PHANTOMS TO ACCELERATE TECHNOLOGY DEVELOPMENT AND STANDARDIZATION IN BIOPHOTONICS

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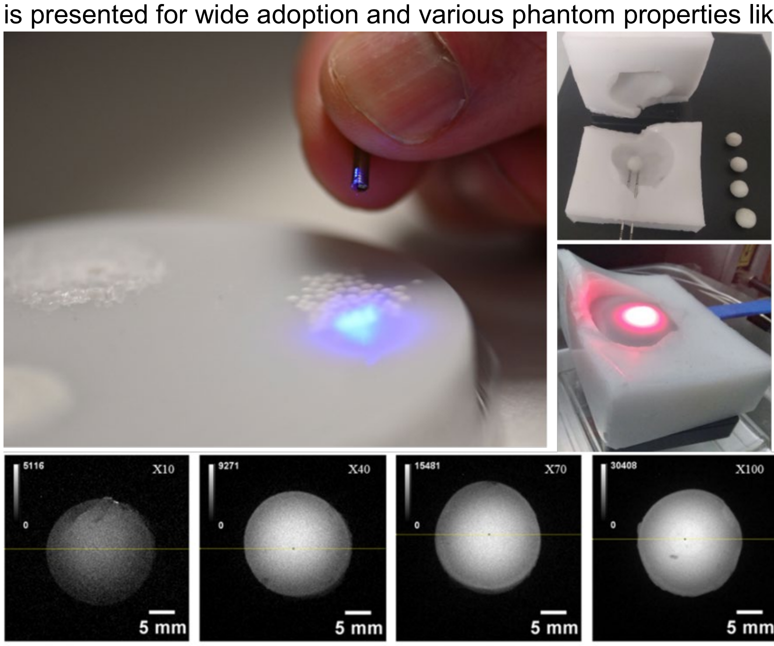
Tissue optical phantoms play a critical role in the testing, characterisation, calibration, and development of Biophotonics technologies. The recent success of translational research in Biophotonics emphasizes the requirement of standardized tools to expedite the advancement and standardization of these cutting-edge technologies. In this this presentation we will introduce and elaborate on diverse phantom tools that have been strategically designed to accelerate device development, seamlessly bridging the gap from laboratory innovation to clinical implementation. Following an introduction, four specific case studies will be presented.

The first example presents a wide range of phantom tools developed for emerging Biophotonics application like deep tissue imaging using upconverting nanoparticles (UCNP). In total 24 phantoms, classified into 4 types, namely homogeneous, multilayer, inclusion, and base phantoms, were designed and fabricated. A simple recipe is presented for wide adoption and various phantom properties like linearity, stability and reproducibility will be reported. The deep tissue imaging case shows possible, with reduced UCNP emission for increased thickness of tissue. The second case presents range of multilayer calcification phantoms for development of the chip on tip endoscope breast cancer surgical guidance application. Phantom optical properties were tailored to optimize algorithm to increase penetration depth and eliminated specular reflection from tissue. The third case involves development of anthropomorphic phantoms for optimization of dosimetry algorithms in photodynamic therapy application. Hybrid heterogeneous optical phantoms were developed comprising a photosensitizer embedded in gelatin tumor within liquid intralipid prostate phantom surrounded by solid silicone outer shell mimicking surrounding tissue. The hybrid model proposed can be extended to mimic other anatomical sites of the body. Finally, phantoms for standardization of diffuse Raman spectroscopy using multi-biomarker Raman measurements. In this work, gelatin-based phantoms were designed to simulate tissue optical properties where India ink and intralipid were used as absorbing and scattering agents, respectively. Raman multiple biomarkers were simulated by varying the gelatin concentration to mimic the change in tissue hydration and hydroxyapatite concentration to mimic bone signature.



Phantom tools for Biophotonics applications

With increasing advancement in Biophotonics and global initiatives in standardization we foresee phantom tools playing vital role in validation and standardization of Biophotonics devices.