Detection of Vertically and Horizontally Stacked Underground Utility Pipelines Using Non-Destructive Testing Technique

Siow Wei Jaw and Mazlan Hashim

Institute of Geospatial Science & Technology, T06, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor Darul Takzim, Malaysia; Tel: +6(0)-16-3037-463; +6(0) -19-7173-861; Fax: +6(0)-7-556-6163; E-mail: swjaw2@live.utm.my; swjaw@yahoo.com; mazlanhashim@utm.my; profmhashim@gmail.com

Abstract: The urban infrastructures, specifically the utility infrastructures provide services to the public for promoting the agriculture, industrial, business activities and sustaining human's daily life since ancient civilization until today. The demands for utility services keep increasing in response to rapid population growth and urbanization. In this regard, the utility owners have embedded more utility pipeline in the underground spaces for supporting these growing demands for the utility services. Most of these pipes or cables are embedded in the form of stacking in multiple layers for space saving. In this context, the underground spaces are now saturated with different types of utility pipelines such as electrical cables, gas pipes, water reticulation pipes, telecommunication cable and even fiber optics. With such a labyrinth of underground structures, underground utility pipelines detection has become a difficult and challenging task. The stakeholders from utility related industries often having great challenge in retrieving the precise location of these buried utilities, and this resulted in the occurrence of many third party utility damages due to failed excavation. They often mislocate the desired utility and many mishaps take place. Therefore, this study was conducted to investigate the detection sensitivity of vertically and horizontally stacked utility using image-based non-destructive testing technique. With regard to this, the widely used underground investigation measuring tool- ground penetrating radar (GPR), was used in this study, experimented in both lab controlled and in-situ environments with different interval distance between two buried pipes or cables that stacked in both horizontal or vertical orientation. Optimum values obtained from the in-situ measurement and finite-difference time-domain (FDTD) numerical modeling are then used for validating the results of the study. Results of the study contributed new finding showing that, the constraints of GPR measurements within the crowded underground utility infrastructures yield a “best practice” procedure for determining the safe buffer zone for maintenance works; very crucial aspects in installation of new utility infrastructure and detecting aging utility. With such “best practice” procedure, the detection of buried utilities during utility mapping become easier and the signal wave will not be disturbed by neighbouring utility pipeline that buried near to each other’s. Indirectly, this can reduce the concerns and problems caused by deregulation of utility service.

Keyword: Underground utility pipeline, stacked, detection sensitivity, ground penetrating radar, finite-difference time-domain (FDTD).