

Project Title: Hybrid Optical X-ray CT for Head and Neck Cancer Diagnosis and Surveillance

Abstract: Head and neck squamous cell carcinoma (HNSCC) is the 6th leading cancer world-wide and results in considerable morbidity and mortality and mandates constant surveillance after treatment, severely impacting the quality of life of patients. In addition to the physical exam, CT and MRI are used to assess the extent of disease. Surgical resection, when feasible, in conjunction with chemo and radiation therapy, is the main treatment modality. While these imaging techniques offer high spatial resolution, they generally suffer from poor contrast for distinguishing tumors from normal tissue. As a result, the mortality rates from recurrent tumors remain stubbornly high. Near infra-red optical imaging can provide both intrinsic (blood oxygenation) and extrinsic (fluorescence) contrast that can delineate the tumor region based on hemoglobin and vascular permeability. While standalone optical systems have previously been employed to image breast cancers, head and neck cancers and for sentinel lymph-node mapping, the optical images are often poor in resolution and lack anatomical specificity. We propose to build a new Hybrid Optical X-ray CT (HOX-CT) for primary diagnosis, intra-operative tumor margin detection, and surveillance after treatment. Building upon our previous success of fabricating a dual ring system that seamlessly integrates into Siemens volume CT scanner, we will further incorporate optical components in this ring system. We will also adapt our state-of-the-art multi-modality optical imaging reconstruction algorithms to provide spatially co-registered anatomical and functional images. We will validate the performance of this system using phantom experiments and demonstrate the proof-of-concept by staging HNSCC in clinical subjects.