Automated Target Detection for Geophysical Applications

Abstract:

In many geophysical surveys, there is a predefined goal-to detect and locate very specific anomalies, those that correspond to buried objects (targets). The types of targets range from various types of pipes (metallic or not), to rebars or wires in walls to land mines. This paper presents a novel unsupervised method for automatically detecting targets, and extracting information about them and the medium in which they reside. Most existing detection methods are supervised, which means that one has to provide a training set (which can be labor expensive) in order to train a classifier. By contrast, the method presented here is unsupervised and is model based, which alleviates the need to manually annotate a training set. Another drawback of many existing methods is the underlying assumption of a homogeneous medium. This assumption is greatly relaxed for this method, since it assumes no a priori knowledge of the medium. Instead, it learns the medium's properties from the targets themselves. Furthermore, our method is designed to be computationally efficient and applicable in real-time applications. It was implemented on the StructureScan Mini XT system (Geophysical Survey Systems, Inc.), and the runtime on that system was measured to be 20 μs per scan of 512 samples. Experiments on 50 ground penetrating radar images with 278 targets show that our method is able to detect the targets with high positioning accuracy, with a 95.3% detection rate and near-zero false alarm rate.