

한정무 / Jeongmoo Han 박사 후 연구원 / Post-doctoral Research Fellow 한국과학기술원 기계공학과 / Dept. of Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST)

위상자 역연산 기반의 시분해 형광 신호 처리를 통한 생화학적 성분의 무표지 분석 Label-free characterization of biochemical components using phasor deconvolution-based time-resolved fluorescence signal processing

Abstract

Fluorescence lifetime imaging microscopy (FLIM) is a powerful technique for probing molecular environments and intrinsic biochemical properties in cells and tissues. Phasor analysis, which simultaneously provides lifetime and phasor information of pulse signals, has emerged as an effective tool for fluorescence lifetime extraction and biochemical analysis. However, traditional photon counting methods, such as time-correlated single-photon counting (TCSPC), are limited by pixel rate constraints, reducing their efficacy for high-speed imaging. This presentation introduces a novel algorithm for accurate phasor extraction at high speeds. Our custom-built multi-spectral FLIM system, operating at a 1 MHz laser repetition rate without pulse averaging, enables the rapid acquisition of high-resolution (1000 \times 1000 pixel) images in just 1 second with 40 ps accuracy. This method facilitates label-free imaging of cellular metabolic states and tissue characterization, offering valuable insights for high-speed fluorescence lifetime imaging in biomedical research.

Brief Biosketch

Jeongmoo Han, Ph.D, is a post-doctoral research fellow of Korea Advanced Institute of Science and Technology (KAIST) funded by Sejong Science Fellowship, since 2024. He earned his Ph.D. in Mechanical Engineering from KAIST and received his B.S. and M.S. degrees in Biomedical Engineering from Hanyang University in 2018 and 2020, respectively. His current research focuses on label-free diagnosis of various biological specimens using next-generation autofluorescence lifetime imaging. He is a member of the Biomedical Optics and Optical Metrology (BOOM) Lab at KAIST, led by Prof. Hongki Yoo.