Ground Penetrating Radar Survey for Detection of Underground Utilities

正確步驟你要知
探地雷達測量易

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Why the Ground Penetrating Radar Survey?

GPR is a continuous survey method. The radar is either towed or pushed along the ground. It is rapid - from fast walking pace up to motorway traffic speed, depending on surface conditions and the method of propulsion. GPR is non-destructive, causes no damage to the areas being surveyed and is the only geophysical survey technique suitable for environments such as wetlands, tarmac, concrete.

GPR, if calibrate accurately, gives automatic depth information and can detect targets that other geophysical methods have difficulty with such as plastic pipes and targets a great depth. Note, however, GPR has its limitation. It detects changing condition from the surface down but cannot identify the precise nature of the materials surveyed.

為什麼要進行探地雷達測量？

探地雷達是一個連續測量方法。　雷達通常沿着地面拖拉或者推進操作。雷達操作速度是取決於地表狀況或者推進方法，通常是可以同步與快速步伐，甚至機動車輛的行駛速度。探地雷達是一種非破壞的且唯一可應用於濕地，柏油路面及混凝土表面等環境的地球物理學系探測方法。

如校準精確，探地雷達不僅可以自動給出探測目標的「深度」信息，甚至可以探測出普通地球物理學系探測方法很難識別的位於較深區域的塑膠管道及目標。需要補充，探地雷達同樣也有限制，譬如其可以探出從地表至下方的變化狀況但卻無法識別不同材料的精確性質。

How GPR works?

GPR(Ground Penetrating/Probing Radar) works by sending a radio signal or series of signal into the ground and then receives the reflected signal. The returning signals provide information about changing ground characteristics with depth. Basic radar output presents this as patterns of signals at depth against the distance travelled along the ground by the radar. The radar measures depth in terms of the times it takes for a signal to return after emission, soil conditions decide how fast the electromagnetic waves can travel through the ground. Therefore, to get accurate depth information, the data will be calibrated for soil conditions on the day(s) of survey.

GPR works best when there are well defined differences in the electromagnetic properties of the materials being surveyed: gradual change is not as easy to detect. This makes GPR a very good detector to pipes and services(intrusive material), buried building materials(also intrusive) and changes in stratigraphy whether man-made(e.g.pavement profiling) or natural(e.g.peat basin detection), GPR can also be used to look inside structures either to check on the state of construction or to locate hidden objects(e.g.voids).

探地雷達如何工作？

探地雷達的原理通常是通過往地底發送一束或一組雷達信號。然後回收反射回來的信號。反射信號提供了地底不同深度不同材質特徵的信息。一般的雷達輸出代表了雷達推進吁一距離在某一深度的信號特徵。雷達測量中的深度是通過同一傳輸速度的信號在送出後經發射的全過程時間計算得出。地下土壤的狀況決定了雷達電滋波在地底傳輸的速度。因此，實施測量前，為了得到準確的深度信息，雷達應該對要求的地盤土質進行校準。

在地底土壤材質的反射電磁信號強特性明顯差異時雷達將會有清晰的輸入結果，較難對漸住變化的進行清晰深測。因此，信一特性早就了探地雷達針對管道及設施，建築材料和人造或天然的不同地層有非常好的探測效果。另外探地雷達還可以應用在探測結構內部隱藏的空洞或者檢測施工質量。

Important Notes for Ground Penetrating Radar Survey

The following points should be noted for the GPR survey:

1. The personal carrying out the survey should be well-trained, with relevant experience and competent persons;
2. The survey operators should be equipped with personal protective equipement during the survey;
3. Both the employees and employers should stick to the occupational health and safety regulations and obligations to ensure a safe working environment and reduce the influence on the public.

探地雷達測量需注意的要點

當住行探地雷達時，以下幾點需要注意：

1. 進行測量的人員應該有足夠的訓練，相關的經驗和為合資格人士；
2. 進行測量的人員應使用個人保護裝備；
3. 僱主及僱員都應遵守相關的職業健康及安全條例，確保工作環境和個人安全，並將對公眾的滋擾減少至最低限度。

Pre-survey preparation for GPR Survey

Before commencement of the survey, the following procedures should be reasonably taken:

1. A detail safety plan and also a risk assessment should be done. Depending on the site situation, Tempoyr Traffic Arrangement(TTA) may be required.
2. The chosen of frequency of GPR(i.e. 400MHz and 270MHz) should depends on the combination of requirement of client and practical site condition.
3. Good condition of battery should be confirmed.

探地雷達測量的準備工作

在探地雷達開始前，以下的措施應恰當地進行：

1. 須有一個詳細的工作計劃和進行地盤風險評估。視乎具體情況，可能需要臨時交通管制措施（TTA）；
2. 探地雷達的選擇需要考慮客戶的具體要求及地盤的具體狀況；
3. 出地盤前，電池的充足狀況需要得到保障。

How to operate GPR?

1. Preparation before survey; Check of the battery condition, complete set of equipment and relavant information;
2. Setting up of safety: e.g. TTA
3. Setting up of permit for field survey in the suitable position, record of site condition in detail, including surrounding utilities, depth
4. Wheel calibration(Distance calibration): check whether the wheel is accurate and calibrate it if inaccuracy;
5. Calibrate of dielectric constant;
6. Design of survey grid;
7. Act as requested by client and modify the orignal plan to be in practical;
8. Record the field data clearly;
9. Clear up the field and pack the equipment in order;
10. Save the field document and data as requested by companies' guideline.

如何操作探地雷達？

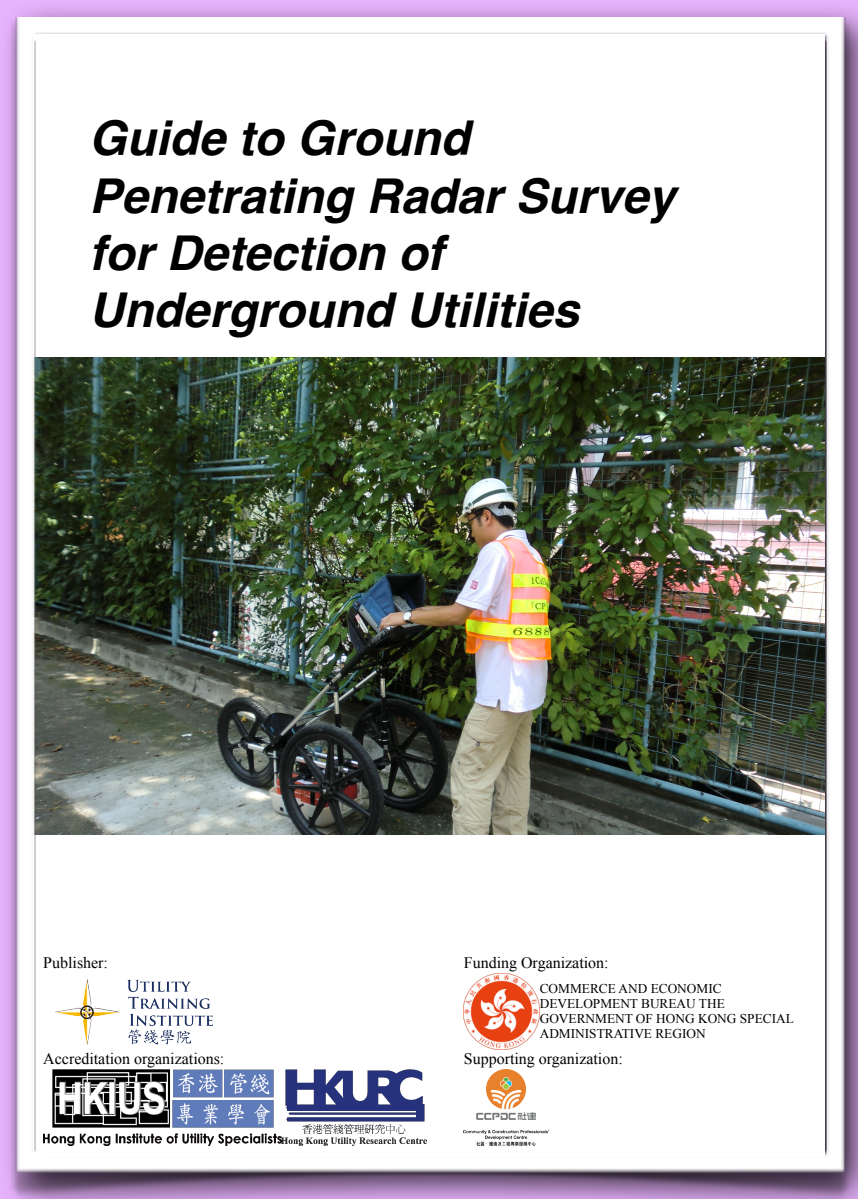
1. 開工前準備：儀器充電，探地雷達檢查，準備資料；
2. 搞好安全工作：交通安全，臨時交通安排等；
3. 地盤條件許可應放置醒目位置，詳細記錄測線儀經過的地盤條件，包括地面設施、測線可能切過的管綫的深度及位置、臨近平行管綫等；
4. 輪距校正：檢查輪距是否準確，不準確則進行輪距校準（可提前進行）；
5. 介電常數校準：選擇可代表地盤電條件的已知點進行介電常數校準；
6. 探地雷達工作剖面設計：開工前根據資料進行初步設計，根據地盤情況多為「井」型設計
7. 如客戶要求，則按客戶要求進行；以初步設計為基礎，根據實際情況進行設計修正，開展探地雷達工作；
8. 完整、清晰填寫探地雷達表格；
9. 妥善放置探地雷達；
10. 按公司要求存放文件及數據。

Further Information

Up to now, there is no general standard for carrying out the GPR survey in Hong Kong. However, the Utility Training Institute(UTI) is planning to publish guides and set a good practice for the field of GPR survey. Readers may reach the website of Hong Kong Institute of Utility Specialists(HKIUS) http://hkius.org.hk for further information.

更多資訊

目前為止，香港並無任何統一的準則以進行探地雷達測量。因此管綫學院正計劃出版相關的指引和為探地雷達測量的工作建立規範。
讀者可以到香港管綫學專業學會網頁 http://hkius.org.hk了解更多的資訊。



Enquiry 查詢

Address:
Unit 209, 2/F, Favor Industrial Centre, 2-6 Kin Hong Street, Kwai Chung, N.T., H.K.
Tel: (852) 2690 3899
Fax: (852) 2618 4500

地址：
香港新界葵涌健康街2至6號飛亞工業中心二樓209室
電話：(852) 2690 3899
傳真：(852) 2618 4500

UTILITY TRAINING INSTITUTE 管綫學院
網頁 Website: http://www.uti.hk
電郵 Email: info@hkius.org.hk

CCPDC 社建
Community & Construction Professionals' Development Centre
社區、建造及工程專業發展中心
網頁 Website: http://www.cpdc.hk
電郵 Email: info@cpdc.hk

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電郵 Email: info@hkurc.org.hk

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