Defect detection and classification in sewer pipelines

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Theme 4: Data analysis, forecasting, statistics, correlations, machine learning, …

Abstract: Sewer pipeline defect detection and classification on CCTV (Closed-Circuit television) inspection videos can be a challenging task. Indeed, many factors make this problem difficult namely the variability in the pipelines, the high number of defect types and the fact that many types among them are underrepresented. In this work, we propose a supervised machine learning framework composed of models to detect and classify the defects respectively while dealing with the imbalance in the dataset.

Key words: pipelines, defect detection, classification, computer vision, local descriptors, imbalanced dataset.

1. Introduction

The aim of the proposed work is to help automate the analysis of the defects in sewer pipelines videos and reduce the time spent on this task by the operators. Different approaches have been proposed in the literature to detect defects and classify them in sewer pipes. In some of them, local descriptors are computed, then, a classifier is applied. More recently, some deep learning-based methods have been developed. However, a huge amount of data is needed to train these models, hence this operation is computationally expensive. In this work, we propose a model with a lower training computation time than a neural networks-based model. As opposed to the datasets used in the literature, the images extracted from our dataset present high variability among the pipelines and the lightning conditions and the number of observed defects is high. Our model handles this variability and, on top of that, its architecture attempts to deal with the high imbalance in the proportion of observed defects.

2. Methodology of the supervised machine learning framework and results

- Preprocessing: ensure the quality of:
    - the images extracted from the inspection videos
    - and their labellisation.
- Feature engineering: construction of local descriptors.
- Train the models to detect defects and classify them while dealing with imbalance.
- Test the models on a validation set.

The detection of defects reaches 87% of accuracy which is similar with state of the art performances. Due to the fact that many classes of defects are underrepresented, the classification of the defects can be improved. Nevertheless, this framework is a step forward towards the automation of sewer pipelines inspection.

3. Perspectives

For future work, we expect to collect more samples of underrepresented classes in order to reduce the dataset imbalance and, if the number of samples is sufficient, a neural network will be trained and its performances compared with our framework's. If the imbalance in the dataset is not reduced in spite of the new collected data, we plan to explore neural networks methods based on few shots learning.