#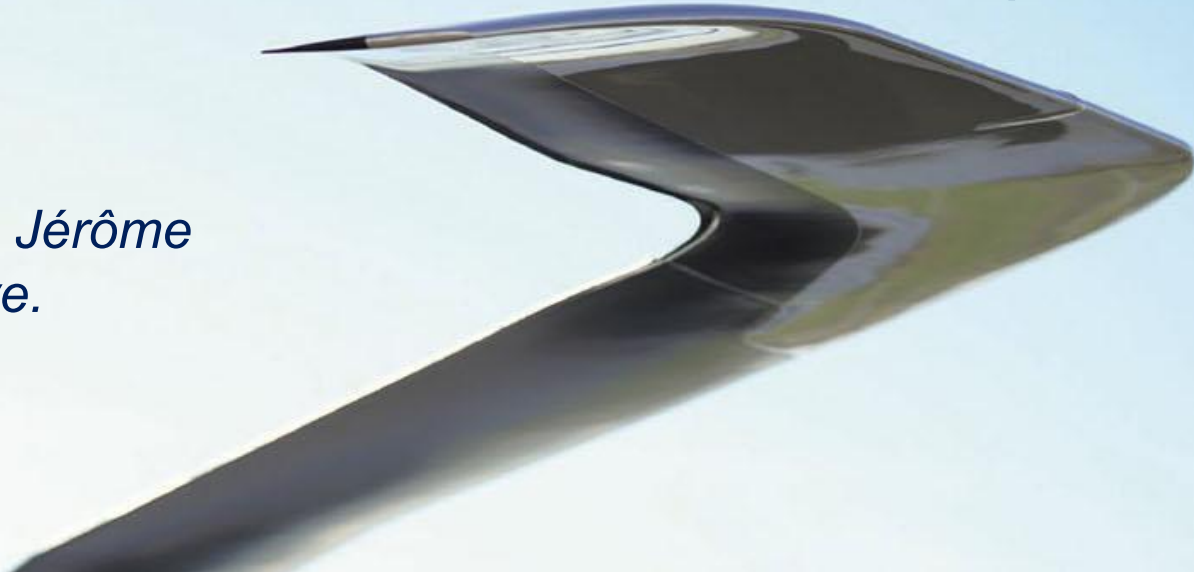 Une IA hybride pour la surveillance de la santé du système de lubrification et de refroidissement de la BTP d'un hélicoptère

Ammar Mechouche, Matthis Houles, Jérôme Belmonte et Pierre-Loic Maisonneuve.

HELICOPTERS

Ammar Mechouche

Advanced Analytics & Big Data eXpert
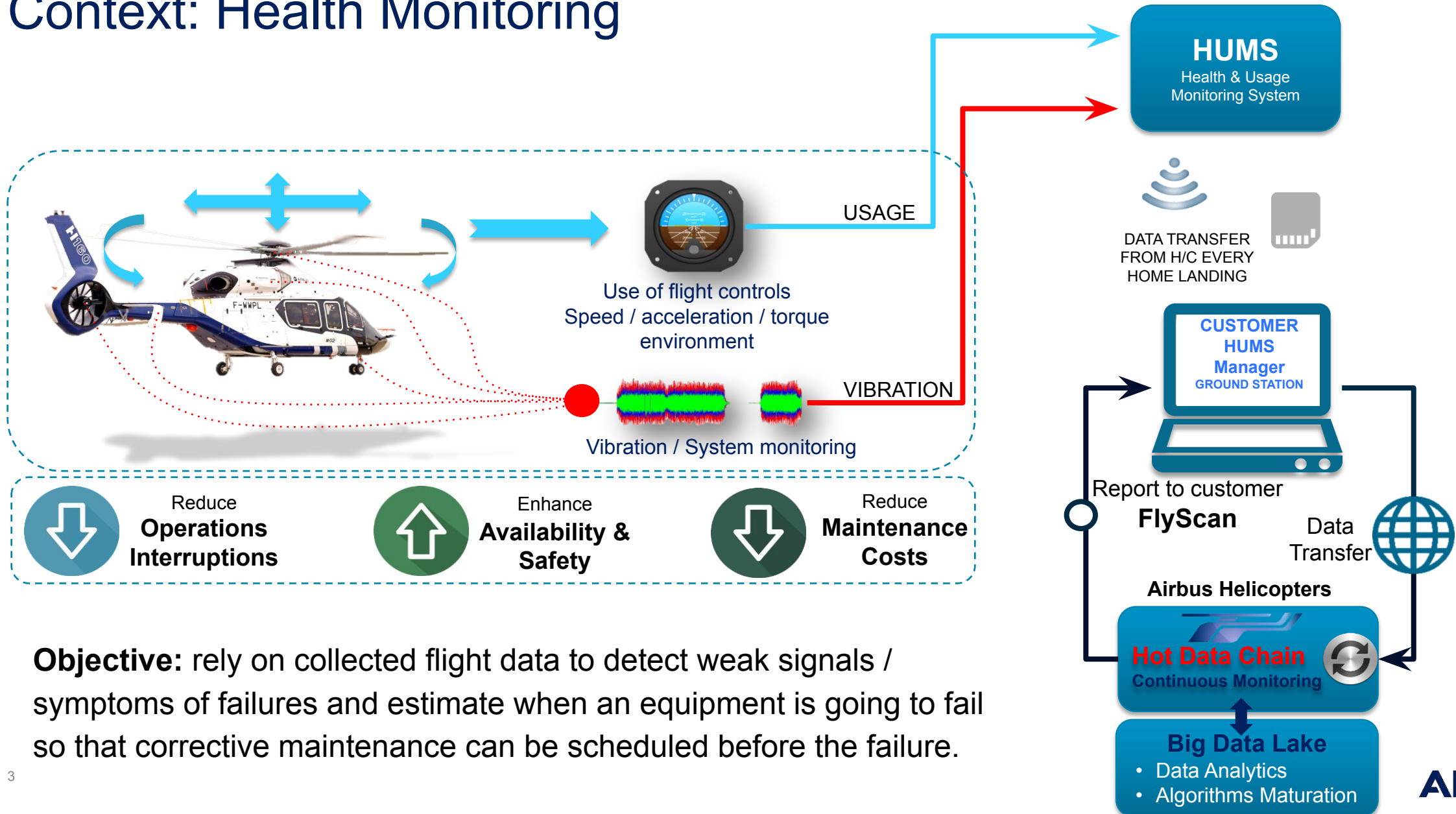
Airbus Helicopters

30 juin 2025, Dijon, France

Conférence Nationale sur les Applications Pratiques de l'Intelligence Artificielle (APIA 2025)
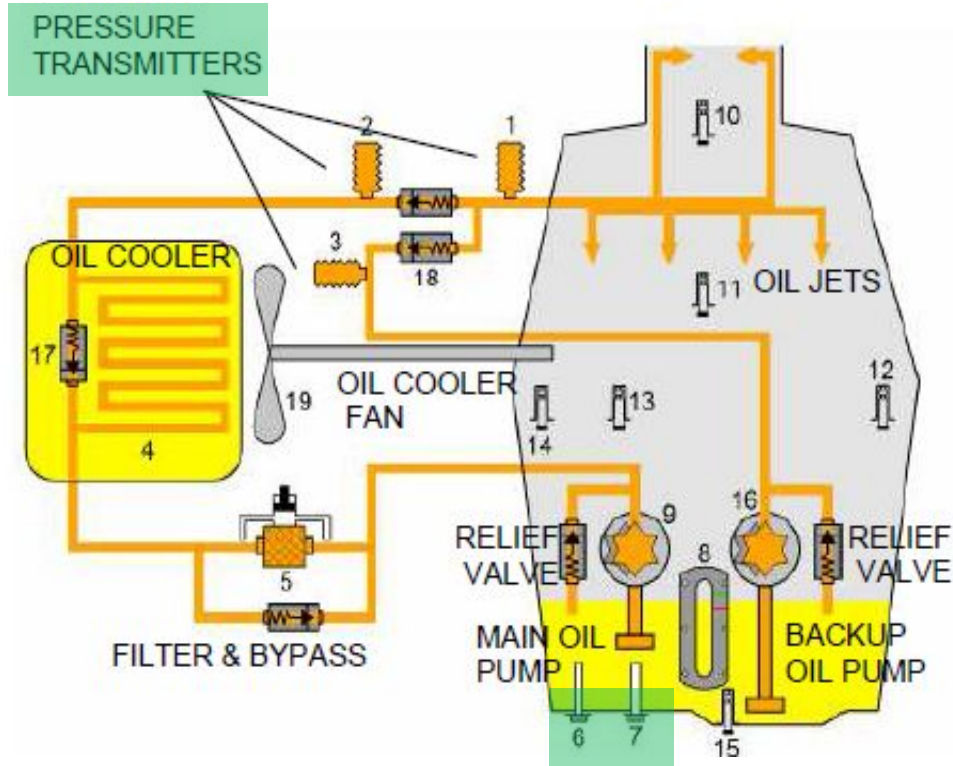
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Outline

- Context
- System & solution description
- Results
- Conclusion

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Context: Health Monitoring

APIA

HUMS
Health & Usage
Monitoring System

USAGE

Use of flight controls
Speed / acceleration / torque
environment

VIBRATION

Vibration / System monitoring

DATA TRANSFER
FROM H/C EVERY
HOME LANDING

**CUSTOMER
HUMS
Manager**
GROUND STATION

Report to customer
FlyScan

Data
Transfer

Reduce
**Operations
Interruptions**

Enhance
**Availability &
Safety**

Reduce
**Maintenance
Costs**

Airbus Helicopters

Hot Data Chain
Continuous Monitoring

Big Data Lake
- Data Analytics
- Algorithms Maturation

Objective: rely on collected flight data to detect weak signals / symptoms of failures and estimate when an equipment is going to fail so that corrective maintenance can be scheduled before the failure.

3

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MGB Lubrication and Cooling System Case (1/2)

**Composition**: 2 pressurized circuits:
- The first is equipped with an oil filter and an oil cooler
- The second one is integrated to the housing to minimize the sources of failures leading to external leakages

Functions:
- Lubrication of parts in contact for power transmissions
- Collection of the heat generated at each contact + its evacuation at the oil cooler
- Collection of other pollutants + bringing them to the oil filter…

Solution Overview

1. Use AI to assess the **normality** of the following sensor data: MGBT (elements 6 and 7 of the figure), MGBPr: (1), MGBP: (2), MGBPb (3)
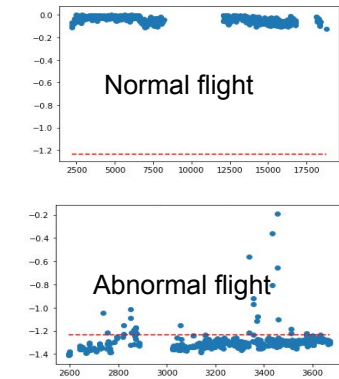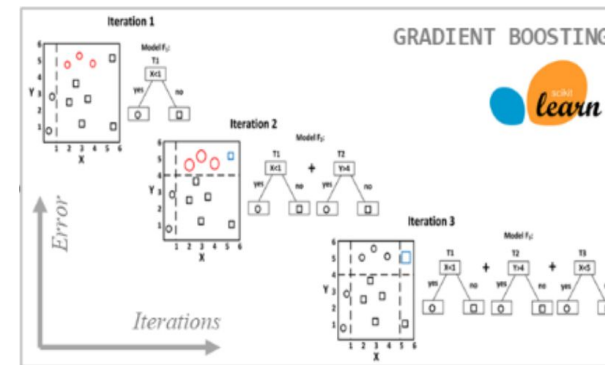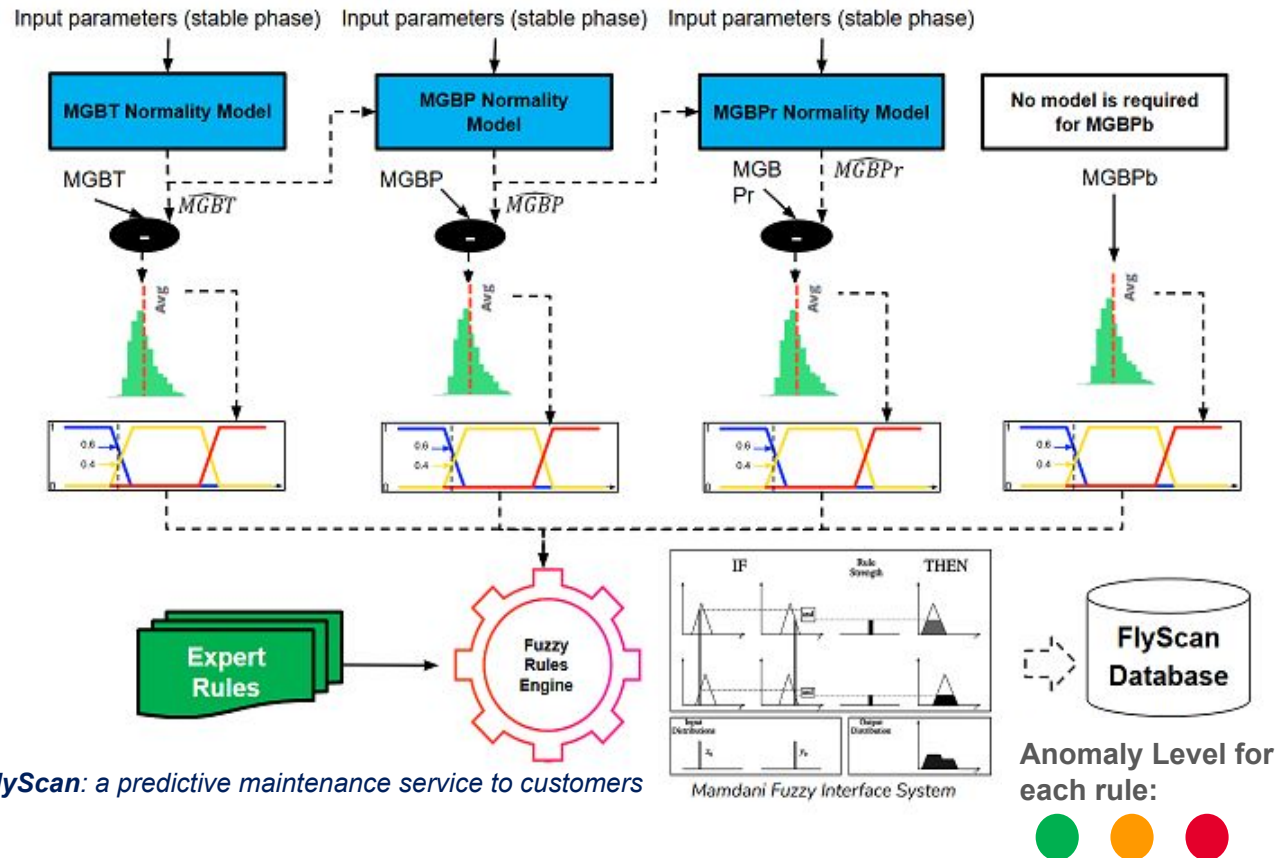

2. Use the result of 1) to feed and enable 'fuzzyfied' expert diagnosis rules:

   ○ Example: *IF* MGBP_is_high *AND* MGBPb_is_normal *AND* MGBPr_is_high *AND* MGBT_is_normal *THEN* ANOMALY_IS_MGB_OIL_JETS_CLOGGING

Allows identifying more than 10 different root causes of anomalies related to the MGB lubrication and cooling sub-systems

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MGB Lubrication and Cooling System Case (2/2)
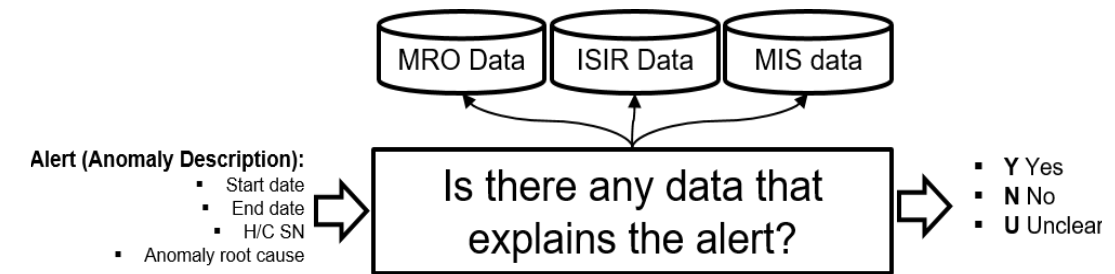
Detailed view of the solution

FlyScan: a predictive maintenance service to customers

Mamdani Fuzzy Interface System

Anomaly Level for each rule:

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Experiments / Results

Normality models performance assessment

Model / Metrics	R2 (%)	RMSE
MGBP	74.4	0.27 (bar)
MGBT	85.1	3.89 (°C)
MGBPr	96.0	0.10 (bar)

Table 1: Normality Models Performance Results: R2 vs RMSE (>100K FH)

Integrated solution performance assessment

Alert (Anomaly Description):
- Start date
- End date
- H/C SN
- Anomaly root cause

Is there any data that explains the alert?

- **Y** Yes
- **N** No
- **U** Unclear

#H/C	#FH	#Y	#N	#U
14	62000	7	1	1

Table 2: Overall System Performance: Recall versus Precision like Assessment

- A maintenance work card has been defined for each rule
- Improvements of the system have been made following feedbacks from FlyScan team after a first deployment for maturation:
  - More robustness and better management of uncertainties

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Conclusion - AI for H/C Health Monitoring

Lessons learnt / Key takeaways

- High value (AI brings solutions to difficult problems)
  - Especially when AI is combined with domain knowledge
- Lack of 'trust' (adoption) by end users / professionals
  - Both non detections and false positives are very costly
    - Predictions should be reliable and understandable

Way forward / Challenges (already partially addressed, cf. VFS'2025)

- Models robustness:
  - Generalization & stability
  - Uncertainty quantification & management
  - Monitoring
- Predictions explainability
- Certification

Challenges

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Thank you!

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