

FTEC Project: Image processing using computer vision and machine learning for sensors mounted on robots in tunnels and inside cavities

Department:

EN

Description:

The EN-SMM-MRO section is responsible for the development of robotic solutions at CERN used for interventions around inspection, maintenance and repair as well as the mechatronic design and operation of beam intercepting devices (BIDs). This position will support and expand our capabilities to use computer vision (CV) and machine learning (ML) to automatically characterise and understand the environment that we perceive from our robotic platforms via multiple sensors (cameras, depth cameras, macro cameras, LIDAR etc).

Within the section, previous work in CV and ML has been used for the detection of Beam Loss Monitoring (BLM) sensors mounted in the LHC from cameras mounted on the Train Inspection Monorail (TIM) robot, for the mapping and analysis of the tunnel structure, and recently for the automatic detection and classification of defects on the material surface inside radio frequency cavities. This project will build upon and expand these projects, particularly exploring the use of point cloud images for environment and object classification, and the use of macro images to detect defects in the surface of RF cavities. The software development will be done within the CERN Robotics C++ Framework, which already incorporates OpenCV, TensorFlow and PyTorch libraries. A possible expansion to this framework in the scope of this project would be to add and test the TensorRT library.

Functions and training value:

You will:

- learn how to access images from different types of sensors within the CERN Robotics Framework (CPP)
- apply computer vision (CV) processing algorithms and machine learning (ML) algorithms either in TensorFlow, PyTorch or TensorRTExplore
- learn about CV and ML methods to detect anomalies from images (e.g. surface defects), or to automatically classify and characterise objects from images (e.g. object detection)
- understand the practical applications of CV and ML to robots used at CERN, where the challenges in this field can be small datasets and featureless environments.

Qualification / skills required:

- MSc/Meng in Computer Science, Computer Engineering, Mechatronics Engineering or equivalent
- Good communication skills in English or French
- The ability to work independently and in a team
- Excellent knowledge of C++ programming
- Good knowledge of computer vision and machine learning algorithms
- Experience using sensors (cameras, LIDAR, depth imagery) would be an advantage