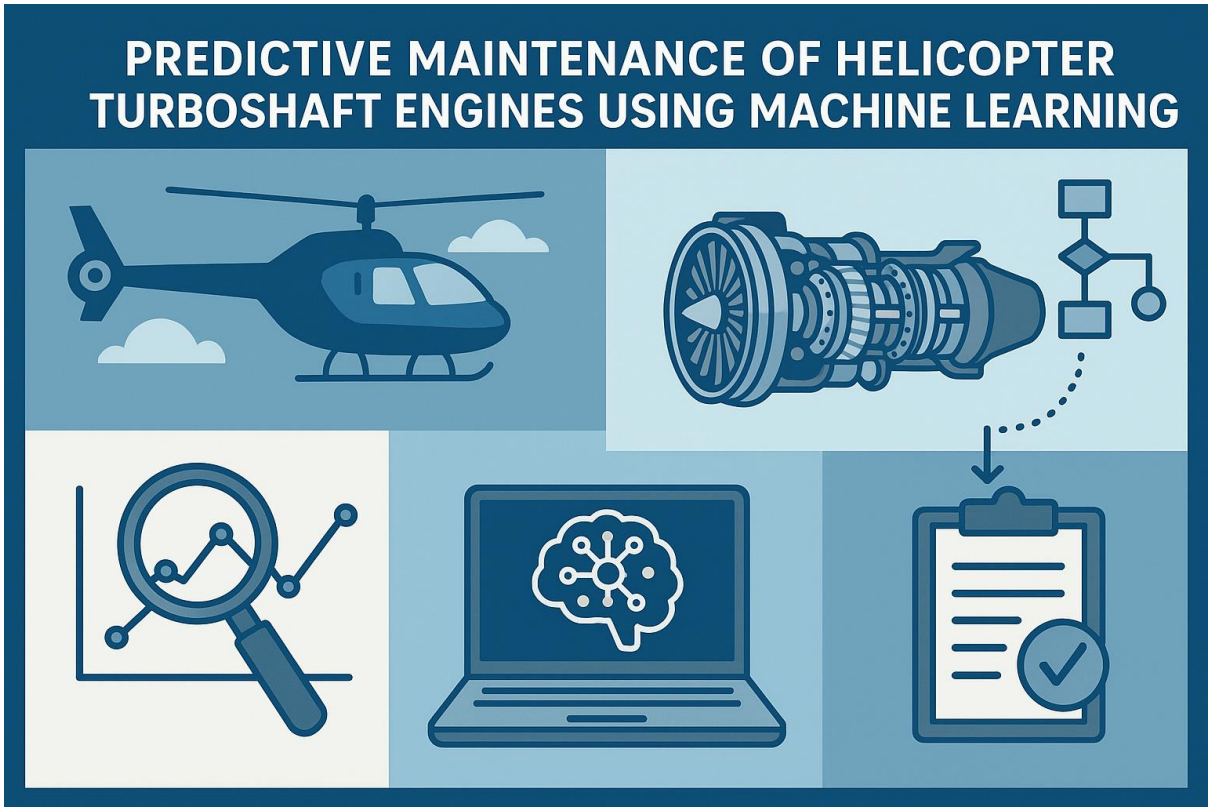
Workshop Proposal



Overview

This 2-hour online workshop aims to introduce students to the real-world application of machine learning in aerospace engineering, particularly in predictive maintenance of helicopter turboshaft engines. Using a publicly available dataset and hands-on implementation, participants will learn how to use data science techniques to detect early signs of engine failure—enhancing both safety and efficiency in aviation systems.

Problem Statement

Helicopter turboshaft engines are vulnerable to unexpected failures due to factors such as overheating, excessive vibration, and irregular fuel flow. These failures can result in costly maintenance, operational downtime, and even compromise flight safety. Traditional reactive maintenance strategies are no longer sufficient in modern aviation.

Proposed Solution

By applying machine learning models to analyze real-time sensor data, we can predict engine failures in advance. This predictive maintenance approach helps identify faults before they occur, reducing downtime, minimizing costs, and improving overall safety.

Key Takeaways for Participants

- Understand the fundamentals of predictive maintenance.
- Explore real-world aviation sensor data.
- Learn how to build a basic machine learning pipeline for fault detection.
- Understand the role of AI/ML in aerospace safety and diagnostics.
- Gain exposure to classification and anomaly detection techniques.

Workshop Agenda (2 Hours)

Time	Topic
0:00 – 0:15	Introduction to Predictive Maintenance and Aviation Use Cases
0:15 – 0:30	Overview of Helicopter Turboshaft Engines & Common Failure Modes
0:30 – 0:45	Dataset Walkthrough and Problem Framing
0:45 – 1:15	Hands-On: Data Cleaning, Labeling, and Preprocessing
1:15 – 1:40	Model Building: Classification & Anomaly Detection
1:40 – 1:50	Testing and Evaluating the Model
1:50 – 2:00	Q&A + Future Scope in Predictive Maintenance

Dataset

We will use the dataset titled **"Helicopter Turboshaft Fault Detection"**, which contains over 7,000 hourly sensor readings from a helicopter turboshaft engine. The dataset includes key features such as:

- **Temperature** of compressor and turbine
- **Compressor pressure** and **vibration**
- **Turbine speed**, **fuel flow**, **altitude**, **airspeed**, and **ambient temperature**
- A **timestamp** for each reading and a **fault label** indicating whether the engine was in a normal or faulty state

This dataset is ideal for fault classification and performance monitoring in predictive maintenance systems.

Helicopter Turboshaft Detection Dataset – Kaggle

How Machine Learning Detects Engine Failures

1. **Collect Data** – Use historical sensor data such as temperature, vibration, and pressure readings.
2. **Preprocess Data** – Clean and scale sensor readings, convert timestamps if needed.
3. **Label Data** – Use the Fault_Label column to train on both normal and faulty conditions.
4. **Select Model** – Use classification algorithms (e.g., Random Forest, SVM) or anomaly detection.
5. **Train the Model** – Learn patterns and conditions that lead to engine faults.
6. **Evaluate the Model** – Test accuracy using unseen data samples.
7. **Predict in Real-Time** – Apply the model to monitor live data for early fault warnings.

Ideal Audience

This workshop is best suited for:

- Undergraduate & postgraduate students of **Aeronautical, Mechanical, Electrical, or Computer Science Engineering**
- Students with interest in **Artificial Intelligence**, **Data Science**, and **Aerospace Systems**
- Beginner to intermediate learners of **Python and Machine Learning**

Prerequisites

Participants should have:

- Basic knowledge of Python (variables, functions, libraries)
- Familiarity with machine learning concepts (classification, training/testing)
- A laptop with Python installed (Jupyter Notebook or Google Colab preferred)
- Internet connectivity for downloading datasets and participating interactively

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Tools & Libraries Used

- Python
- Pandas, NumPy
- Scikit-learn
- Matplotlib/Seaborn
- Google Colab or Jupyter Notebook

Expected Outcomes

By the end of this workshop, participants will:

- Be able to handle sensor data and apply basic preprocessing
- Understand how ML is used to monitor critical systems in real time
- Create a simple predictive model for classifying engine health

- Develop an appreciation for the role of data in aviation safety and maintenance planning

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Facilitator

Mr. Sarthak Narnor, 4+ Years' Experience
Aeronautical Engineering Graduate | ML & Data Science Enthusiast
Worked on multiple interdisciplinary projects combining aerospace systems with machine learning.
Passionate about making advanced tech accessible to learners from all backgrounds.

Mode & Requirements

- **Mode:** Online (Zoom/Google Meet/MS Teams)
- **Duration:** 2 Hours
- **Requirements from the Host:**
    - Online platform hosting access
    - Promotion to relevant student groups
    - Confirmation of at least 25 registered participants