A sneak peek into ML certification using EASA First Usable Guidance for Level 1 AI/ML applications

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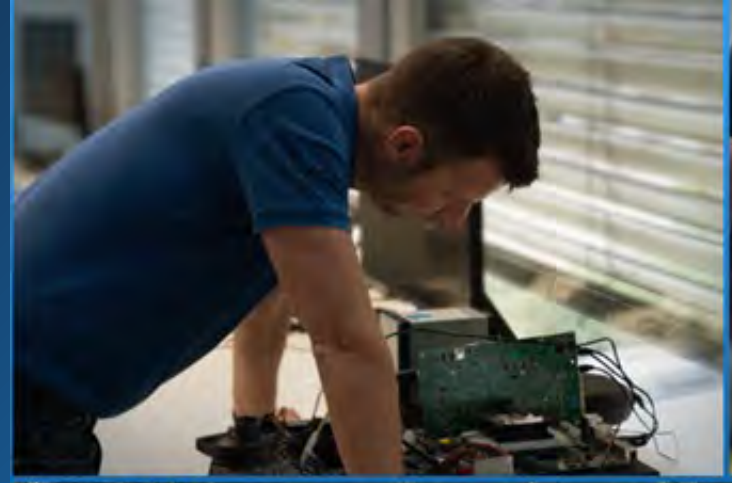
Systems Engineer • Daedalean

We are Daedalean

150+	18	17
staff	PhDs	pilots

Google
SpaceX
Airbus
intel
Airbus Helicopters
Pilatus
kopter
Lufthansa Aviation Training
DLR German Aerospace Center
Rolls-Royce
Honeywell
CERN
FLARM
BCG
wingtra

Carnegie Mellon University
Imperial College London
University of Cambridge
University of Oxford
ETH zürich
Stanford University
Universiteit van Amsterdam
TU Delft
RWTH Aachen University
Universidad Politécnica de Madrid



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Daedalean's Computer Vision suite to assist and to pilot in VMC

Making decisions and judgement calls that are currently the exclusive domain of the human pilot

Where am I?

Visual Navigation

High-precision positioning in GPS-denied situations

Where can I fly?

Visual Traffic Detection

Detection of cooperative (e.g. planes) and non-cooperative (e.g. drones, bird flocks) airborne hazards

Where can I land?

Visual Landing Guidance

Runway and helipad landing guidance

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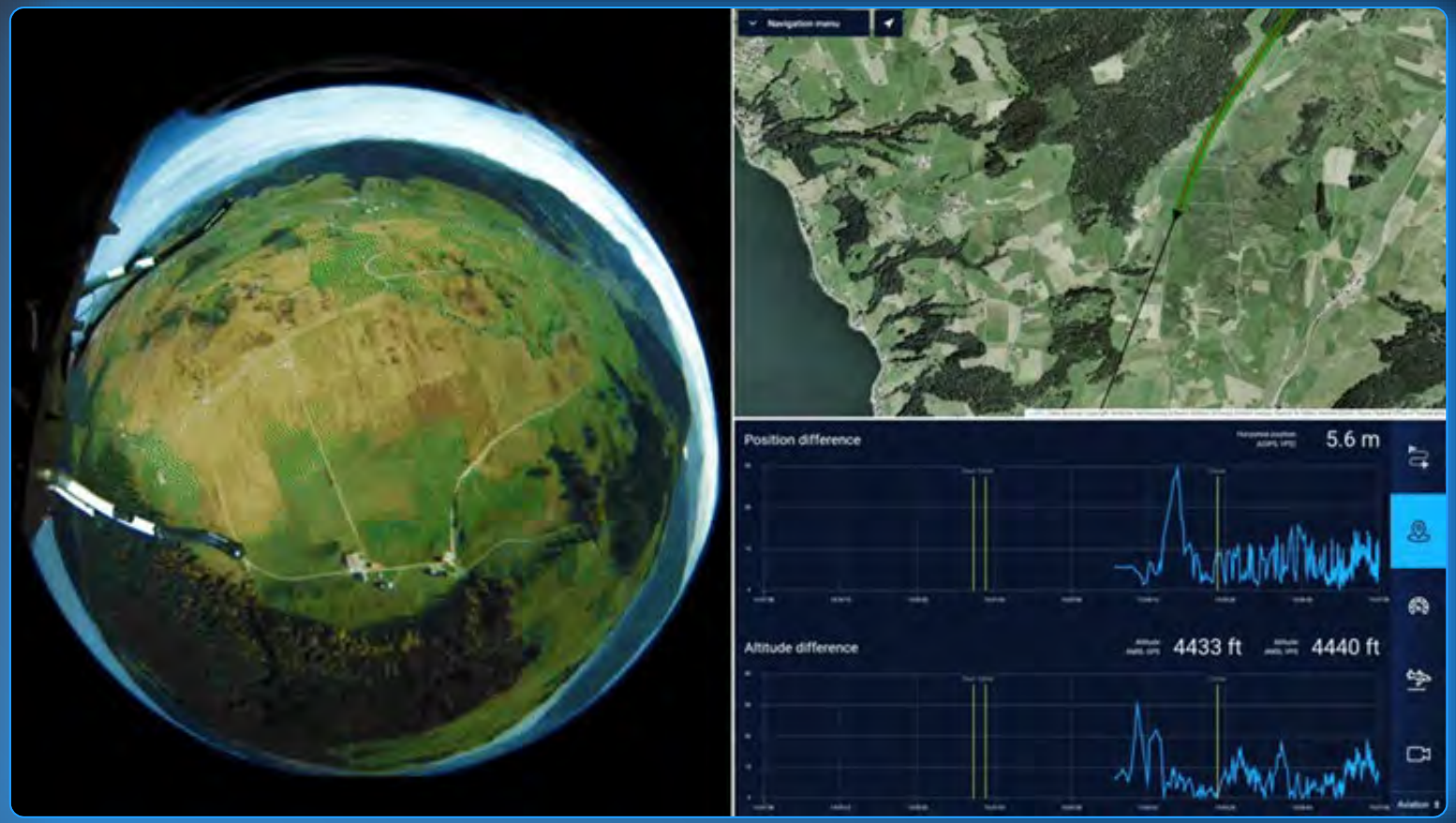
Visual Positioning

Camera-based navigation and landing guidance



Functions

Continuously outputs position, heading, velocities, height above ground, landing guidance and corresponding uncertainties

Properties

Navigation data on par with high-end INS/GNSS and ILS is designed to integrate with existing INS-/GNSS-based navigation systems while being dissimilar

Safety certification level

DAL-C+

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Visual Traffic Detection

Noticing all fixed wing, rotorcraft and drones in time

Functions

- Detects and tracks traffic
- Classifies traffic
- Identifies size, position, direction of movement, time to collision

Properties

- Better accuracy than human pilots
- Detection range up to 3.5 km
- Up to 10 Hz
- Integration with existing flight deck instruments as a pilot-aid

Safety certification level

DAL-C+

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Visual Landing Guidance

Onboard GNSS-independent landing guidance for VTOL and fixed-wing aircraft

Functions

- Lists runways, helipads or landing markers in view
- Provides guidance on final approach to touchdown to the selected runway, helipad or landing marker

Properties

- Continuous real-time tracking of ownship position relative to the runway, helipad or landing marker
- No equivalent instrument exists

Safety certification level

DAL-C+ target

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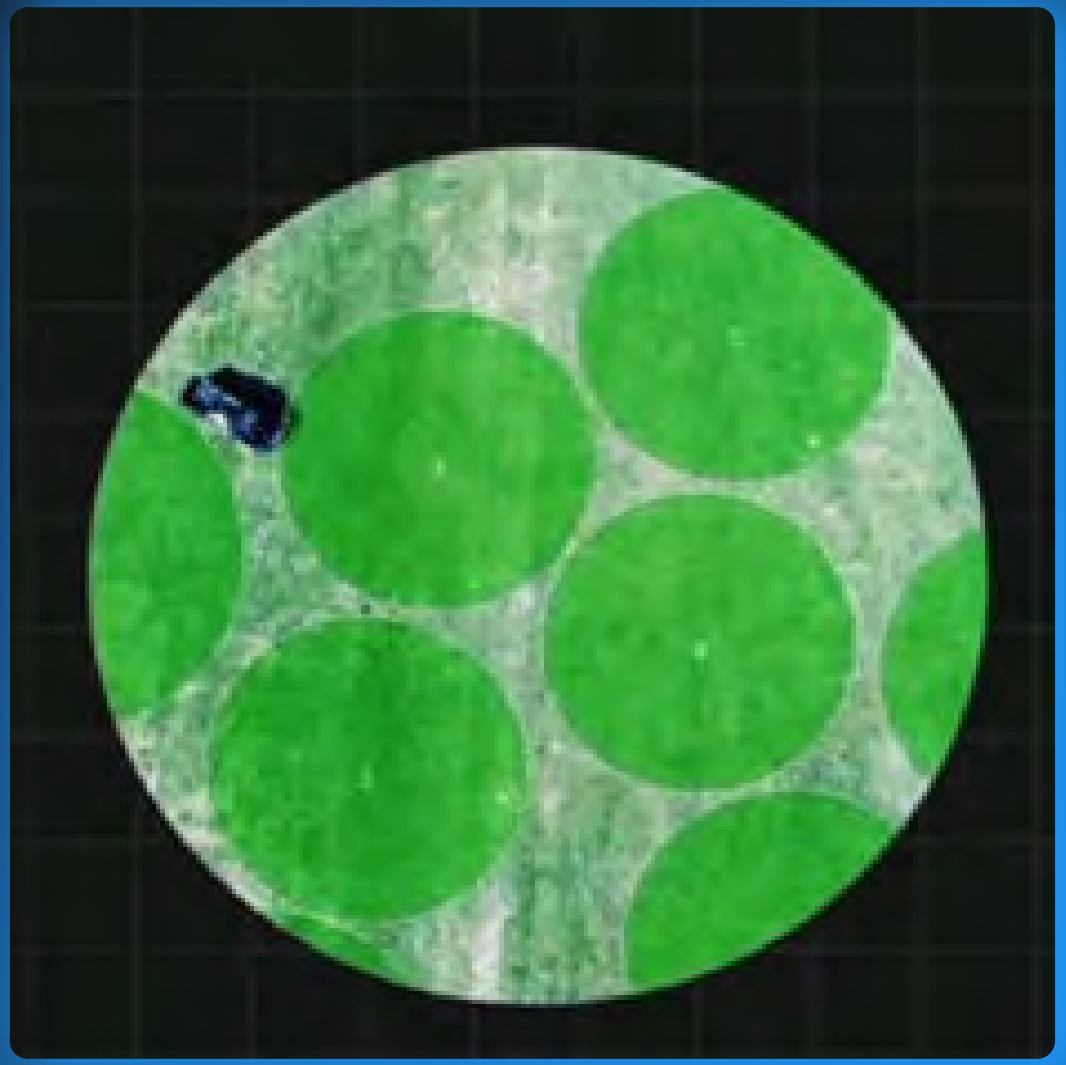
Real-time landing site finder



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PILOTEYE

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System Components

The complete system to be certified is referred to with different names depending on context:

Ailumina Vista

Agnostic of the connected avionics suite

PilotEye

Integrated with Avidyne IFD and SkyTrax

Both names describe the same scope of system components:

- **1 × VXP (Visual Everything Processor)**
- **3 × VCU (Visual Capturing Unit)**

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AILUMINA
VISTA

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Hardware overview

Output rate	**30Hz**

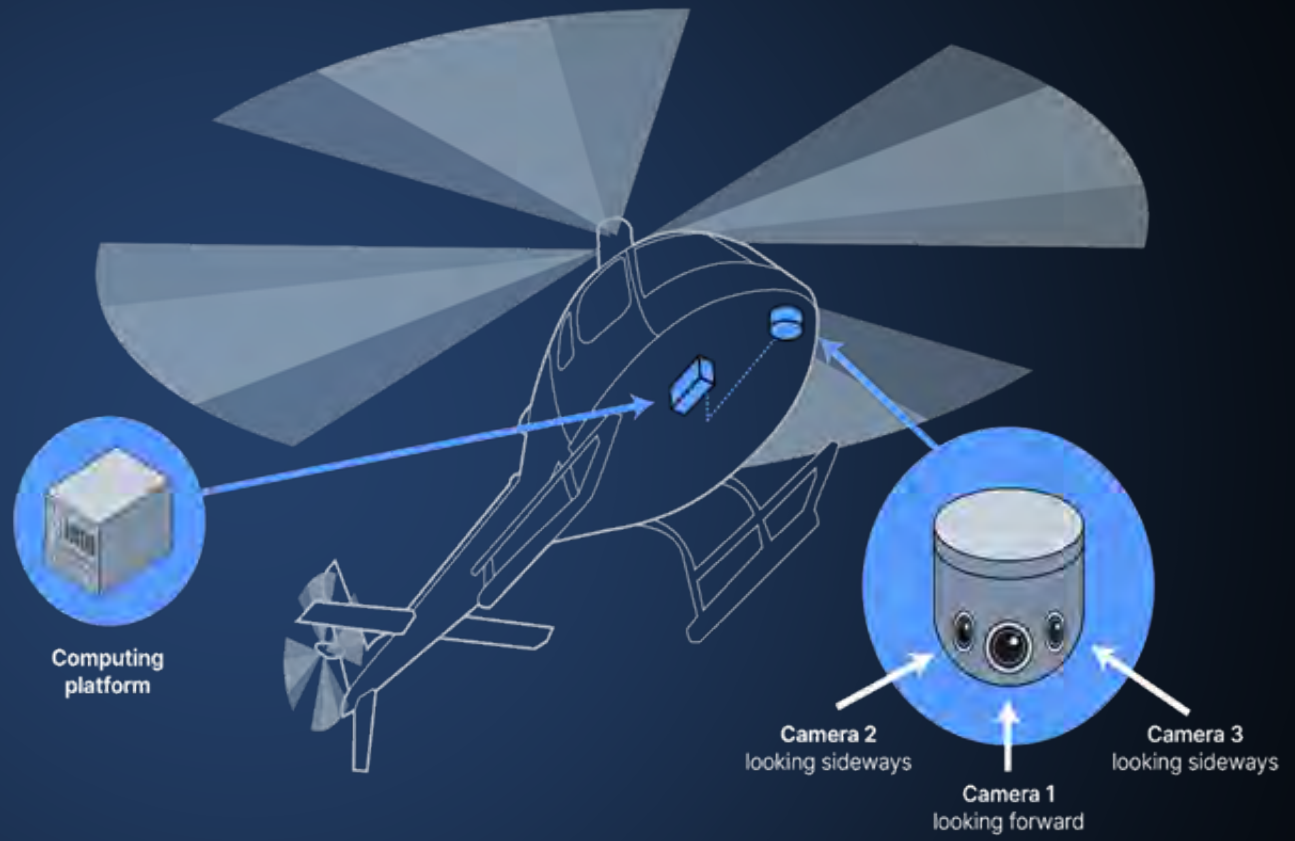
Single camera system

Weight	**5.0 kg**
Power – typical	**75W**

3 camera system

Weight	**6.4 kg**
Power – typical	**155 W**

Preliminary data, subject to change without notice



- DO-178C DAL-C (B planned) (software)
- DO-254 DAL-C, (B planned) DO-160G (hardware)

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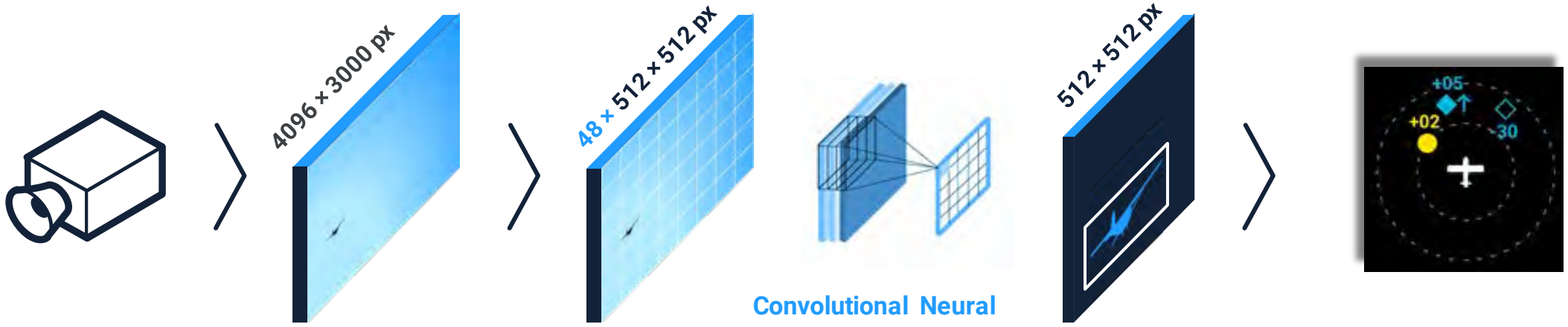
System architecture

A fundamental part of our system is based on deep neural networks

Software level



- High-resolution avionics-grade cameras with IMUs
- Pre-processing (classical software)
- Neural network scanning the full-resolution image at every frame and performing the core object detection
- Tracking/filtering of the detections (classical software)

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Certification of neural networks

Joint projects with EASA and FAA to help drive future policy

Complex topic where Daedalean is at the forefront

1

A concept for Learning Assurance proposed, used by EASA in their “First usable guidance for Level 1 AI/ML application”

2

STC application

3

EASA/FAA issue CRI and IP

4

A specific application gets certified, referencings the NN policy among alternative means of compliance

We are here (2024-04)

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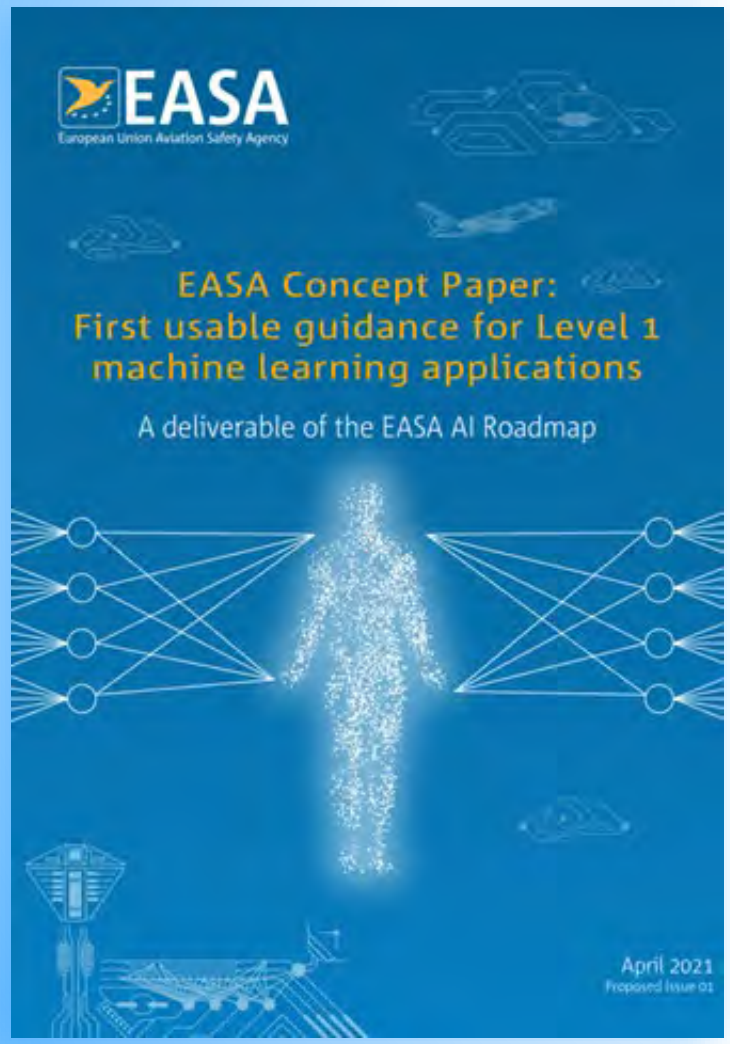
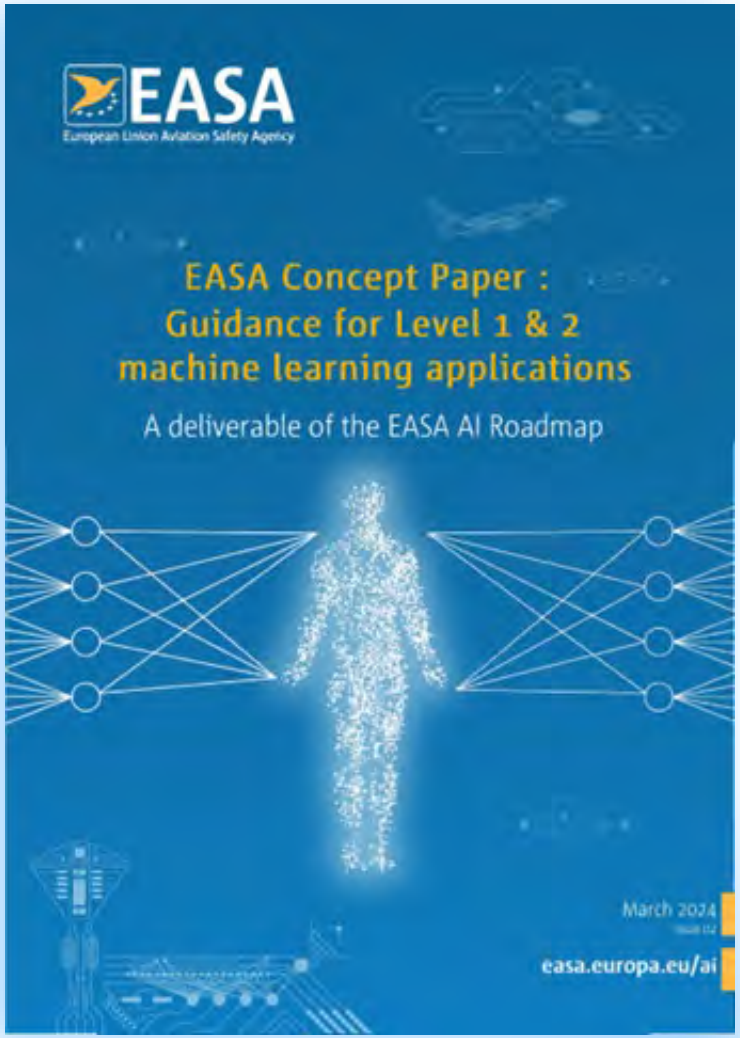
EASA guidance (2021 and 2024)

Drawing from the CoDANN reports and other partnerships with industry and academia





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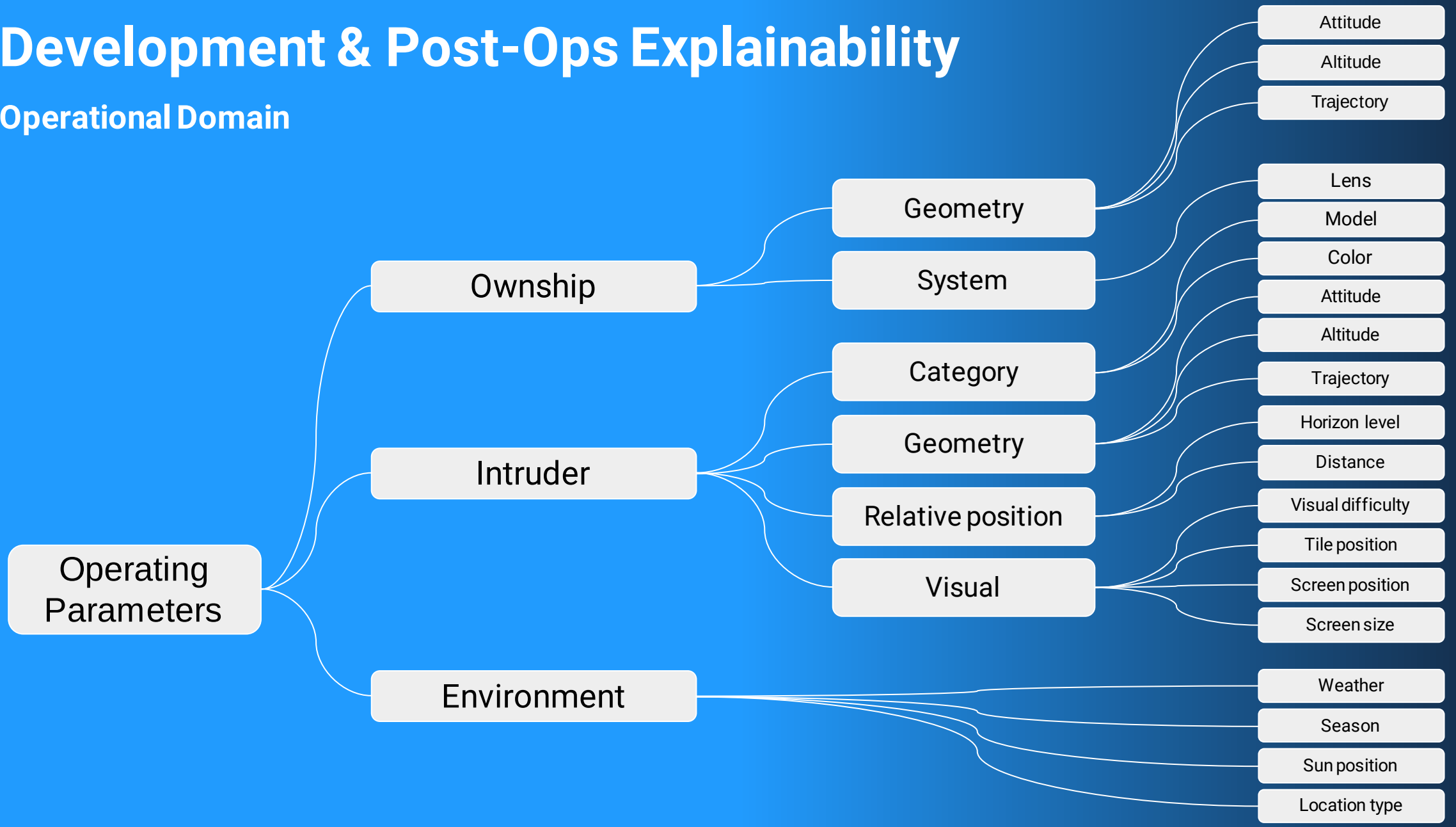
Development & Post-Ops Explainability

Operational Domain



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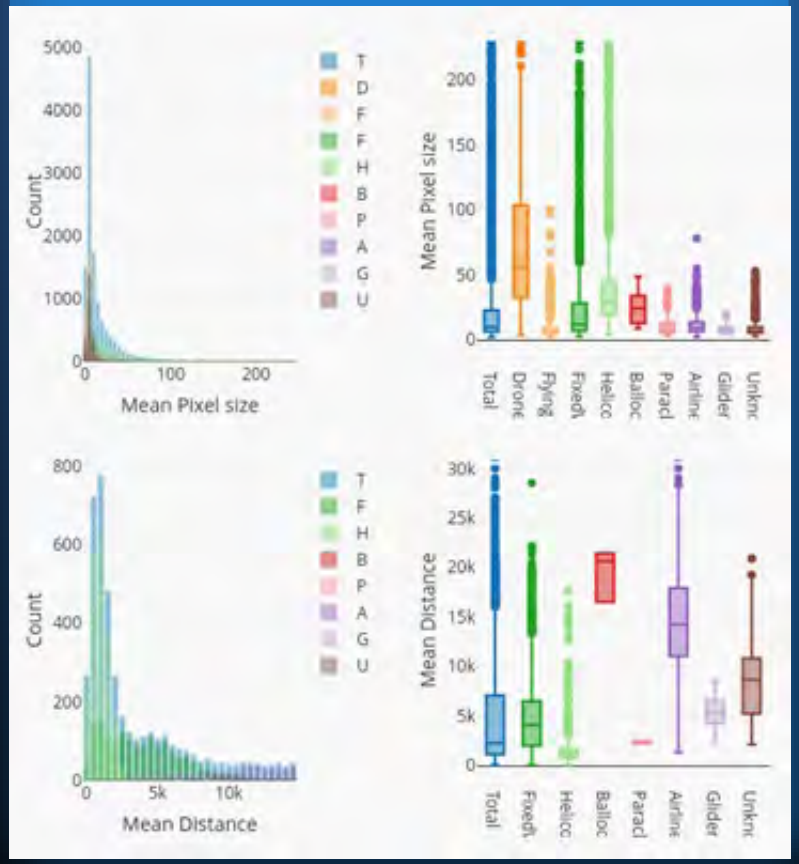
Development & Post-Ops Explainability

Data Completeness and Representativeness

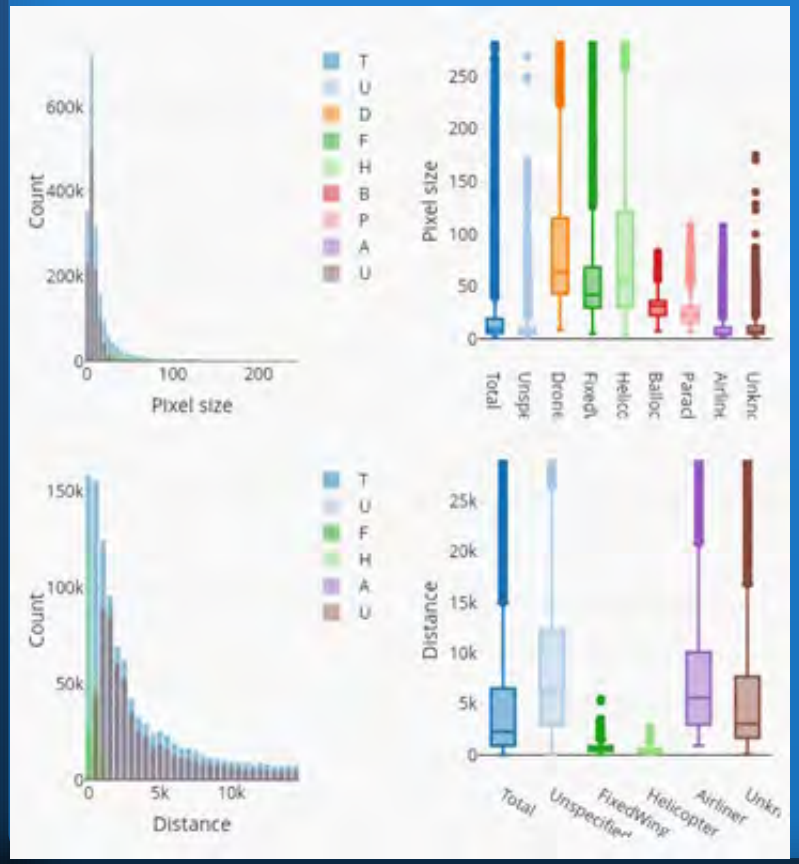
Tracks statistics

By class

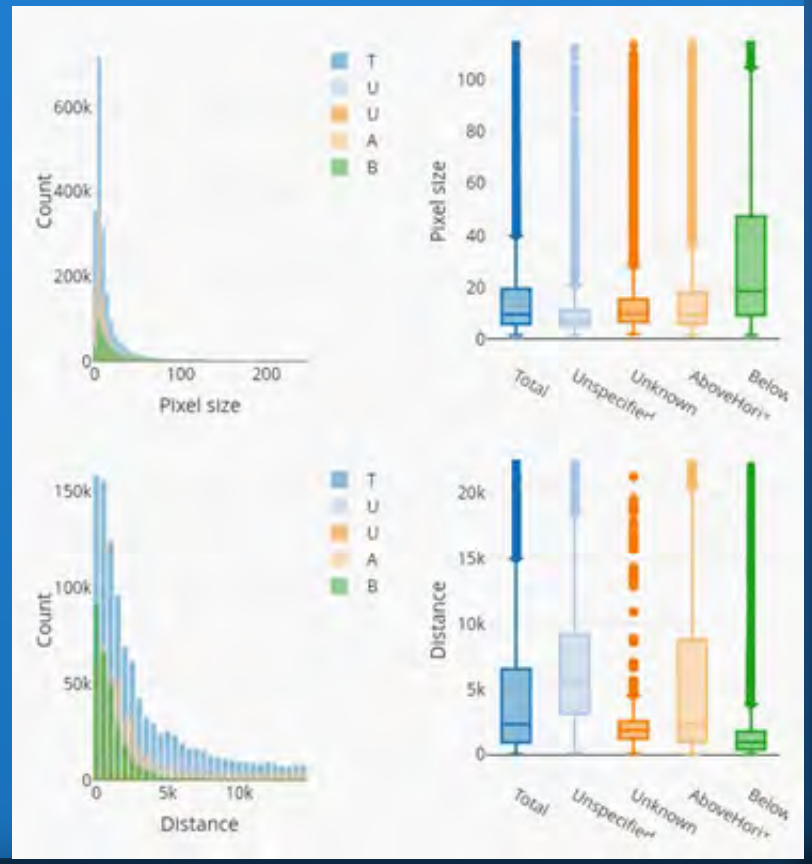


Frames statistics

By class



By horizon relative position



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Development & Post-Ops Explainability

Data Recording

Main certification objectives:

- Support monitoring of systems behaviour in operation (more on this later)
- Support accident/incident investigation;

But also…

- Data is key in developing new and improved ML aviation systems. With key benefits for the OEM, the user, and authorities due to the potential benefits of increased safety features.

It is in everyone’s best interest to properly design, implement and ensure the data recording of the system works as intended.

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Development & Post-Ops Explainability

Continuous Safety

What happens if?

…. user operates their system in a operational domain that is completely unexpected from what was considered during the development of the ML-based system?

… the airspace traffic distribution changed over time?

Our Data Management Plan,
the Data Recording System,
and the data flow pipeline we've established
are built from the start to enable continuous safety in operation.

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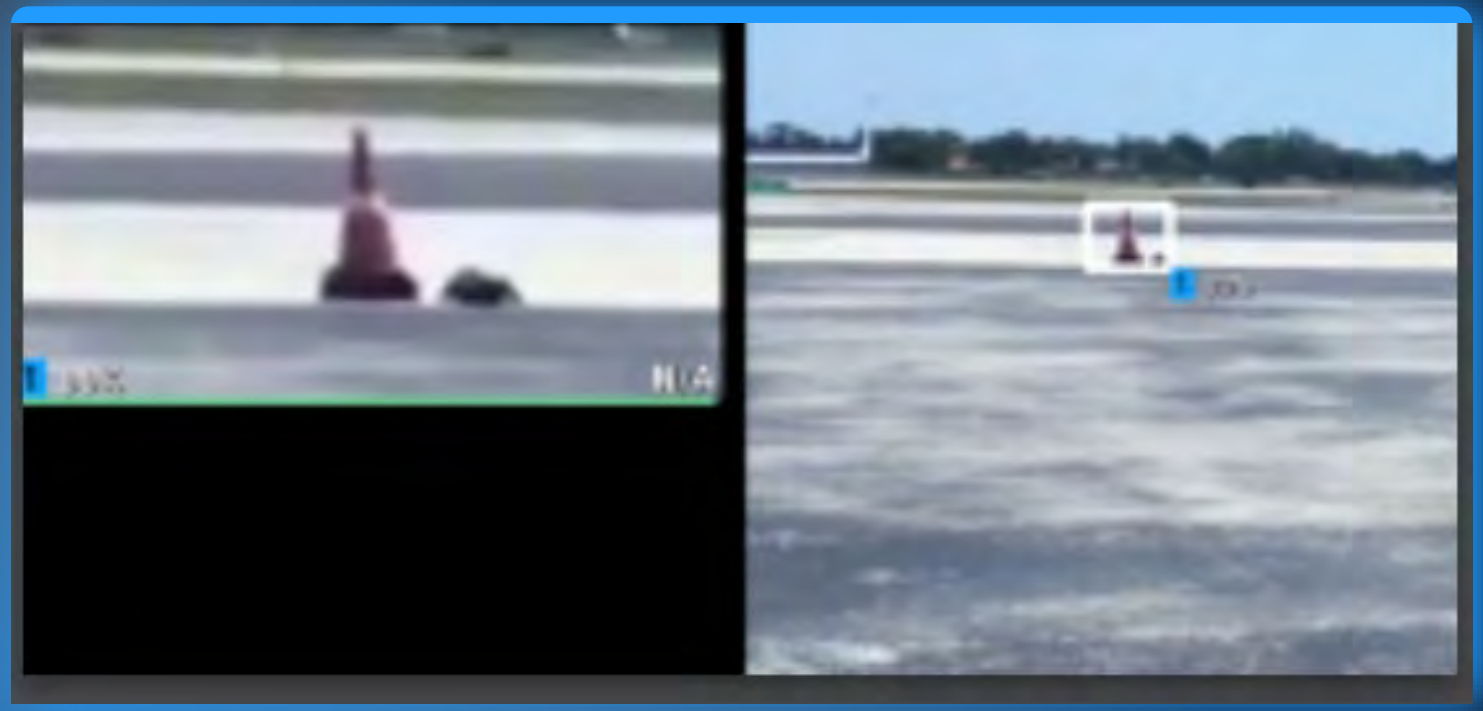
Development & Post-Ops Explainability

Continuous Safety

We’ve seen this already happen during the research phase of our traffic detection system, and we must continue to do so during operation.



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