



JOB DESCRIPTION - INTERNSHIP (MASTER 2)

JOB TITLE: INTERNSHIP - ENGINEER/DATA SCIENTIST

based at Thales Research & Technology - Palaiseau (91)

Thales Research & Technology is looking for a :
**INTERNSHIP - Engineer/Data Scientist - Application of Topological Data Analysis (TDA)
to trusted AI for critical systems (M/F)**
Based in Palaiseau (91)

WHO ARE YOU?

- Do you have a BAC+5 specialized in AI/Data Science?
- Have your studies and experience (projects, internships) given you a solid grounding in mathematics, topological data analysis, machine learning, deep learning, algorithms and programming (Python)?
- Are you passionate about research and would like to continue with a PhD thesis?
- Are you recognized for your adaptability and organizational skills?
- Are you fluent enough in English to work in a professional environment?
- Do you like to work independently and are you able to synthesize information?

WHAT WE CAN ACHIEVE TOGETHER:

The mission of THALES Research & Technology France is to provide the THALES Group's operating units with the technologies, knowledge and skills they need to ensure their development and competitive advantage over the medium and long term.

In this context, your missions will be as follows:



Introduction

As part of its mission, Thales supplies its customers with mission-critical systems in a variety of fields, including aeronautics, naval, space and defense. The “critical” nature of these systems (e.g. the cockpit of an aircraft) requires that they operate reliably within a well-defined Operational Design Domain (ODD). The ODD represents the set of conditions under which a system is expected to function correctly, such as environmental, operational and contextual conditions. In mission-critical systems, poor definition or coverage of the ODD can lead to serious failures, compromising safety and reliability. This internship proposes to experiment with Topological Data Analysis (TDA) to characterize and visualize the ODD, identify gaps in training data, and define an optimal dataset for robust learning.

Internship objectives

The objectives of this internship are to:

1. Use TDA to analyze and visualize the ODD of a critical system.
2. Identify gaps in training data, particularly under-represented or critical conditions.
3. Propose an optimized set of training data covering all relevant operational conditions.
4. Validate this approach by demonstrating improved coverage and robustness of the trained model.

Case study: Drone landing on a numbered chessboard

The proposed case study concerns a control system for a drone tasked with landing precisely on a square of a numbered chessboard on the ground, according to the number selected by the user. Operational conditions that may influence drone operation include:

- Light variations (day, night, shadows simulated with an adjustable lighting system).
- Weather conditions (light winds simulated with one or more fans).
- Various camera angles and perspectives due to drone positioning.

Work plan

The work will be carried out in the following stages:

1. Literature review: Study TDA and its tools (e.g., persistent homology, dimension reduction).
2. Data collection and preparation: Simulate or collect data from drone landing scenarios under various conditions.
3. TDA application: Analyze SDO coverage and identify gaps in training data.
4. Proposal of an optimized data set: Add or simulate scenarios to fill the gaps detected.
5. Experimental validation: Train an autonomous control model for the UAV and evaluate its performance.



Expected Results

Expected results include :

- A clear methodology for analyzing and visualizing the ODD of a critical system using TDA.
- A detailed identification of areas covered and gaps in the ODD for the case study.
- An optimized training data set, covering all critical conditions.
- Experimental validation demonstrating the improved performance and robustness of the model thanks to this optimized training set.

After the Internship - Prospects

This internship may be pursued as a PhD thesis.

Host Laboratories

Lab	Address
Thales CortAlx Labs* * AI research center of the Thales Group, formerly Thales Research & Technology	1, avenue Augustin Fresnel Palaiseau 91767 Cedex
LIP6 Laboratory of Sorbonne University Team: APR - Algorithms, Programs and Resolution	169 Tour 26, Couloir 26-00, 2e étage. 4 place Jussieu. 75252 Paris Cedex 05

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