DEVELOPMENT OF IMAGING PLATFORM FOR MULTI-SPECTRAL BIOLUMINESCENCE IMAGING

By

Vivek Venugopal

A Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE

Major Subject: ELECTRICAL ENGINEERING

Approved:

Birsen Yazici, Thesis Adviser

Xavier Intes, Co-Thesis Adviser

Rensselaer Polytechnic Institute
Troy, New York

November 2007
(For Graduation December 2007)

ABSTRACT

The field known as biomedical optics has evolved considerably over the last couple of decades. The widespread availability of suitable laser sources and detectors has aided the rapid development of new optical technologies for the monitoring and diagnosis, as well as treatment, of patients. Furthermore, new optical techniques are helping to advance fundamental biomedical research. Bioluminescence imaging and tomography is a fairly new optical imaging technique which is finding wide ranging applications in cancer research and immunotherapy. My Masters thesis involved the development and evaluation of a prototype multi-view, multi-spectral optical tomographic imaging system, whose principal application is imaging bioluminescence signals in small animals.

The platform developed is capable of acquiring multi-view images at a high angular resolution of 10° and an error in angular position control of $\sim 1^{\circ}$. The spectral imaging capability of the acquisition system allows for imaging the exiting light within a 20 nm spectral band giving this platform one of the highest spectral resolution among the state-of-the-art bioluminescence imaging instrumentation. The tomographic aspect of the platform is accomplished in a novel way by employing a stereo camera system to extract a surface of the test subject.

The system's sensitivity was characterised and the performance was analysed through phantom studies. The system was found to be capable of imaging bioluminescent signals from as deep as 1.5 cm within the animal body. The accuracy of the surface reconstruction was seen to be within 4 % which further ensures accurate measurements using this system.