

路政署創新科技 在道路建設和維護的應用

Building and Maintaining Highway Infrastructure through Innovation in Highways Department

引言 Introduction

路政署致力應用先進測量技術以協助規劃、設計和管理全港的道路網。路政署是首個政府部門引入厘米級高精度移動激光掃描及影像系統，並於2017年全面地應用於日常工作中。該系統搭載於測量車上，快速而精確地以點雲配上相片格式記錄道路和周邊環境的地理空間數據，並在無需封閉道路的情況下，完成測量工作。路政署今年更引入新一代的移動激光掃描及影像系統，藉以提升工作效能。

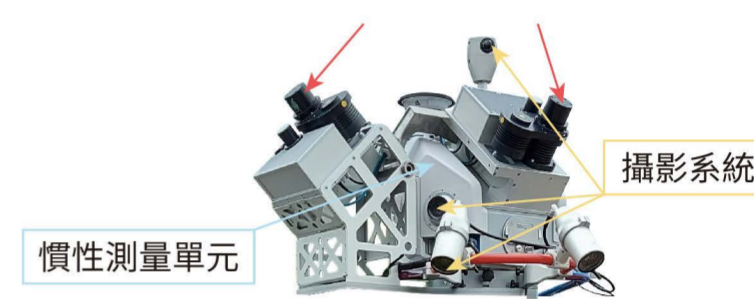
Highways Department is committed to apply advanced surveying technologies to assist in the planning, design and management of the road network in Hong Kong. The department is the first government department deploying the centimeter-level high-precision mobile laser scanning and imaging system (MLS), and fully applying such technology in the daily work since 2017. The system is mounted on a survey vehicle to collect point cloud and image data of roads and surrounding environment quickly and accurately. There is no need to close the road to complete the survey work. This year, the department has acquired a new MLS with enhanced performance to improve work effectiveness.

激光掃描儀

移動激光掃描及影像系統 Components of MLS

系統由兩組激光掃描儀、兩組全球衛星導航系統接收器、慣性測量部件、測距儀和攝影系統所組成。系統以每秒200萬激光點測量數據組成點雲，並配以全景相片測量周邊環境的地理空間。

The system includes two laser scanners, two Global Navigation Satellite System Receivers, an inertial measurement unit, a distance measuring instrument and a camera system. The system can survey the spatial data of surrounding environment with laser scanning point at a speed up to 2 million points per second supplemented with panoramic images.



移動激光掃描及影像系統組件



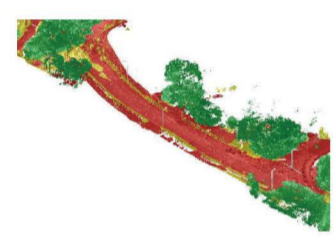
移動激光掃描及影像系統搭載於測量車上

系統應用 Applications of MLS

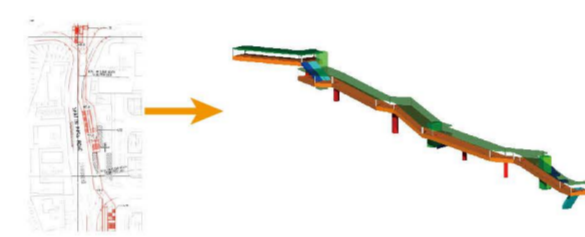
1) 可視化及審視設計 Design Visualisation and Review

分析工程設計與現狀環境模型之間的關係。

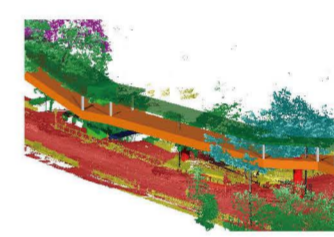
Examine the relationship between road design and existing conditions model.



收集工地範圍的點雲數據
Collecting point cloud of a site



以工程設計圖作藍本建立擬建構築物的三維模型
Creating 3D model of proposed structures from design drawings

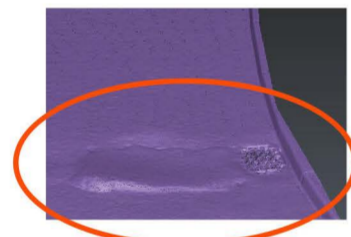


透過重疊現場點雲數據和三維模型來審視工程設計對現場環境的影響
Overlaying 3D model on existing site point cloud to review impact of design on existing environment

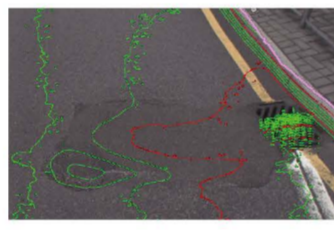
2) 道路狀況測量 Road Conditions Survey

移動激光掃描及影像系統所收集的點雲及路面影像數據能協助監測路面不平狀況及辨認潛在道路損壞，以安排維修及保養工作。

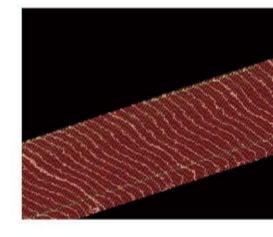
The point cloud and images captured by MLS can support monitoring of road conditions and identification of potential road defects, facilitating arrangement of road maintenance work.



透過三維網格模型分析道路狀況
Analysis of road conditions with the aid of 3D mesh model



透過等高線分析道路狀況
Analysis of road conditions with the aid of contour lines



由點雲數據製作出等高線，將路面不平的狀況可視化，從而偵察道路欠妥，例如車轍凹痕
Contour lines generated from point cloud data can visualise the undulation of road surface. This could be further utilised for other applications such as detection of rutting

3) 更新街景影像 Street View Updating



透過激光強度和全景相片來辨認道路不同物件，例如燈柱和路面標示。

Road features such as lamp posts and road markings can be classified by point cloud intensity and panoramic image.

4) 採集道路設施數據 Road Inventory Data Acquisition



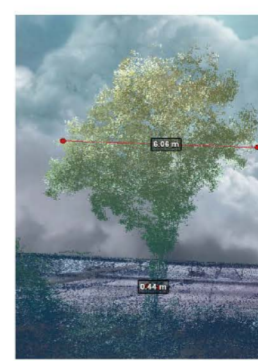
指示牌、欄杆、觸覺磚等道路設施可數據化並使用地理資訊系統的技術作分析。

Road inventories such as sign boards, railing and tactile paving can be digitised and analysed with Geographic Information System (GIS) technology.

5) 碎部測量 Detail Survey



利用著色點雲數據顯示地貌
Viewing ground features with colorised point cloud

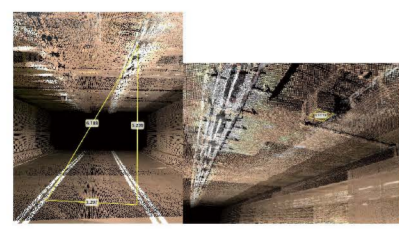


收集的數據可製作測量圖以及提供三維模型來量度地形物件的大小，例如樹冠大小及樹木高度
Colourised point cloud can be utilised to produce survey plans and 3D model to perform measurements on topographic features such as tree crown spread and tree height

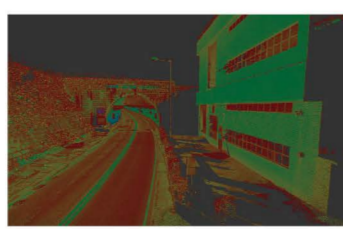
6) 隧道測量 Tunnel Survey

用戶可使用隧道的點雲數據測量物件的長度和面積，並建立建築信息模型，從而協助隧道的維修及街道設施管理。

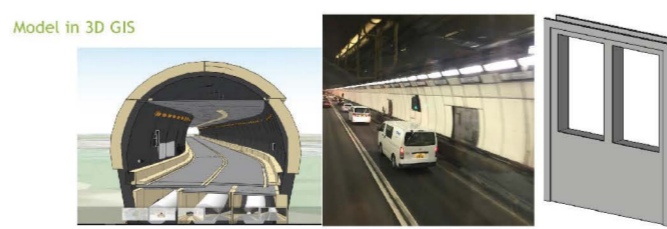
Users can perform length and area measurements from point cloud captured inside a tunnel and form BIM models to facilitate tunnel maintenance and road inventory management.



隧道結構檢查
Inspection of tunnel structure



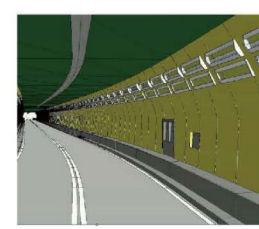
建立三維模型
Creation of 3D model



製作建築信息模擬物件
Creation of BIM object



獅子山隧道的點雲數據
Point cloud of Lion Rock Tunnel



獅子山隧道的建築信息模型
BIM model of Lion Rock Tunnel

願景 Vision

透過路政署現有兩台移動激光掃描及影像系統，工程師能得到更多細緻和精確的測量數據，在各類計劃、建設和維護道路工作上，更準確評估路面狀況以及減少封閉道路對使用者帶來不便，改善測量員工在道路上工作時的安全度，達致更優質公共服務。

Through the two existing MLSs of Highways Department, engineers can obtain more detailed and accurate survey data. In planning road, construction and maintenance work, they can obtain road conditions more effectively, improve the surveyors' work safety on roads and reduce the inconvenience caused by road closure.