UNIVERSITÄT ZU LÜBECK

FACH HOCHSCHULE LÜBECK
University of Applied Sciences

Program: Biomedical Engineering

Master's Thesis

Title: *Analysis of the scattered radiation distribution in the Angiographic/Cardiological examination.*

Summary:

In the medical field especially in the Cardiology and interventional radiology, the use of X-ray imaging plays an important role and has increased significantly nowadays. The physician or operator has to be aware of the risk associated with radiation exposure primarily for the patient and secondarily for himself as well.
Due to the X-rays characteristics, exposure can occur, not only by the main beam (X-ray source) directed towards the patient, but also by the scattered radiation occurring during the treatment. However this is difficult for the personal to assess it because it depends on different parameters, e.g. (angle, dose, irradiated area).

The clinical routine life shows that the personnel lose the sensitivity to their radiation exposure with time. This has many reasons, one of them depends on that the currently available methods for measurement the radiation exposure because it needs extra effort and times for the operator. Therefore, these methods are not favorable, limited in use in the clinical days and not practical. On the other hand, the rays are invisible and its effects are not directly visible except at extremely high doses.

The primary goal of this work is to increase personnel safety from the produced scatter radiation, but without the need to additional efforts. Moreover, to increase the sensibility of the operator in dealing with scatter radiation.

So this work presents an approach of modeling and visualizing the scattered radiation in the operating room of the cardiac catheterization laboratory (Artis Zee Floor, Siemens) for varying setups using the simulation system Geant4 and an anthropomorphic phantoms (Alderson Rando phantom) to simulate the patient. This system addresses the different physical processes that occur during the interaction between the X-Rays and the Patient and scatter radiation is produced as a result of these effects.

The simulation system was validated by measurements of the real system and a statistical comparison between the simulated results. The correlation factor between

the real measurements and the simulation was by 0.9406 which shows a good agreement and presents sufficient information to analyze the scatter radiation distribution in Angiographic/ Cardiological examination.

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