AbstractID: 13965 Title: Development of an X-ray/Optical Luminescence Imager for Improved X-ray Contrast Sensitivity

Purpose: A dual-modality X-ray/optical imaging system is being developed to enable the imaging of ultra-low concentrations of contrast agents under X-ray excitation. This imaging system uses nano-sized inorganic phosphors to convert X-ray photons into optical photons, which are then imaged with an optical camera. This work presents initial data on the performance capabilities of this system, and demonstrates a significant improvement in contrast agent sensitivity over X-ray fluoroscopy.

Method and Materials: Nano-sized phosphors were fabricated from Gadolinium Oxysulfide and doped with Terbium (a green-emitting dopant) or Europium, (a red emitting dopant). A 2.5x4cm cylindrical optical/X-ray phantom was constructed from 1%Agar:99%Distilled water, india ink (for optical absorption), and titanium oxide (for optical scatter) to match biological tissue optical properties. Phosphors were homogeneously mixed at a concentration of 10mg/ml, and poured into a 1cm plug-shaped inclusion in the phantom. An X-ray fluoroscopy scanner was positioned vertically above the setup, with the tube voltage/current at 100keV/10mA. Light output was imaged on a lead-shielded CCD camera, placed 15cm from the phantom, during sample irradiation. An X-ray fluoroscopy image was collected for comparison. Images acquired via the optical camera and the X-ray fluoroscopy system were compared to measure the Weber contrast between the phosphor-filled inclusion and the background.

Results: Analysis performed on the X-ray fluoroscopy image showed a 0.6% contrast between the inclusion and the background. This slight contrast difference is due to the fact that Gadolinium has relatively high X-ray stopping power compared to water. In contrast, the X-ray/optical luminescence image showed a 260% difference.

Conclusion: The potential of a hybrid X-ray/optical imaging system was shown in a tissue-simulating phantom. This technique showed improved contrast to background; this contrast is expected to increase with the addition of Diffuse Optical Tomographic methods, which take into account photon scatter into the background.