	<-2 dots [5s]	
	Excessive localizer deviation	>1 dot (left or right) [5s]	>1.5 dots (left or right) [5s]	

The following pages provides some key points and findings derived from the implementation of the logic for the detection of Unstable Approaches, detailing the rationale underlying the selection of different criteria and thresholds

The establishment of a maximum height range in which to consider potential Unstable Approaches is required to define the rest of algorithm criteria

1 Height ranges

	1st threshold	2nd threshold	Height range
High airspeed	>(Vref + 20kt) [3s]	>(Vref + 35kt) [3s]	1000ft to 50ft
Low airspeed	<(Vref – 5kt) [3s]	<(Vref – 10kt) [3s]	1000ft to 50ft
Fast descent (vertical speed)	<-1200fpm [5s]	<-1500fpm [3s]	1000ft to 50ft

	1st threshold	2nd threshold	Height range
Late gear extension	Any deployment or not deployed		1000ft to 0ft
High pitch attitude	>10º and <-3º [3s]	>15º and <-10º [3s]	1000ft to 50ft
High roll attitude	>15º and <-15º [3s]	>30º and <-30º [3s]	1000ft to 50ft

KEY POINTS

The upper limit of 1,000ft above airfield elevation for instability conditions is set as a mean of the definition of the rest of criteria and a common standard consideration among industry experts.

– **Findings:** even though approaches may be identified above this threshold (e.g. below 2,000ft), the detection of Unstable Approaches with the standardised criteria presented in this document is defined for a window height below 1,000ft. Otherwise, an overhaul of many of the criteria thresholds would be necessary to adapt for the extended flight period

The criteria and thresholds of airspeed conditions are generalised, but the computing method may depend on the data available or specific aircraft types

2 Airspeed condition

	1st threshold	2nd threshold	Height range
High airspeed	>(Vref + 20kt) [3s]	>(Vref + 35kt) [3s]	1000ft to 50ft
Low airspeed	<(Vref – 5kt) [3s]	<(Vref – 10kt) [3s]	1000ft to 50ft
Fast descent (vertical speed)	<-1200fpm [5s]	<-1500fpm [3s]	1000ft to 50ft

	1st threshold	2nd threshold	Height range
Late gear extension	Any deployment or not deployed		1000ft to 0ft
High pitch attitude	>10º and <-3º [3s]	>15º and <-10º [3s]	1000ft to 50ft
High roll attitude	>15º and <-15º [3s]	>30º and <-30º [3s]	1000ft to 50ft

KEY POINTS

The high / low airspeed 'instability' condition compares the aircraft airspeed during approach against the reference speed (Vref), plus some operational margins.

– **Findings:** some aircraft may not have the Vref available or not sufficiently reliable to be used in the Unstable Approach detection. In that case and considering the importance of this criteria in the evaluation of instabilities, a value can be estimated by using landing charts of specific aircraft models, as a function of the flap position and the Gross Weight

The Vref value could be estimated by using landing charts of specific aircraft models, as a function of the flap position and the Gross Weight

2 Airspeed condition *– Three (3) potential ways of using the 'Vref' depending on the data available*

A *Use decoded Vref parameter*

– Use the Vref recorded in the FDM database

B *Both GW & flap parameters available*

– Estimate Vref as a function of Gross Weight and flap configuration

C *Only GW parameter available*

– Estimate Vref as a function of Gross Weight but assuming constant flap configuration *(e.g. Flap 40)*, in case this parameter is not available or presents any other quality issue

Figure 3: Aircraft reference speed table (Vref) example

WEIGHT (1,000 KG)	FLAPS (º)	
	40	30
85	160	168
80	155	163
75	151	158
70	146	153
65	141	148
60	135	142
55	128	136
50	122	129
45	115	122
40	108	115

The thresholds established in the fast descent condition are important so as not to end with excessive false positive triggers in UA detection

3 Fast descent condition

	1st threshold	2nd threshold	Height range
High airspeed	>(Vref + 20kt) [3s]	>(Vref + 35kt) [3s]	1000ft to 50ft
Low airspeed	<(Vref – 5kt) [3s]	<(Vref – 10kt) [3s]	
Fast descent (vertical speed)	<-1200fpm [5s]	<-1500fpm [3s]	

	1st threshold	2nd threshold	Height range
Late gear extension	Any deployment or not deployed		1000ft to 0ft
High pitch attitude	>10º and <-3º [3s]	>15º and <-10º [3s]	1000ft to 50ft
High roll attitude	>15º and <-15º [3s]	>30º and <-30º [3s]	

KEY POINTS

Setting the limiting value and the duration of a fast descent exceedance, as it is proposed, is found essential to conclude with a valid instabilities detection criterion.

- **Findings:** when using lower values (e.g. <-1000fpm) and shorter time periods (e.g. 3 seconds) in the 1st threshold for the fast descent criteria, the proposed UA algorithm captures high amounts of false positive triggers which may compromise the overall accuracy of the methodology

Low thrust criterion for Unstable Approaches detection is found more accurate and reliable when defined at a product-specific level (1/2)

4 Low thrust condition

	1st threshold	2nd threshold	Height range
High airspeed	>(Vref + 20kt) [3s]	>(Vref + 35kt) [3s]	1000ft to 50ft
Low airspeed	<(Vref – 5kt) [3s]	<(Vref – 10kt) [3s]	1000ft to 50ft
Fast descent (vertical speed)	<-1200fpm [5s]	<-1500fpm [3s]	1000ft to 50ft
Low thrust (N1)	Fleet specific (1st percentile) [10s]		1000ft to 50ft
TAWS alerts	Modes 1 (Alert & Warning), 2 (Alert & Warning), 4 (Terrain)		1000ft to 0ft
Late flap extension	Any change > 2 degrees or 1 notch		1000ft to 0ft

KEY POINTS

In the context of the UA detection algorithm, a generalised condition is implemented to standardise the N1 threshold. Thus, this criteria is fine-tuned at product-specific level (aircraft and engine), by using the **1st percentile of N1 values** for all approaches and engines of each product as the threshold.

- **Findings:**
  - Better accuracy is achieved by fine-tuning this parameter at product-specific level based on the distribution of N1 values, instead of establishing the same threshold across all products (e.g. N1<35% / N1<30%)
  - Additionally, the duration of the low thrust condition is defined at 10 seconds as seen the most representative time period under this criterion

Low thrust criterion for Unstable Approaches detection is found more accurate and reliable when defined at a product-specific level (2/2)

4 Low thrust condition

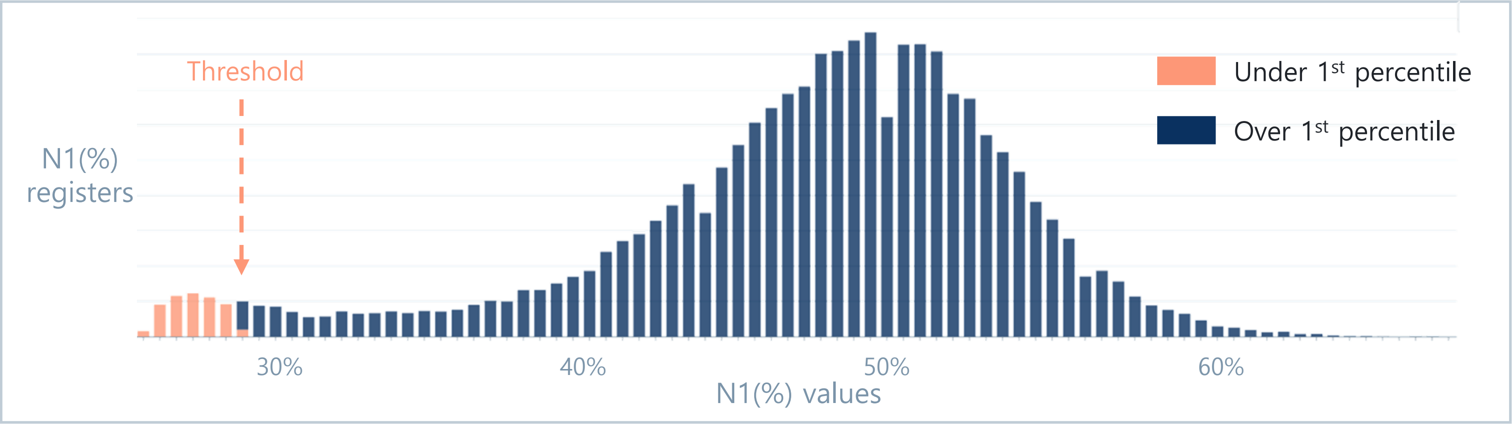
- Despite the fact that some operators could establish their own N1 thresholds for their products (some may not), there is a need to define a generalised approach across all product types
- As such, **a method using the 1st percentile could be implemented**, demonstrated to be consistent and reliable

Criteria

For each product (aircraft & engine):

- Threshold: **maximum value of N1(%) for the 1st percentile**
- Condition: **N1 < Threshold for 10 seconds**

Figure 4: Illustrative example of N1 value distribution during approach (1,000ft to 50ft)



Terrain Avoidance and Warning System (TAWS) criterion considers only Modes one (1), two (2) and four (4) to prevent false UA triggers detection

5 TAWS condition

	1st threshold	2nd threshold	Height range
High airspeed	>(Vref + 20kt) [3s]	>(Vref + 35kt) [3s]	1000ft to 50ft
Low airspeed	<(Vref – 5kt) [3s]	<(Vref – 10kt) [3s]	
Fast descent (vertical speed)	<-1200fpm [5s]	<-1500fpm [3s]	
Low thrust (N1)	Fleet specific (1st percentile) [10s]		
TAWS alerts	Modes 1 (Alert & Warning), 2 (Alert & Warning), 4 (Terrain)		1000ft to 0ft
Late flap extension	Any change > 2 degrees or 1 notch		

KEY POINTS

When evaluating TAWS condition, including only triggers over **Mode 1** (Alert & Warning), **Mode 2** (Alert & Warning) and **Mode 4** (Terrain) is found to be the most representative in terms of Unstable Approaches events identification

– **Findings:**

- Mode 5 (Glideslope) is not found appropriate to be included due to the generation of too many false positives and the overlap made with the *Low/High Glideslope* criterion in the present UA logic

Late flap extension criterion evaluates significant flap changes during an approach window, yet excludes non-deployment occurrences

6 Late flap extension condition

	1st threshold	2nd threshold	Height range
High airspeed	>(Vref + 20kt) [3s]	>(Vref + 35kt) [3s]	1000ft to 50ft
Low airspeed	<(Vref – 5kt) [3s]	<(Vref – 10kt) [3s]	1000ft to 50ft
Fast descent (vertical speed)	<-1200fpm [5s]	<-1500fpm [3s]	1000ft to 50ft
Low thrust (N1)	Fleet specific (1st percentile) [10s]		1000ft to 50ft
TAWS alerts	Modes 1 (Alert & Warning), 2 (Alert & Warning), 4 (Terrain)		1000ft to 0ft
Late flap extension	Any change > 2 degrees or 1 notch		1000ft to 0ft

KEY POINTS

Late flap extension condition would be triggered when there is any change greater than two (2) degrees (or 1 notch) below 1,000 feet, as a single threshold for the criterion.

- **Findings:**
  - A 'not deployed' flaps is not included in the logic, as it would change the nature of the condition and may be mostly capturing a different operational case; principally a technical flaps problem rather than a procedural issue, thereby jeopardising the actual instabilities identification

Any deployment or non-deployment of the landing gear within the height range window is considered as a UA trigger

7 Late gear extension condition

KEY POINTS

Either a landing gear deployment or a non-deployment during the 1,000ft to 0ft approach period is considered as an Unstable Approach trigger. Furthermore, a two consecutive conditions without value changes for this sensor parameter is included to mitigate potential quality issues

	1st threshold	2nd threshold	Height range
Late gear extension	Any deployment or not deployed		1000ft to 0ft
High pitch attitude	>10º and <-3º [3s]	>15º and <-10º [3s]	1000ft to 50ft
High roll attitude	>15º and <-15º [3s]	>30º and <-30º [3s]	
High glideslope dev.	>1 dot [5s]	>2 dots [5s]	1000ft to 500ft
Low glideslope deviation	<-1 dot [5s]	<-2 dots [5s]	
Excessive localizer dev.	>1 dot (left or right) [5s]	>1.5 dots (left or right) [5s]	

Low thrust (N1)	Fleet specific (1st percentile) [10s]	
TAWS alerts	Modes 1 (Alert & Warning), 2 (Alert & Warning), 4 (Terrain)	1000ft to 0ft
Late flap extension	Any change > 2 degrees or 1 notch	

Glideslope and localizer conditions detect prolonged deviations in aircraft approach path, evaluated within a thoroughly selected height range window

8 Glideslope and Localizer condition

KEY POINTS

The defined thresholds for glideslope (high or low) and excessive localizer deviations are set to capture a prolonged (5 seconds) erroneous approach path, within the 1,000ft to 500ft analysis window.

– **Findings:**

- The trigger of this criterion is substantially affected by the height range window, dependent on **operational conditions** and the **actual airfield**, together with potential sensor data issues that may be present
- To enable a generalisation of this criterion, the lower end of the window range is limited to 500ft. Nevertheless, the height range could be modified for specific operations and airfields, if deemed necessary (e.g. 200ft for glideslope and 50ft for localizer)

	1st threshold	2nd threshold	Height range
Late gear extension	Any deployment or not deployed		1000ft to 0ft
High pitch attitude	>10º and <-3º [3s]	>15º and <-10º [3s]	1000ft to 50ft
High roll attitude	>15º and <-15º [3s]	>30º and <-30º [3s]	1000ft to 50ft
High glideslope dev.	>1 dot [5s]	>2 dots [5s]	1000ft to 500ft
Low glideslope deviation	<-1 dot [5s]	<-2 dots [5s]	1000ft to 500ft
Excessive localizer dev.	>1 dot (left or right) [5s]	>1.5 dots (left or right) [5s]	1000ft to 500ft

The glideslope and localizer deviation parameters may generate UA events at a higher rate than expected, thus needing in-depth analysis and considerations

8 Glideslope and Localizer condition *– Issue diagnostic*

Main contributors to high rates

01.

Parameter deviation at low height

Parameters usually behave as expected up to the end of the approach (~200ft for glideslope, ~50ft for localizer), where **fast growth of deviation** occurred, thereby triggering unusual instabilities events

02.

Operational-specific cases

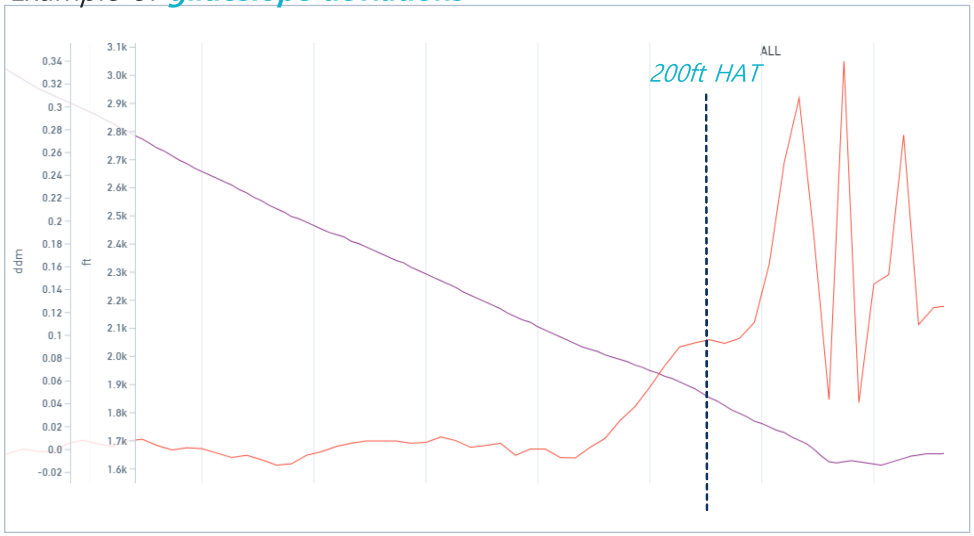
Erratic parameter evolution may be observed due to late interception or non-interception of glideslope / localizer signals, generating false positive UA events

Glideslope and localizer may not behave as expected near the low height threshold, presenting abnormal deviations and triggering false UA events

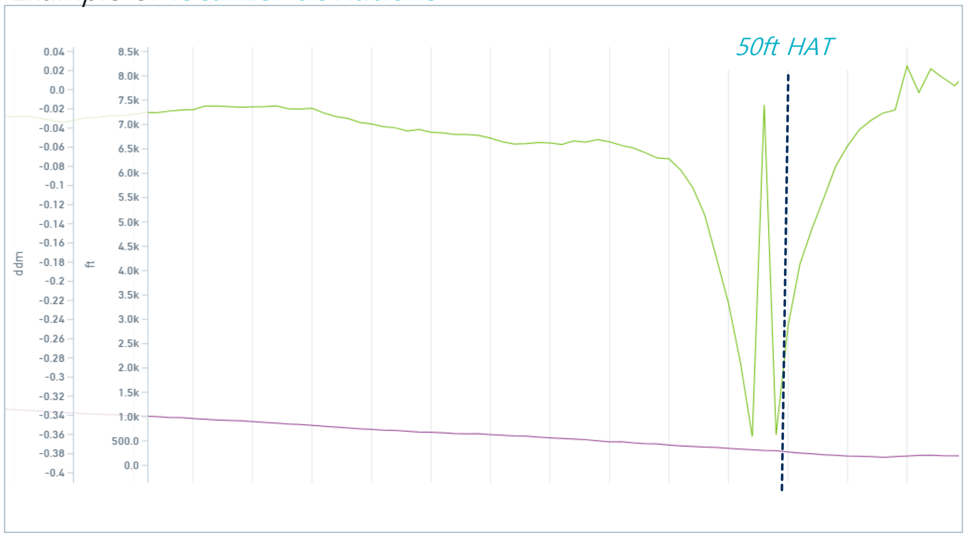
8 Glideslope and Localizer condition

01. ***Parameter deviations at low heights***

*Example of **glideslope deviations***



*Example of **localizer deviations***



Pressure altitude | Glideslope | Localizer

FINDINGS

- Deviations usually take place **near the end of the approach**, but just before a theoretically reasonable height threshold (~200ft for glideslope, ~50ft for localizer) for triggering the criterion
- These deviations generate false UA events even when the parameters had actually behaved as expected throughout the approach window

Glideslope and localizer may show erratic behaviour due to late or non-interception of signals when approaching specific runways

8 Glideslope and Localizer condition

02. ***Operational-specific cases***

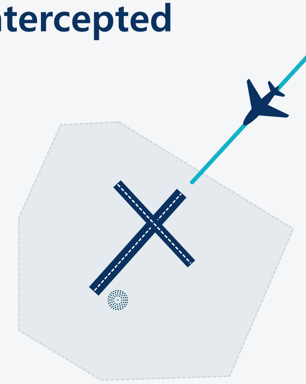
Scenarios related to interception of glideslope / localizer

A Intercepted glideslope / localizer with good behaviour of the parameter along the approach phase

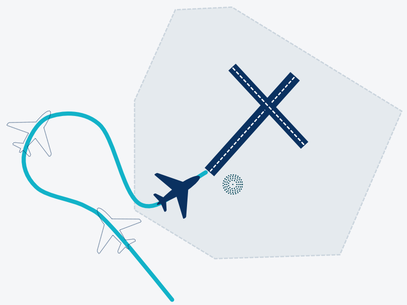
B Late interception of the glideslope / localizer with erratic behaviour of the parameter at the beginning of the approach

C Not intercepted glideslope / localizer, with erratic behaviour of the parameter along the approach phase *(visual approach / instrumental guidance not available)*

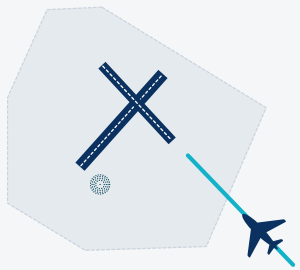
A Intercepted



B Late interception



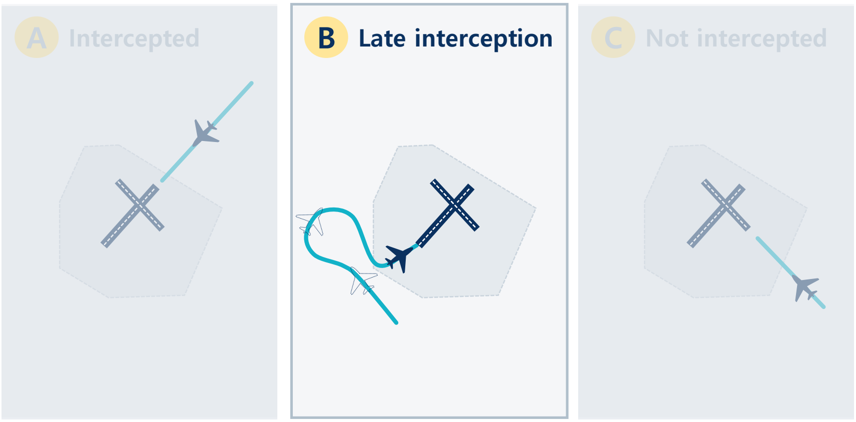
C Not intercepted



Late interceptions may capture operations that took a long period to align with the runway, triggering glideslope / localizer conditions in the approach window

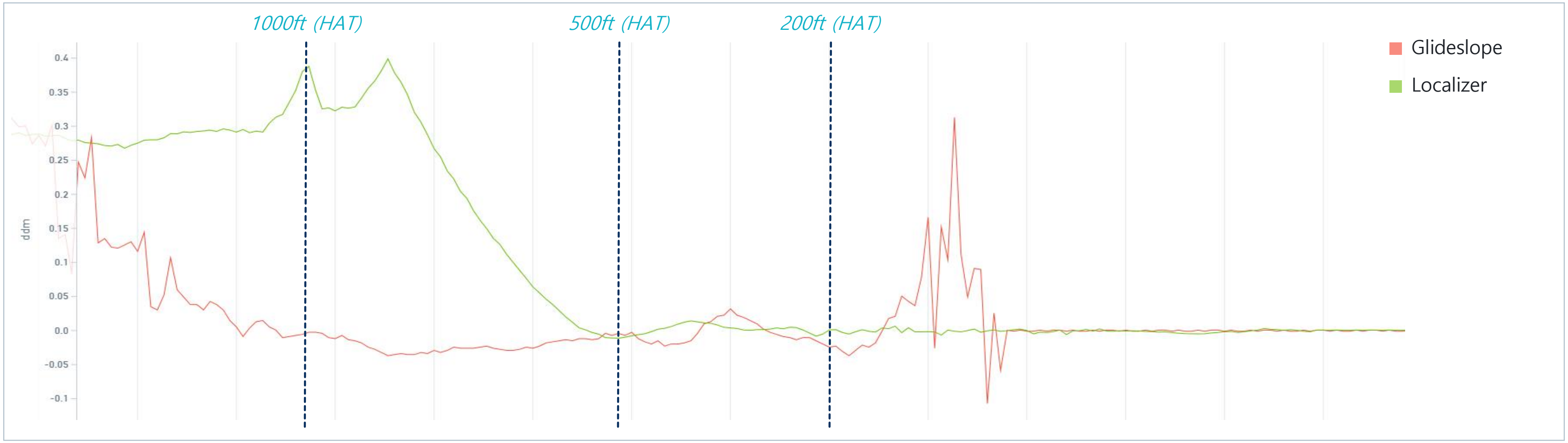
8 Glideslope and Localizer condition

02. *Operational-specific cases*



Late interceptions

- Glideslope and localizer may have late interceptions in some flights, stabilising at the end of the approach near the touchdown point
- Late interceptions depend on the aircraft operation and mainly occurs when the approach takes too long to align with the runway
- Specific filtering conditions could be applied by practitioners over individual cases, considering concrete operations manoeuvres

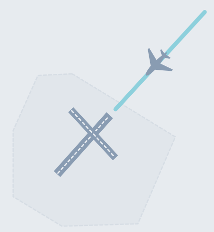


Glideslope / localizer signals may not intercept at any moment during the entire approach, due to the lack of ILS systems at specific landing runways

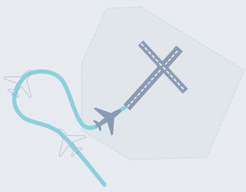
8 Glideslope and Localizer condition

02. *Operational-specific cases*

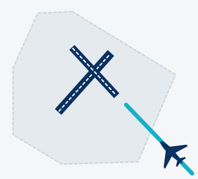
A Intercepted



B Late interception

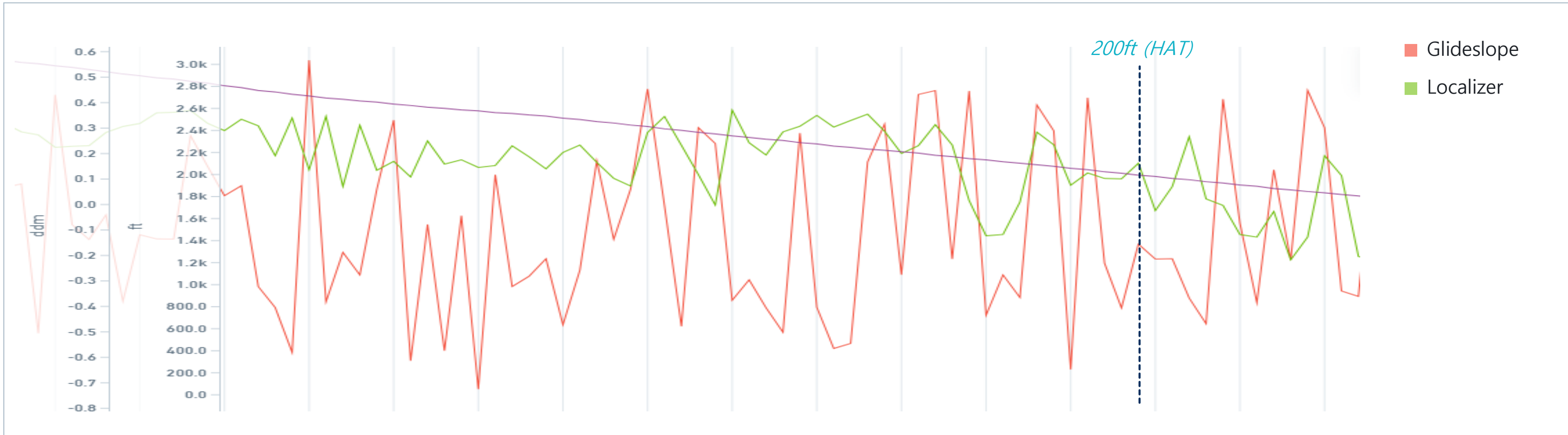


C Not intercepted



No intercepted

- Glideslope and localizer may present random values throughout the entire approach
- No interception of glideslope and localizer are mainly linked to a lack of guidance systems at the destination runway
- Specific filtering conditions could be applied by practitioners over individual cases, based on landing runways and the presence of ILS systems



SECTION 4

Introduction

Unstable Approaches detection

Assumptions and lessons learnt

Conclusions

The D4S programme defined a generalised Unstable Approach detection methodology, providing valuable insights for the industry

Key conclusions from the document

- As part of the work performed in the Data4Safety programme, an algorithm and a comprehensive methodology to harmoniously identify Unstable Approach events in FDM data were developed, which is based on the combination of 12 operational criteria and valid for multiple operators and aircraft types
- Due to the provenance of the FDM data source used in the Data4Safety programme, the Unstable Approach logic presented in this document is accordingly generalised, enabling its applicability for any operator or product type under analysis
- Outcomes from the performed iterations, validations and results discussions over the presented Unstable Approach criteria, provide valuable insights over how to deal with different flight parameters to extract instability conditions during approaches
- The methodology described in this document allows practitioners to systematically identify Unstable Approach events whilst enabling further in-depth and specific analysis for industry practitioners or at an organisational level

The presented UA detection algorithm is not to be understood as the only valid definition, but as a UA metric that has been tested on a large number of aeroplanes and could be used as a start, as it has the advantage of not being aircraft-type specific. Therefore, operators should not hesitate to try different threshold values when found more relevant for their fleet.

The work presented in this document was performed through a close cooperation between D4S participants and powered by ALG

Task Team composition

Powered by

Data4Safety

Partnership for Data Driven Aviation Safety Analysis

Supported by **EASA**

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