Abstract

Summary

The photoacoustic tomography is a technique used to display an image representation of a cross section through a human body using a phenomenon of photoacoustic effect.

In this phenomenon, acoustic energy is generated when optical energy is provided to photoacoustic object. Using the generated acoustic signal it is possible to obtain the image of optical absorption distribution of the object. By adding point Photoacoustic source, which when illuminated with pulsed optical energy acts as a point ultrasound source. It allows simultaneous imaging of optical absorption distribution, speed of ultrasound sound distribution and acoustic attenuation distribution. The 3D Photoacoustic tomography setup gives collection of the 2D image representation of a cross section through an object at different projection angle. By further processing of this 2D image's, the 3D representation of the object can be obtained. In order to get the accurate 3D representation of the object calibration of the setup is necessary.

The presented thesis work deals with the calibration of the 3D imaging photoacoustic tomography setup. The accuracy of the reconstructed image representation of the 3D object is determined by the accuracy of the calibration of the setup. The exact geometrical (or calibration) parameters need to be known because of many factors like, a) Sensors position offset which arrive during fabrication is unknown, b) Difficult to align the detectors straight and exactly parallel to z-axis. c) Difficult to fix the centre of rotation at pre-assigned co-ordinates. To get the parameters algorithm that is mentioned further were followed.

The thesis work is divided into four parts; the first part consists of Introduction about the concepts that are used in this work.

The second part consists of construction simulation based model, which includes photoacoustic source and detector array rotating at different projections in 3D Photoacoustic tomography setup. This simulation based model is constructed in order to get raw detector signal.

The third part consists of signal processing of pressure wave (acoustic signal), because the received detector signal has noise and some low amplitude measurements. It includes extracting the time of flight using template based approach and a procedure is prescribed for the same. It also includes classifying the time of flight and grouping vthem using RANSAC(3) method to recognize the source from which it is coming from, identify the number of sources and Estimate the position of sensors(16).

The fourth part consists of estimating the speed of ultrasound and centre of rotation of the detectors array by first obtaining the initial guess and then the final estimate. Accuracy of calibration was also included in this part to find the uncertainty in the estimated parameters(16). In the last section of this part thesis is concluded.