

1. LiDAR Data Acquisition and Pre-processing:

- **Objective:** Understand and implement the process of acquiring LiDAR data for river embankments, including setting up the necessary parameters for data collection, develop and train machine learning models to interpret LiDAR data for detecting embankment features.
- **Tasks:** Investigate the best practices for LiDAR data collection specific to river embankments. Develop a methodology for pre-processing this data, which includes filtering out noise and irrelevant information, select and train appropriate machine learning models.
- **Skills Required:** Basic understanding of LiDAR technology, data acquisition techniques, Knowledge of machine learning, experience with Python and relevant libraries (e.g., scikit-learn, TensorFlow), and basic statistical analysis.

2. Denoising and Data Enhancement:

- **Objective:** Enhance the quality of LiDAR data by implementing advanced denoising techniques.
- **Tasks:** Research and apply advanced signal processing methods to remove noise from LiDAR data. Evaluate the effectiveness of different denoising techniques in improving data quality for better feature detection.
- **Skills Required:** Understanding of signal processing, proficiency in Python, and familiarity with noise reduction algorithms in the context of LiDAR data.

3. Segmentation and Deterioration Prediction:

- **Objective:** Segment the LiDAR data to identify critical areas of the embankment and predict the rate of deterioration.
- **Tasks:** Implement segmentation algorithms to isolate areas of interest in the LiDAR data. Identify and extract key features from the segmented data that are relevant to assessing the health and stability of flood embankments. Analyse the extracted features to understand their significance in indicating potential deterioration.

- **Skills Required:** Experience with image segmentation techniques, predictive modelling, and Python programming.

4. Predict and Analyse of Environmental Impact on Embankment Deterioration:

- **Objective:** To predict the rate of deterioration and visualize the results for better understanding and decision-making, and to study how environmental factors (like weather, river flow, etc.) affect embankment deterioration.
- **Tasks:** Develop predictive models to forecast the rate of deterioration of flood embankments. Create visualizations of the LiDAR data and the predicted deterioration patterns to aid in interpretation and presentation of the findings, correlating environmental data with deterioration rates, understanding the impact of different factors, and integrating this understanding into predictive models. Assess the potential applications of the predictive model in real-world scenarios and decision-making processes in civil engineering.
- **Skills Required:** Knowledge of machine learning, understanding climate data analysis, experience with Python and relevant libraries (e.g., scikit-learn, TensorFlow), and basic statistical analysis.