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Low Power Low Drag (LPLD) conformance monitoring

Pete Rafano | May 2024

Introduction

- Low Power Low Drag (LPLD) is an established aircraft noise abatement technique introduced by ICAO as far back as 1970
- It describes the lowest noise configuration for a given speed and/or altitude during approach
- Drag from deployed landing gear causes turbulence which creates noise heard on the ground
- Airframe noise dominates aircraft noise on arrival

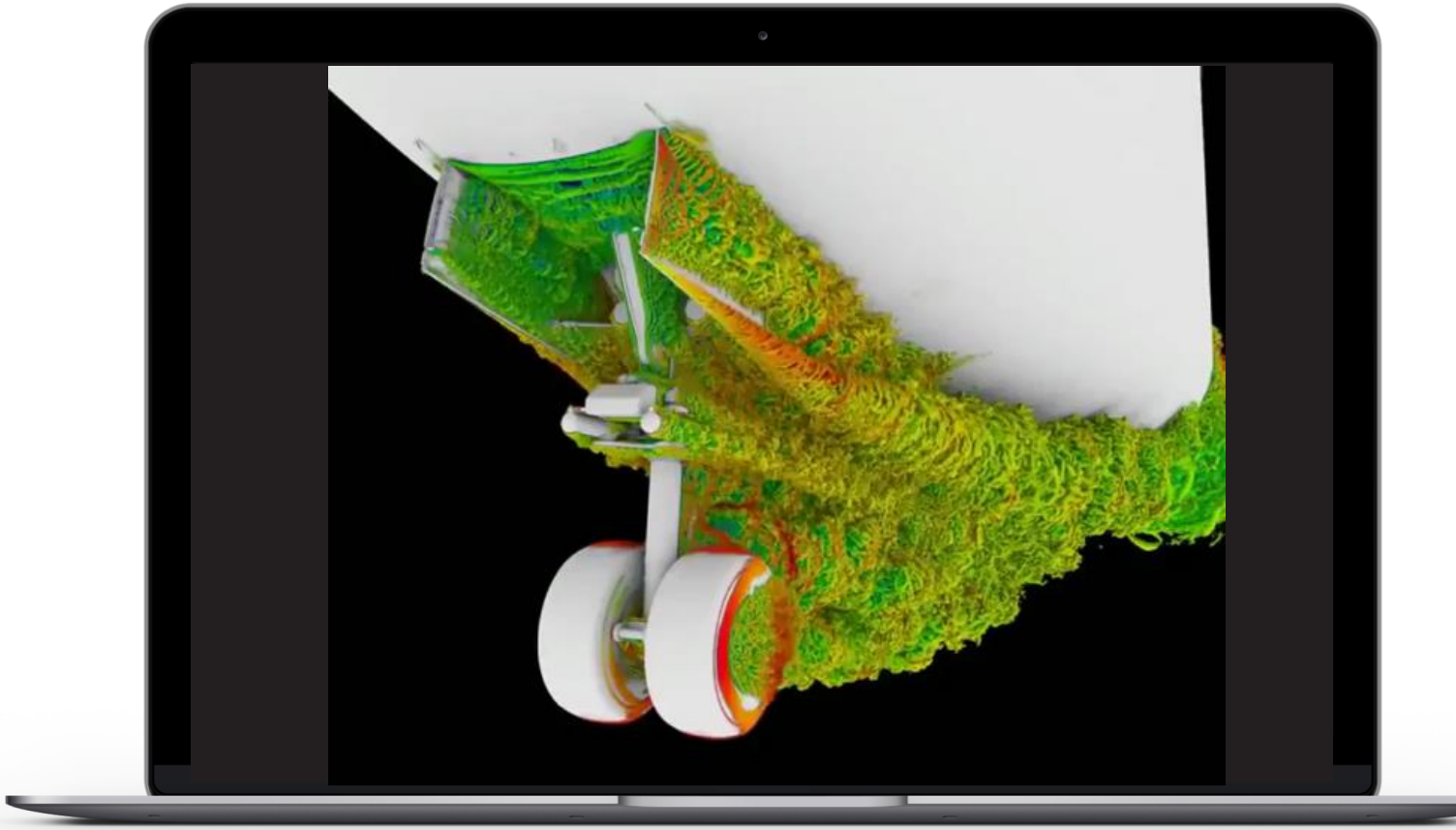
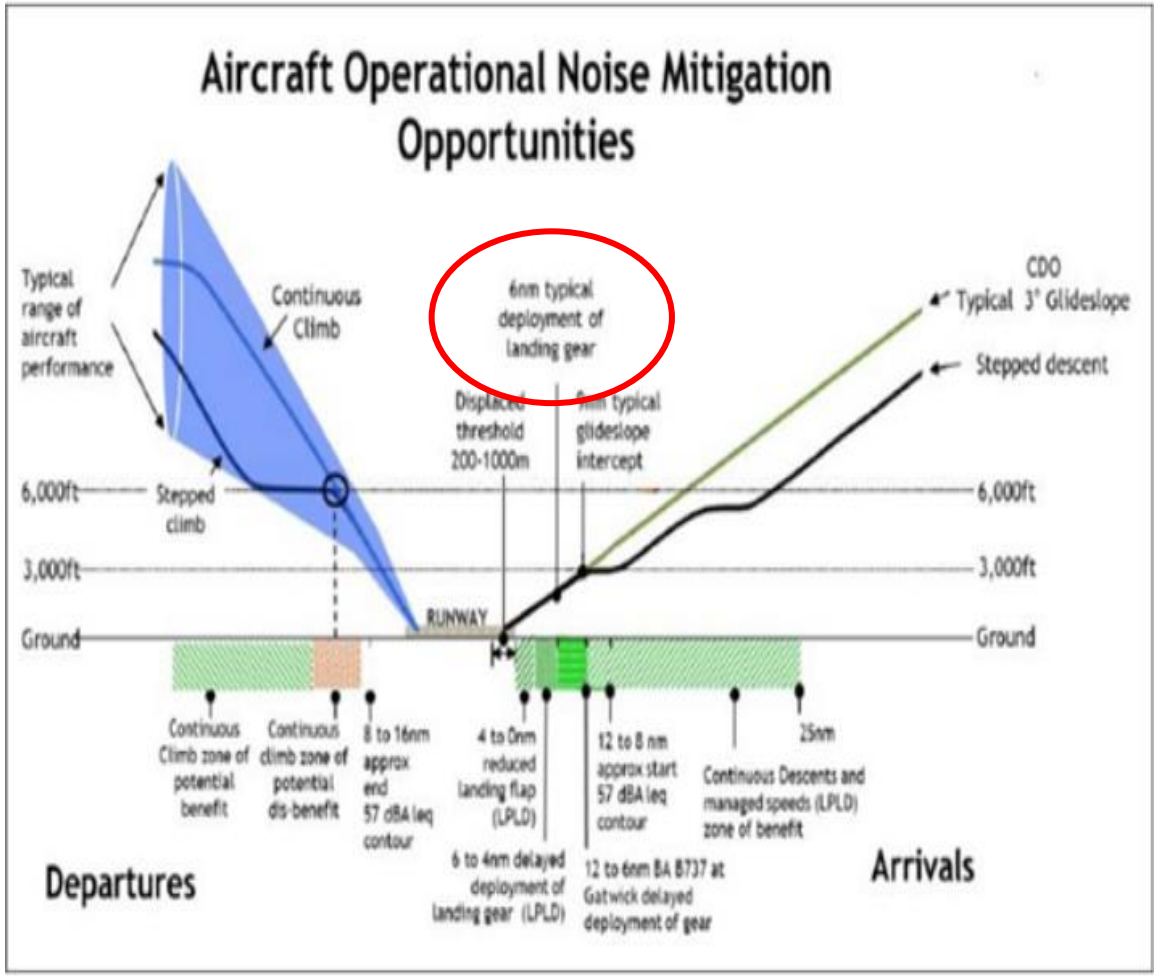


Image credit: NASA's Ames Research Center, Patrick Moran; NASA's Langley Research Center, Mehdi Khorrami; Exa Corporation, Ehab Fares

Where does the requirement for LPLD come from?

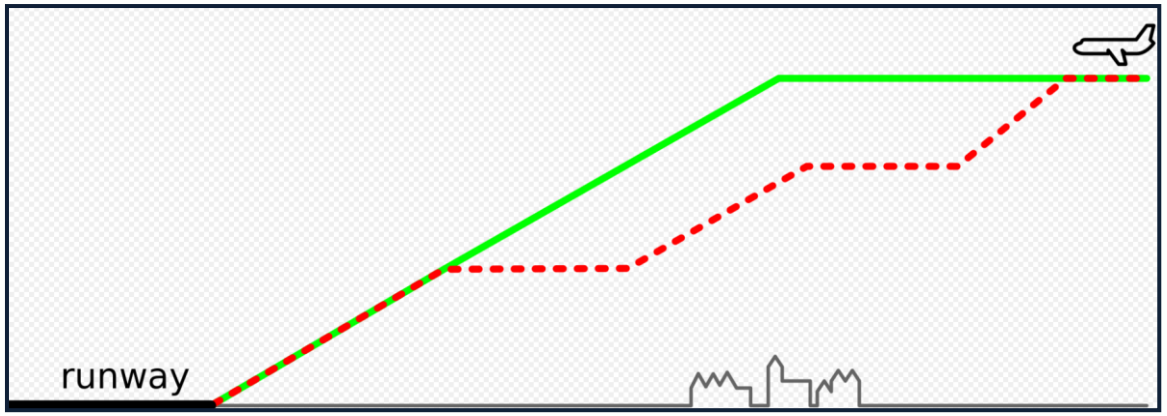
ICAO - Continuous Descent Operations (CDO) Manual (Doc 9931)

ICAO Document 9931, the 'Continuous Descent Operations Manual', CDO is defined as "an aircraft operating technique aided by appropriate airspace and procedure design and appropriate ATC clearances enabling the execution of a flight profile optimized to the operating capability of the aircraft, with low engine thrust settings and, where possible, a low drag configuration, thereby reducing noise, fuel burn and emissions during descent.
The optimum vertical profile takes the form of a continuously descending path, with a minimum of level flight segments only as needed to decelerate and configure the aircraft or to establish on a landing guidance system (e.g. ILS)."



https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg85-88.pdf

Continuous Descent Arrival & LPLD Procedures.



Track Profile

Tracks Only

Name: CDARule
Floor Height (feet AGL): 1800
Ceiling Height (feet AGL): 5500
Min Segment Length (nm): 2.00
Max Segment Length (nm): 2.50
Max Height Variation (feet): 50
Max Level Segments: 1
Max Assessment Distance (nm): 100.00
No Ascent: False
Use TOD: False

From 06:46:36 to 06:47:48
Length 4.901 nm.
From 06:50:08 to 06:51:16
Length 3.235 nm.

London Heathrow
Track Profile
12/11/2023 06:33:57 - 12/11/2023 06:54:28

So where was the landing gear deployed?

Height AGL (feet)

13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0

0 10 20 30 40 50 60 70 80 90 100

Cumulative Flight Distance (nautical miles)

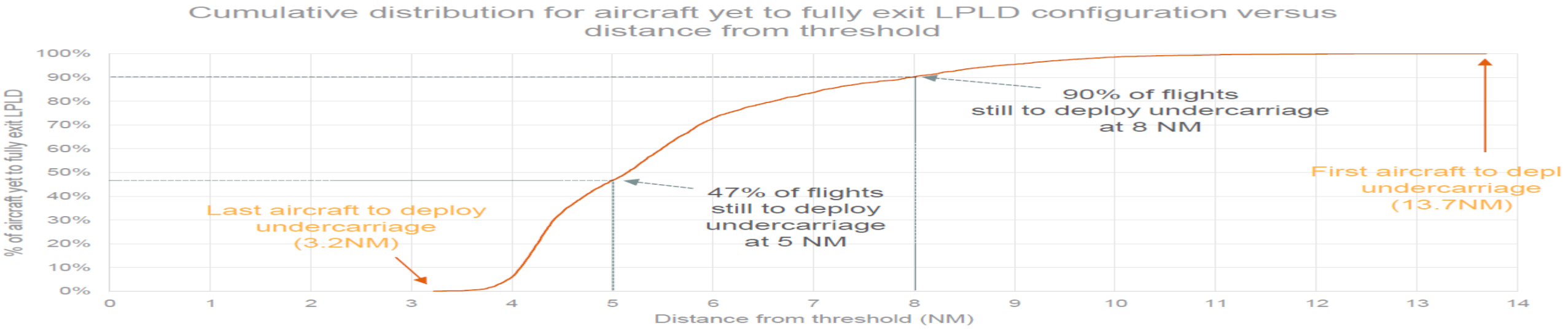
Arrivals
Departures
Overflights
Ceiling Height
Max Top Distance
Floor Height

Past LPLD studies have been purely visual, linked to ANOMS

Quotes: “The integrity of wheels down measurements were investigated by comparing observed overhead times with ANOMS gate penetration times”

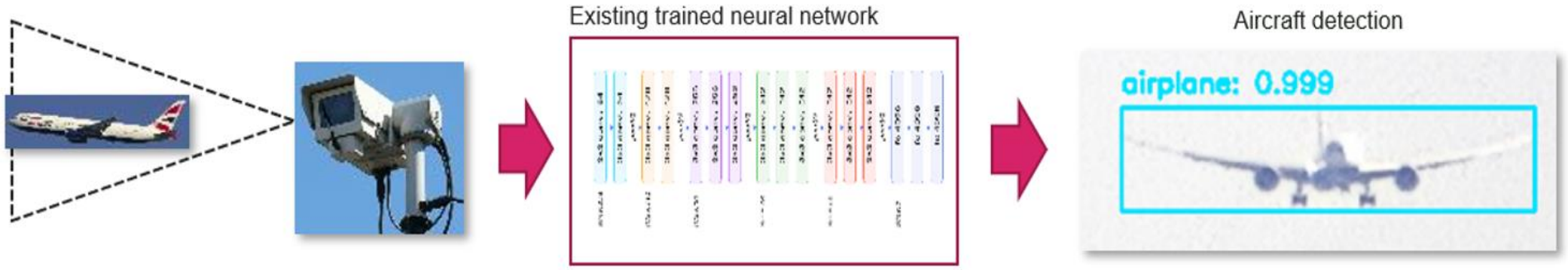
Comparatively lower accuracy for 09L has been attributed to the observation location being **offset by ~1,000 metres from the approach** – made the ‘overhead’ time more difficult to judge

Accuracy for 27L/27R may have been influenced by the observers judgement of when an aircraft was directly overhead

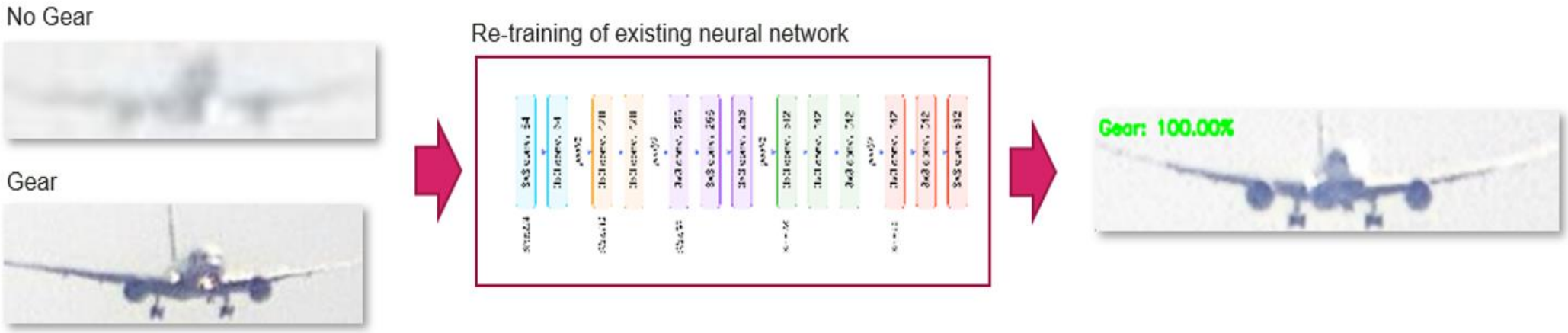


Automation.

STEP 1 – DETECTION OF DESIRED TARGETS IN IMAGERY



STEP 2 – PROCESSING OF IMAGES FOR GEAR



Example results.

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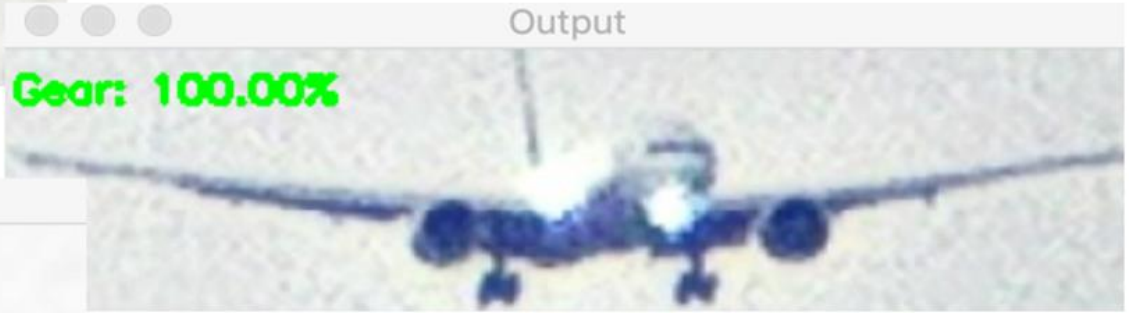
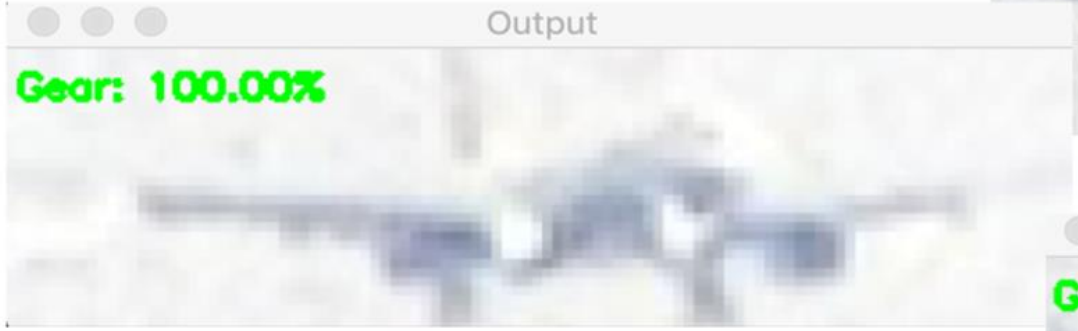
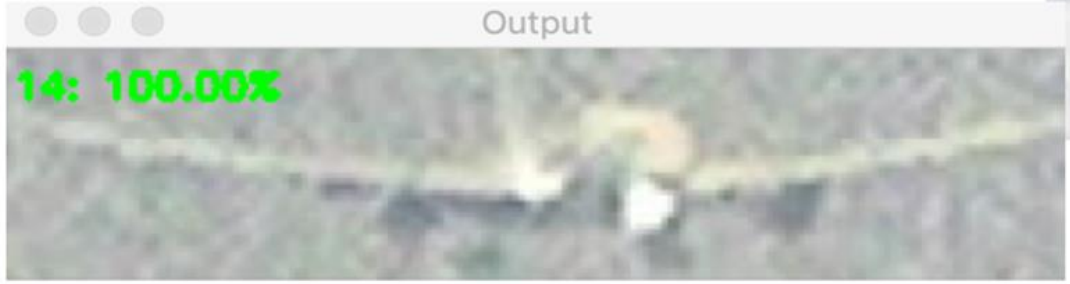






Next steps.

- With the technology now available the opportunity to monitor LPLD presents itself.
- Requirement is for better cameras sited in pairs for each approach.
- Retrain the algorithms which have improved hugely since 2019.
- ANOMS Development work to accept the data and allow it to be reported.

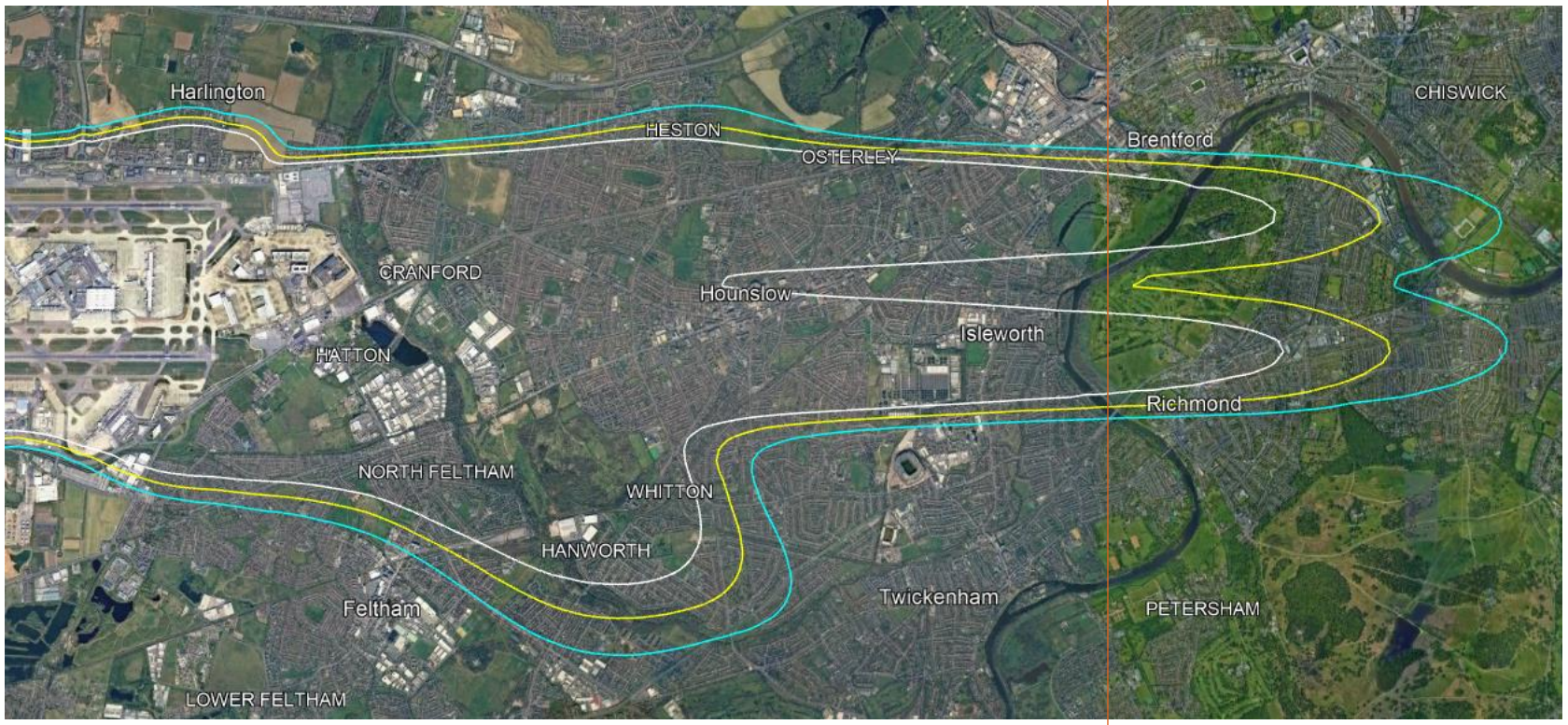
Benefits.

- Reputational benefit for airports.
- Research from UK CAA says an individual aircraft event can be reduced by 3-5dB.
- Every 1dB reduction in noise equates to approximately a 20% reduction in the arrivals contour.

What does that benefit mean?

- Land gear *could* be deployed by 5nm from threshold

LHR 55,56 & 57dB daytime noise contours



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