

# Target Detection and Recognition of Ground Penetrating Radar using Morphological Image Analysis and Graph Laplacian Regularization

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## Background

Ground Penetrating Radar (GPR) is often used for detecting non-intrusively buried targets, in road engineering, manufacturing, and in military fields.

However, after inverse fast Fourier Transform (IFFT), the 3D GPR images, as shown in figure 1, are often out-of-focus and contain high measurement noise. This calls for advanced signal and image processing methods to improve signal-to-noise ratio, isolate the most discriminative features, and perform target detection and localization.

This paper conducted an automated target detection method which combined morphological image analysis and semi-supervised learning via graph Laplacian regularization. Using a vehicle-mounted GPR array data provided in the 2020 UDRC GPR data challenge, the proposed method can detect different types of targets buried at various depths with very low false alarm rate.

## Steps

- Pre-processing: IFFT, Filtering, Eliminating the transmission wave, Trimming B-scan.
- Morphological Detection: Forming a suitable window with designated shape, which fits the feature of target. Scanning the B-scan with the window.
- Graph Laplacian Regularization (GLR)-based classification: In order to reduce the false positive rate, the potential targets isolated using morphological detection are fed into a GLR-based classifier

## Conclusion

We showed that by performing morphological feature detection and graph-based semi-supervised classification, we can recognize several types of targets buried in the soil, at various depths with a very low false positive rate. Future work will focus on further improving the results, especially for targets at lower depths via de-blurring and further optimizing the classifier performance.

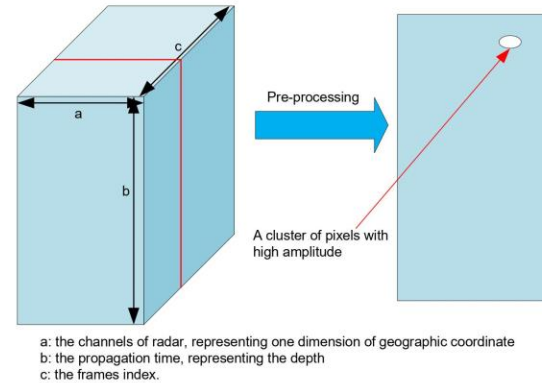


Figure 1: sketch of dataset

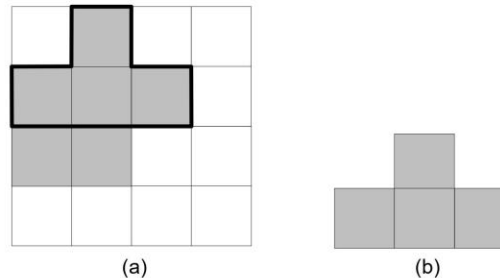


Figure 2: Morphological detection process:

(a) when the scanning window fits the image (b) scanning window

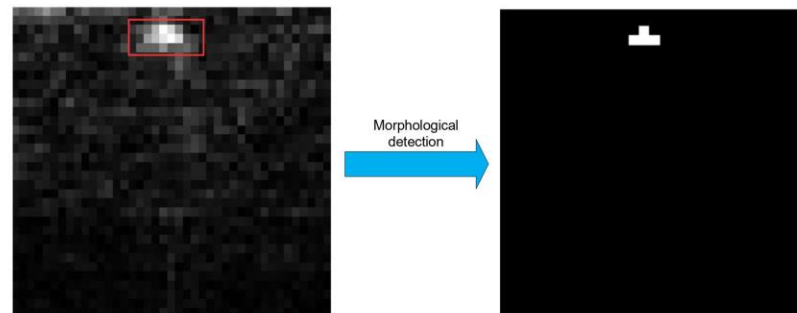


Figure 3: Result of morphological detection

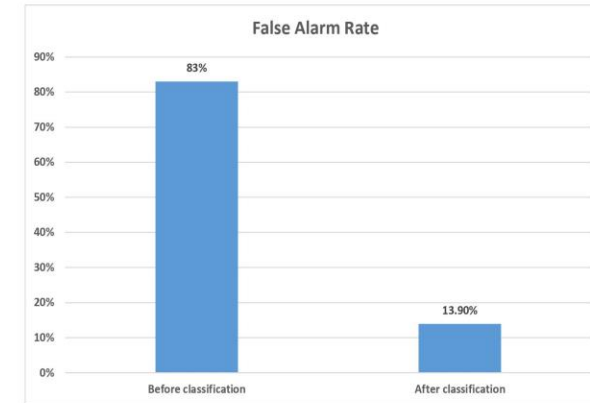


Figure 4: False Alarm Rates before and after GLR-based classifier