

# 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

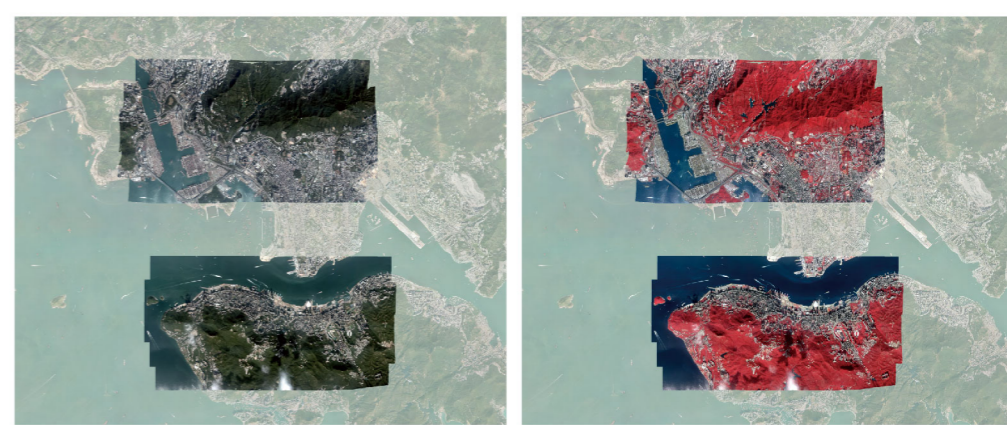
路政署定期進行樹木檢查工作及統計；進行樹木現場檢查的工作量大、耗時長，並且在導致樹木倒塌的壓力下，或在識別樹木健康狀況惡化等方面受到限制。

Highways Department conducts tree inspections and data collection regularly; on-site inspection of the trees is labour-intensive, time-consuming and limited in the potential of identifying trees with deteriorating health condition.

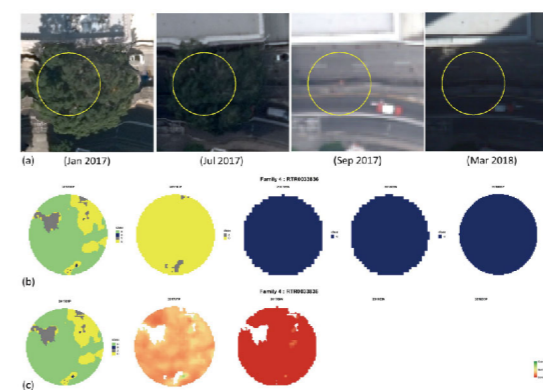
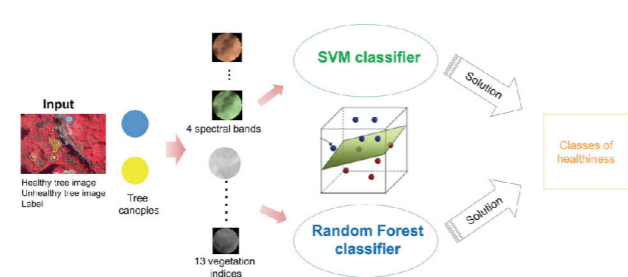
### 遙感技術的多光譜成像 Multispectral Imaging with Remote Sensing Technique

透過遙感技術中的多光譜成像，分析近紅外及可見光波段測量值之間的差異，可以幫助了解樹木的健康狀況。

By developing Remote Sensing based methodology and algorithm based on multispectral images, tree health condition can be represented by the difference between NIR and visible bands measurements.



### 樹木健康分類 Tree Health Classification



1. 基於機器學習的樹木健康分類可以分為樹冠級及像素級。

Machine learning based tree health classification can classify tree health at canopy level and pixel level.

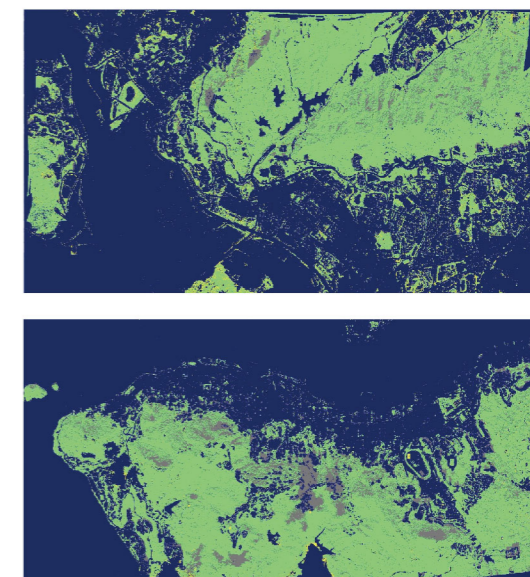
2. 閾值確定樹木健康分類方法可以提供數據以確定閾值，並應用於樹木樣本與及變化檢測。

With threshold-based tree health classification, data is collected for threshold determination and further apply the threshold to tree samples as well as change detection.

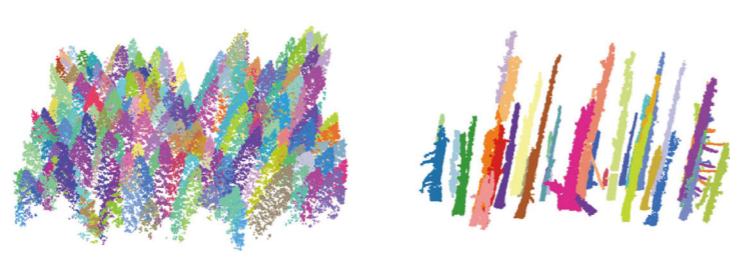
### 好處和潛在用途 Benefits and Potential Usages

樹木健康指數能有效和準確地反映機載多光譜圖像中樹木的健康狀況；使用此技術，可以定期監測及分析不同時間的樹木健康狀況。

Efficient and accurate Tree Health Index (THI) allows Highways Department to proceed routine monitoring and time series analysis of tree health condition.



### 通過激光遙感測量 (LiDAR) 技術獲取基本樹木數據 Acquiring Basic Tree Data through Light Detection and Ranging (LiDAR) Technique

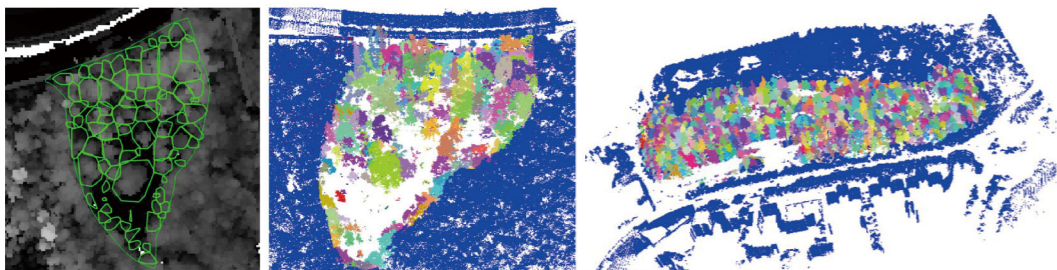


無人機載激光遙感測量 (LiDAR) 為先進遙感技術之一，可以測量點雲以估算樹木高度、樹冠大小和樹木胸徑等資料。

Airborne Light Detection and Ranging (LiDAR) is an advanced remote sensing technology to acquire point clouds in order to estimate the tree height, canopy size, and diameter at breast height (DBH).

透過無人機載 LiDAR 進行測量，可以提取樹木屬性以製定有效的規劃和管理方法，並進行高效的樹木庫存測量和在難以到達的地區進行樹木研究。

To conduct a LiDAR survey, an integrated UAV LiDAR system is used to extract tree attributes for devising effective strategic planning and management, as well as undertaking tree inventory collection and undergoing studies of trees at inaccessible areas.



三維分割方法可以應用於 LiDAR 數據，通過圖像分析獲得點雲體積像素，於三維地理空間內分割出單棵樹。

The method of 3D segmentation can be applied onto the LiDAR data, through image analysis to a voxel representation of point clouds to segment individual trees within 3D geospatial space.

### 為香港常見樹種設立高光譜庫 Hyperspectral Library for Common Tree Species in Hong Kong

高光譜影像是當代遙感技術之一；原理包括光譜學與及提供高解析度光譜數據的精細光譜解析度相機。透過此技術，路政署可以建立樹木光譜庫模型以及相關的樹木光譜和物候曲線規範。

Hyperspectral imaging is one of the contemporary remote sensing approaches; it involves spectroscopy and a fine spectral resolution camera to provide high-resolution spectral data. With this technology, a spectral library model for trees and the associated tree spectrum and phenology curve specification is produced.

此外，工作人員會使用升降車，每兩個月採集一次屬於 19 個樹種、75 棵城市樹木的高光譜圖像。每棵樹的平均冠層光譜特徵會用作計算和繪製，以開發香港 19 種城市樹種的高光譜庫。

In addition, the staff use a lifting wagon to collect hyperspectral images of 75 urban trees belonging to 19 species bi-monthly. The mean canopy spectral signature of each tree is computed and plotted to develop a hyperspectral library of the 19 urban tree species in Hong Kong.

