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PHYSICS AND ASTRONOMY COLLOQUIUM (Online)

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"ANALYZER SYSTEM AND METHOD FOR REAL-TIME SYNCHRONOUS DETECTION OF THE CHARACTERISTIC NEAR-INFRARED WAVELENGTH FEATURES OF OPTICALLY ACTIVE SUBSTANCES"

Abstract

"An optical system and methods have been developed for real-time synchronous detection of vibration and/or rotation modes in biotic (e.g., fat, glyceride, vitamins, bilirubin, etc.) and abiotic systems (e.g., alcohol contents). The system and methods include a modulated (typically at 5600 Hz) light source (e.g., a laser at 1064 nm wavelength), laser beam shaping and light collecting optics, optical detectors, appropriately selected optical filters, mechanical or electronic laser beam modulator, current-to-voltage converters (e.g., transimpedance amplifiers), lock-in amplifiers (and/or operational amplifiers), data acquisition and system control hardware and software. One or multiple lock-in amplifiers are used to extract weak signals from noisy background. The system has three configurations/embodiments for in-situ and ex-situ end uses – (i) tabletop probe, (ii) handheld probe and (iii) miniature handheld probe. The handheld probe is for ex-situ and open surgery whereas the tabletop probe can be combined with other systems for ex-situ (monitoring) assessments. The miniature handheld probe can be used in conjunction with needle biopsies.

The weak signal of characteristic optical scattering (e.g., Raman scattering) peaks of target biotic indicators (e.g., glyceride, vitamins, bilirubin, etc.) and abiotic molecules (e.g., alcohol) are identified using sensitive lock-in amplification technique, which supersedes the state-of-the-art for other similar approaches and allows for the detection of weak Raman signals in ambient light conditions (e.g., LED and luminescent light). The system has been shown to provide a quantitative result of the fat content quickly and accurately in (i) lipid phantoms and (ii) liver samples, demonstrating a strong linear correlation (e.g., $r > 0.98$) between output voltage signals and fat contents in the clinically relevant range."

Wednesday, February 9, 2022

3:30 p.m. PDT

via Zoom: Zoom link will be shared on Tuesday