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Ultra Low Radiation Dose Computed Tomography Scanner for X-ray Mammography

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Technology description

Breast cancer is the most common cancer among women today with all women having approximately an 11 to12 percent chance of developing this cancer and a 30 to 40 percent chance of death after development. X-ray mammography is the best detection method, which reduces mortality by 30 to 50 percent. However, 30 percent of breast cancers cannot be detected by this method due to large amounts of noise, low resolution, dense breast tissue, normal tissue mimicking tumors and other reasons. The median detectable breast cancer tumor size is 11mm, but the spread of the tumor to other areas, or metastasis, can occur 16 months before the tumor reaches a detectable size. If the detectable size is reduced to 3mm the tumor can be detected 18 months earlier, before metastasis.

The two preferred X-ray mammography techniques are tomosynthesis imaging and dedicated cone beam computed tomography (CT) breast imaging. Tomosysnthesis has superior 2-D, or "in-plane," imaging resolution, but very low resolution in the third dimension. Cone beam CT has very good isotropic 3-D spatial resolution for superior contrast resolution to distinguish cancerous tissue from normal tissue, but low 2-D in-plane resolution. To minimize radiation dose to the patient it would be preferable to combine the benefits of both imaging techniques. A UW–Madison researcher has developed a line scan X-ray cone beam CT scanner system and method with an ultra low radiation dose to provide high in-plane spatial resolution and excellent low contrast resolution. The system is made up of an x-ray cone beam source and a 2-D X-ray detector array. Both move linearly on opposing sides of the breast in opposite directions to capture data from various angles. They do not move in a circular pattern around the breast.

An image is reconstructed with the data from a limited amount of angles, which results in a significantly lower X-ray dose to the patient. The cone beam data is converted into a parallel beam projection data set to create an image using a novel image reconstruction method. This method determines the image quality by using a determined metric to measure it against with the image quality continually increased until a preset quality is met. The limited number of angles required for this method leads to an approximate 20- fold reduction in radiation dose.

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a line scan X-ray cone beam computed tomography (CT) scanner system and method with

an ultra low radiation dose to provide high in-plane spatial resolution and excellent low contrast resolution.

Application area

Low radiation dose breast cancer X-ray mammography detection
Cardiac CT scanning, CT profusion imaging and pediatric CT scanning where radiation dose is a major concern

Advantages

Significantly lower radiation dose (around 20-fold lower) to patient
Able to detect smaller clusters of cancerous tissue with higher resolution images
Excellent low contrast resolution to distinguish cancerous tissue from normal tissue

Institution

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