

Internship and Thesis Projects at Tractebel

Computer Vision and Machine Learning Aided System Reliability Modelling

Probabilistic Safety Assessment

Business line: Nuclear – Nuclear Engineering Department – Probabilistic Safety Assessment

Duration: ≈ 2 months

Period: January – September 2023

Site: Brussels Engie Tower

Who is Tractebel?

Tractebel, part of the Engie group, has over 150 years of experience and is one of the world's largest engineering company. Tractebel offers its customers multidisciplinary solutions in the fields of energy, nuclear, hydraulic and infrastructure. Our teams are involved in all phases of a project, from feasibility studies to implementation.

With who will you be working with?

You will work with the Level 1 PSA team which is responsible for the Probabilistic Safety Assessment of the Belgian Nuclear Power Plants. The group also performs reliability analyses for other industrial applications.

What will you be working on?

Context

One of the objectives of the Gen IV and SMR technologies, is to recreate public trust in nuclear safety. In order to optimize new reactor design probabilistic safety analysis (PSA) is integrated at early stages into the design. PSA aims to determine a numerical estimate of the risk in order to identify strengths and weaknesses of the design of the plant. In order to achieve such analysis, system reliability have to be constructed and maintained throughout the course of the design and lifespan of the plant. These system reliability models commonly take the form of fault trees.

Piping and instrumentation diagrams (P&ID) are detailed drawings showing the interconnection of process equipment and the instrumentation. These drawings are used throughout to design and play a key role in tracking design modifications. While relatively easily understandable by human the P&ID format is difficult for computers to understand. As P&IDs together with logic drawings form the basis on which the system reliability models are constructed, this activity has been historically a manual expert-driven feat.

This project aims at investigating the feasibility of modern computer vision and machine learning techniques to automate the creation of logical system reliability models. Not only does this improve efficiency but also ensure a larger homogeneity in the complex models constructed for the various safety systems.

Description of the work

This internship proposal consists of using computer vision and machine learning techniques to improve the selection and extraction of crucial system information from piping and instrumentation drawings with respect to the automatic construction of system reliability models.

The aim of the project is to pass through the following machine learning workflow:

1. Data Exploration: Familiarization with P&IDs and fault trees used in PSA.
2. Data Wrangling: Convert the large sets of P&ID examples into usable form. P&IDs are commonly available in PDF format of different sizes and with different margins. Labelling options will need to be examined.
3. Data Versioning: Determination of Train, Test and Validation Sets.
4. Model Engineering: Design & Train model to identify plant components and their relations. Select most appropriate model(s)/libraries based on a small literature and state of industry review. Implement the selected models in Python.
5. Model Evaluation: Tune Model Hyperparameters for best performance.
6. Post-Processing Code: Assist in the development and Specification of the code that will translate the identified components and their relations into fault trees evaluating the system reliability.
7. Documentation.

Scope

- Familiarization with P&IDs and logical Models used in PSA.
- Analyse, compare and map the available techniques/methodology/tools within computer vision and machine learning to identify safety significant components and relationships from P&IDs.
- Define, in concertation with Tractebel experts, the most promising combinations of techniques/methodologies/tools and implement these in a machine learning workflow.
- Examine and evaluate the performance of the constructed model.
- Writing a summary report.

Who are we looking for?

- You have a background or willingness to deep dive in machine learning and computer science.
- You have a good knowledge of reliability and availability estimation.
- You have programming skills.
- You have an analytical mind.
- You are autonomous, rigorous, systematic, willing to listen and learn.
- You are creative, seek solutions and propose ideas.
- You have a good team spirit.
- An interest in the nuclear industry, probabilistic safety analysis and/or reliability assessment is a plus.

What do we offer?

- An interesting internship in a multilingual environment, with a good work-life balance.
- The opportunity to meet industry experts and work in a team of experienced professionals.
- Familiarity with an environment that allows you to strengthen your professional and technical skills.
- An opportunity to experience the ways of working in a design office.

How to apply?

Do you think Tractebel is the ideal solution for your internship?

Contact your teacher and send an e-mail to FEDERICO.AGOSTI@TRACTEBEL.ENGIE.COM with your CV and a concise motivation message.

We hope to see you soon!