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臺灣大學應用力學研究所
演 講 公 告

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主 講 人：吳筱梅助理教授
臺灣大學生物機電工程學系

講　　題：光機電系統於智慧農業之應用：多尺度頻率域螢光壽命週期檢測系統

主 持 人： 周佳靚助理教授

時　　間： 111年3月14日（星期一）下午2時20分開始

地　　點： 臺灣大學應用力學研究所國際會議廳

☆☆ 歡迎聽講，敬請張貼 ☆☆

演講題目（Title）

Optomechatronics in Intelligent Agriculture: Multiscale Frequency-Domain Fluorescence Lifetime Detection Systems

（光機電系統於智慧農業之應用：多尺度頻率域螢光壽命週期檢測系統）

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摘要（Abstract）

In the face of the expanding population and severe weather, improving agricultural production capacity becomes essential. Smart and intelligent agriculture can help us achieve the goal by dynamic monitoring, intelligent control, and automatic implementation. For the amelioration of agriculture, the first step is to monitor the physiological states of crops continuously and non-destructively. Several techniques have been applied to detect the physiological states of plants. Among different methods, chlorophyll fluorescence is a sensitive parameter that changes dynamically with the activation of photosynthesis. Traditionally, fluorescence intensity-based measurement estimates the photosynthetic parameters since the fluorescence intensity gradually increases while photosynthesis starts. However, fluorescence intensity-based measurement can be easily affected by background noise, excitation light intensity, probe concentration, and optical spectrum overlapping. On the other hand, fluorescence lifetimes are only influenced by the state of the molecule and are highly sensitive to its local environment. Therefore, the fluorescence lifetime measurement is used to detect damage to plants and identify early signs of injury. Besides, the frequency-domain fluorescence lifetime imaging (FD-FLI) system using high frequency-modulated CMOS image sensors can acquire widefield images faster with minimal excitation light dosage. This low excitation light dosage can alleviate cell damage due to photo-induced cytotoxicity, making continuous plant observation feasible. Here, multiscale detection by FD-FLI systems will be constructed for dynamic monitoring of the physiology of plants. Two CMOS FD-FLIM camera-based microscope systems will be constructed for leaves and live cells fluorescence lifetime imaging in microscopic scale. Besides, we plan to build up a high throughput FD-FLI system in macroscopic scale to monitor the physiology of crops on a large scale and continuously over a period of time. We believe that the FDFLI systems built up in this project can be potentially used for rapid and remote monitoring of the health of individual plants and crops in field and will aid in the decision making as to change the environmental conditions, adjust the inputs of water and nutrients, and guide the control of plant diseases in greenhouse.