**Title:** Photoacoustic discrimination of viable and heat thrombosed hemoglobin in skin for burn injury diagnosis

**Abstract:**
Burn injury causes up to 50,000 acute hospitalizations each year in the US. The primary question for burn surgeons is whether to perform early excision of the burn site for skin grafting. Currently, this decision is made by subjective methods such as visual inspection and sensory function. Due to highly contrasting and dynamic optical properties of burn injury, we are investigating optical techniques for diagnosing burn injury. In the Viator Laboratory in the Life Sciences Center, we have developed photoacoustic methods for probing burn injury. In this study we use a dual wavelength method for noninvasively discriminating viable and heat damaged blood vessels. The ability to discriminate such vessels would allow clinicians to view a depth map of necrotic and viable tissue in burn wounds.

We used a tunable optical parametric oscillator pumped with a Q-switched ND:YAG laser to generate 5 ns laser pulses at 545 and 625 nm. We developed a burn injury phantom composed of two parallel plastic tubes of 3 mm diameter submerged in a solution of Intralipid with Direct Red dye added for background absorption in order to mimic the optical properties of skin. Both tubes were filled with whole blood. One tube was submerged in a hot water bath at 100°C for 1 minute in order to thrombose the blood. We performed a photoacoustic scan over the vessels at both laser wavelengths and detected the acoustic waves with a PVDF sensor. The ratios of the acoustic amplitude from the 545 and 625 nm pulses were used to discriminate whole from thrombosed blood, as the ratios were approximately 3.7 and 1.2, respectively.

We implemented a simple reconstruction algorithm to provide images of the vessels, highlighting either the whole or thrombosed blood. The images show excellent contrast, indicating the feasibility of non-invasive discrimination of whole and heat thrombosed blood in burn wounds.