PHYSICS AND ASTRONOMY COLLOQUIUM (Online)

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"Action, Lights, Sound: using photoacoustics to probe changes in tissue structure during cancer treatment"

Abstract

"Photoacoustic (PA) imaging relies on generating ultrasound waves from optically absorbing structures. Interest in photoacoustic imaging has been steadily growing since optical contrast can be probed deeper in tissues than optical methods. Most imaging reconstruction algorithms use only the intensity of the detected photoacoustic waves. However, the ultrasound waves produced by light absorption can be analyzed by methods similar to those developed to analyze ultrasound backscatter signals in the field known as ultrasound tissue characterization. These principles can be applied to photoacoustics to help interpret the photoacoustic signals detected by ultrasound transducers. In the absence of exogenous optical absorbers, hemoglobin in red blood cells is the primary endogenous chromophore in tissues (as melanin is predominantly confined to the skin). The spatial distribution of red blood cells, typically limited to the vasculature, determines the frequency content of the photoacoustic signals produced. Therefore, analysis of the photoacoustic signals can reveal information related to the tissue vasculature. We have applied these principles to cancer treatment monitoring and other blood pathologies. Typical blood vessels form hierarchically organized networks, distributed to ensure adequate oxygen and nutrient delivery. Tumor vessels are structurally different: they are torturous and typically hyperpermeable. Therapies that target the vasculature can induce changes in the vascular networks that, in principle, should be detected using photoacoustic imaging. In this presentation, we will review the techniques we have developed, which depend on analyzing the frequency content of ultrasound photoacoustic waves. We will show how we can use this information to filter vessels according to size with high specificity (resulting in a technique we have termed F-mode). For non-resolvable vessels, we will show how the frequency content of the photoacoustic signals encodes information about the size, concentration and spatial distribution of blood vessels. We also show how these techniques can be used to assess the treatment response of novel nanobubble agents used as radiosensitizers for radiation therapy."

Wednesday, November 23, 2022

3:30 p.m. PST

Zoom link available on Uvic Event Calendar