

Design of a positioning system for mammographic x-ray spectroscopy under clinical conditions

Josilene Cerqueira Santos, Tânia Furquim, Paulo Roberto Costa
Instituto de Física da Universidade de São Paulo, SP, Brazil

Alessandra Tomal
Instituto de Física Gleb Wataghin, Universidade Estadual de Campinas, SP, Brazil

Measurement of mammographic x-ray spectra produced by clinical devices is a hard task due to the high photon fluence and geometric limitations. These limitations include the short distance between the focal spot and the image recording system. In this way, the use of spectroscopy system based on state solid detector requires a quite small collimator aperture to avoid pulse pile-up effects and damages to detector. On the other hand, the use of a very small aperture collimator requires an accurate positioning ensuring that the detector is aligned with the central axis of the radiation beam. The purpose this work was to design a positioning system for mammographic x-ray spectroscopy with CdTe detector (XR-100T-CdTe, Amptek) under clinical conditions.

The positioning system was mounted by mechanical adaptation from three mechanical positioners (OPTRON, Brazil): one mini goniometer and two horizontal translators. The system was mounted on a base table that ensures space for the spectrometer cable plugs. Two horizontal translators were installed perpendicular to each other on the base table. It ensures movement on xy plane with a 1 mm step. A mini goniometer was installed vertically on the horizontal translators. It allows angle with 0.1 degrees step relative to the vertical axis. Ultimately, the spectrometer is fixed on the mini goniometer base.

Additionally, an alignment device was designed to works together with positioning system. It is used for checking the alignment of the spectrometer to the central axis of the beam. This device is manufactured in PMMA and has the same basic dimensions of the spectrometer. It was done in order to allow the perfect replacement of the spectrometer by this device on the positioning device. This alignment system has two tungsten spheres with 1 mm diameter in its ends. These spheres are geometrically positioned on the line that crosses the center of detector. The procedure for checking the alignment consists on imaging the alignment device using the mammographic image recording system (CR, DR or screen-film). If the spheres appear superimposed in the image, it can conclude that this device is adequately aligned on the field. In this case, the alignment system is replaced by the spectrometer and the spectrometric measurements can be confidently started.

The system is able to translate on the xy plane (image receptor plane) and to rotate in relation to the z axis (beam direction). As result, the system was found adequate for the positioning and alignment of spectrometer.