NEW

How to Detect Internal Abnormality of the Tree Collapsed on September 16, 2022 at Perth Street, Ho Man Tin, Hong Kong

Spectral Reflectance Analysis of Foliage Pixels
Provides Early Warning of Internal Abnormality
Not Discernible from Onsite Inspection
Applicable to Different Species

A Straightforward, Time-saving and Cost-Effective Technique

No Hyperspectral, LiDAR and UAV data are required
Special Instruments and Invasive Methods are not used

In the morning of September 16, 2022, a flame tree (*Delonix regia*) of 9.5 m high on the pavement outside 6 Perth Street, Ho Man Tin, Hong Kong, suddenly collapsed, crushing 4 vehicles. According to press report, that tree was last inspected on April 22, 2022, and no signs of decay were found on the branches, trunk and the surface of tree roots.

In the light of this incident, we have undertaken a retrospective study of this collapsed tree, using spectral reflectance analysis to evaluate the internal health condition. It is based on chlorophyll content and leaf cellular structure derived from 50cm to 30cm resolution satellite data collected by WorldView-2/-3 satellite. This new technology is analogous to the use of X-Ray, CT Scan and MRI Scan to detect internal body abnormalities. It is different from NDVI (Normalized Difference Vegetation Index) assessment, because our analysis is based on separate evaluation of leaf cellular structure and chlorophyll content, instead of merging them together in one formula of (NIR- Red) ÷ (NIR + Red).

Our study of this tree reveals that before its sudden collapse, it was highly fluctuating in near-infrared (NIR) reflectance, which implied internal unhealthy condition.. The drastic drop of 12.5% in NIR reflectance in just one year from 2021 to 2022 was a serious warning indication. The rise of 2.6% in red reflectance from 2017 to 2018 indicated a drop in chlorophyll content. It then remained relatively consistent from 2018 to 2022 to support the external appearance of green canopy. Hence it appeared "healthy" externally but was actually seriously stressed internally due to deterioration of leaf cellular structure.

The spectral reflectance analysis charts for this tree are given on the following page.

Since 1985

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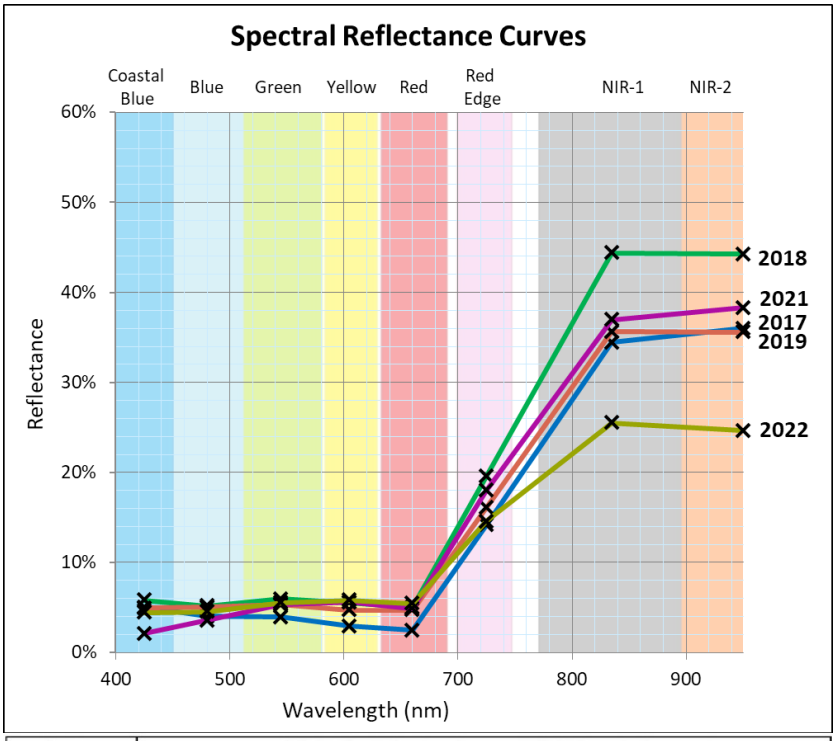
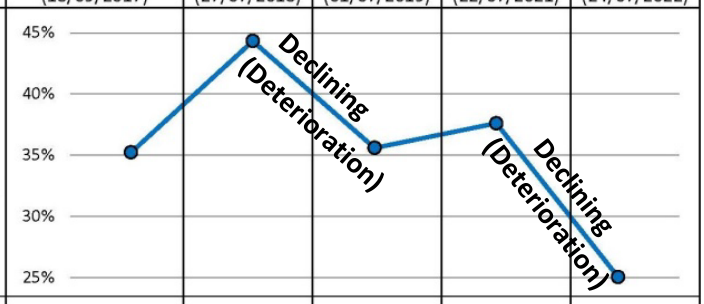
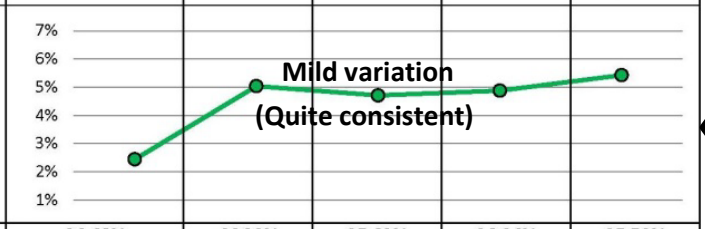
Spectral Reflectance Analysis of the Collapsed Tree



Factor	(A) Leaf cellular structure and (B) Chlorophyll content				
Year	2017 (18/09/2017)	2018 (27/07/2018)	2019 (01/07/2019)	2021 (22/07/2021)	2022 (24/07/2022)
(A) Leaf cellular structure (Average NIR)					
(B) Chlorophyll content (Red)					
Band NIR1	34.46%	44.39%	35.63%	36.94%	25.50%
Band NIR2	36.01%	44.26%	35.58%	38.30%	24.63%
Band Average NIR	35.24%	44.33%	35.61%	37.62%	25.07%
Band Red	2.44%	5.04%	4.71%	4.88%	5.43%

Near-infrared (NIR) and Red bands are effective to detect internal tree health

It is indicated by spectral reflectance derived from subtle changes in leaf cellular structure and chlorophyll content caused by biotic and/or abiotic factors.

In the NIR reflectance, **rise** implies **improvement** and **fall** indicates **deterioration**. But if it **surges** and **declines** drastically, it implies internal **abnormality/ instability**. If it rises and falls or falls and rises, it means fluctuation.

In the Red band, **higher reflectance** implies **less** chlorophyll content to absorb Red light and **lower reflectance** implies **more** chlorophyll content to absorb Red light.

Remarks

Highly fluctuating in NIR indicating internal abnormality/ instability. Drastic drop from 2021 to 2022 implying serious deterioration.

High chlorophyll content in 2017 with mild variation afterwards to support relatively green canopy.

WorldView-3 Satellite Image

2017/09/18

2022/07/24

2022/07/24

Location of the collapsed tree