News Article for RISUD Strategic Focus Area (SFA) Scheme

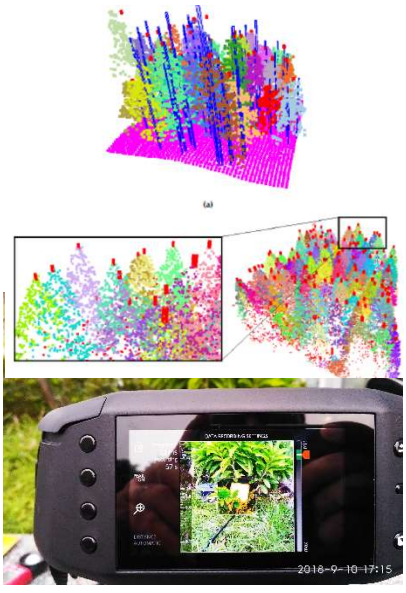
		Name	Department
1.	**Principal Investigator**:	Charles M.S. Wong	LSGI
2.	**Name of SFA:**	Urban Ecology	
3.	**Project Title:**	New Technologies for Smart Management of Urban Trees	

4. **First Year Progress/Achievement (***in layman's language, no more than two A4 pages***)**

Urban trees are considered as a part of green infrastructure in the urban landscape and being essentially an indispensable element to urban planning for enhancing the city livability. The establishment of urban tree is substantially affected by both physical and biological factors, including inherent properties of species, restricted planting conditions and unprecedented environmental changes. As such, the growth of every individual tree is ubiquitous and vary in some degree which greatly increases the challenge for tree manager to determine tree at risk through the traditional method by solely visual inspection. With the growing compactness of our city, the vulnerability of urban trees subsequently increases especially under the changing climate. This offers an opportunity to study on the use of advanced and sparking technology in a sense to supplement the current arborist practice amidst the disciplines of urban forestry management and arboriculture.

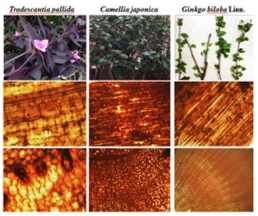
A variety of new technologies assisted to monitor and manage urban trees has been introduced in this project to achieve our ultimate research outcome: *New Technologies for Smart Management of Urban Trees*. A couples of target objectives are being carried out under a scheduled progress, and the progress of individual objective is summarized as below:

1) Identification of potentially dangerous trees using remote sensing techniques, including hyperspectral and near infra-red imaging, tree attributes retrieval and 3D model development from LiDAR and InSAR, phenology monitoring and its interaction with climate change have been conducted. Several field surveys were conducted respectively to select the test sites, followed by acquiring the trial set of hyperspectral images in 2018. Phenology camera was procured under the project to investigate the interactions between vegetation and local climate and it will be installed in the field site, targeted at tree canopies and automatically capture images daily. In addition to a localised field-based investigation of phenological cycle using phenology camera, regional spatial patterns of temporal trends in precipitation, temperature as well as vegetation phenology and productivity are determined in the Great Bay Area. Preliminary experiments on high-density airborne LiDAR datasets of forest plots from temperate test sites have been performed, and further experiments using airborne LiDAR data acquired over subtropical test sites are expected to be performed soon.



2) Field verifications of the causes of tree risk through non-invasive sensing techniques including GPR assessment of main structural roots alongside visual inspection have been carried out. Whilst individual tree roots may be difficult to be distinguished due to its small size compared to GPR wavelengths and its small dielectric contrast with the surrounding soil, it is still traceable by evidence of water surrounding the root. Healthy tree roots are supposed to absorb underground water, yielding higher moisture content around the root. For testing purposes, two GPR with centre frequencies 500MHz and 900MHz, were tested in two trial sites in PolyU campus lawn and Shek Yam, Kwai Chung. The results helped to demonstrate the extent of healthy tree roots and in turn indicate the health of a tree by mapping underground water distribution for further study.The Project Team will also formulate and design a holistic methodology using GPR and thermal infra-red camera to identify the defected areas over tree trunk and roots. The basic rationale of tree thermography is to detect the temperature differences between the defected areas and the normal regions, such that the defected area would get a lower temperature due to their cavity/ defect. The comparison of true color image and in-situ thermal image from a broadleaf tree in Hong Kong has been studied.

3) Procedural laboratory testing through sampling by expert determines the actual health of trees and tree dangers to the surroundings. A total of 20 plant species were collected for laboratory tests, which were classified into three categories, including 7 herbs, 7 shrubs, and 6 trees. To evaluate the effects of water adsorption to the plant samples, physical properties of selected plants including density, moisture content have been ongoing tested in this study.



4) Acquisition of Big Data of static tree attributes and dynamic tree movement data by collecting near real-time data from tree sensors in two of the urban districts of Hong Kong, i.e. East Kowloon and Wan Chai are being in progress. The tree movement data in Typhoon Mangkhut has been recorded under a strong wind during September 2018. This has provided a valuable dataset to our research and vigorous assessment was conducted thereafter for a detailed verification and analysis to study the tree movement behaviour and its failure pattern

5) Rectification of potential dangerous trees using the fabricated FRP implant in a group of tree trunk flexural testing is carried out to assess the strengthening effect thereof. Two similar tree trunk specimens that are of the same species and similar diameters are selected as target specimens.

6) Knowledge sharing and technology transfer, policy recommendation, and community engagement through public education of the advanced technology has been continuously carried out. The team had been actively engaged in various academic events to introduce our project and the geospatial technology in the past few months. By invitation, presentations to Shenzhen Science and Technology Commission on 31 Oct 2018, MIT Senseable City Lab on 15 August, 2018, China University of Petroleum Qingdao on 17 November, 2018, and Beijing Normal University on 7 March 2019 respectively, have been undertaken, for academic sharing to Government officials and oversea academia.