Patient-oriented breast imaging dosimetry for conventional mammography

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A method to obtain patient-oriented mean glandular dose (MGD) conversion coefficients for conventional mammography has been developed. This method has the advantage that can be applied retrospectively to large samples and does not require additional imaging procedures.

The method is based on the Heterogeneously-Layered Breast (HLB) geometry which models the compressed breast core as a series of layers of variable glandular percentage, wrapped in a skin-adipose composite outer layer. The glandular composition corresponding to each layer in the HLB geometry is obtained from the fibroglandular density maps of the CC-MLO image pairs.

This layered approach to the breast core geometry allows for the observation of differences in the MGD conversion coefficients depending on the tissue distribution that are overlooked using the current homogeneous assumption.

These discrepancies were studied using Monte Carlo methods and clinical breast density maps. The deviation was found to be related to the particular tissue distributions by means of the glandular distribution index (I_{dist}). The methods were further adapted by means of a correction (k_{dist}) to the currently available tables of Wu and Dance based on the corresponding I_{dist}. This approach allows for the application of the proposed methods in clinical settings where Monte Carlo methods are not available.

The proposed formalisms were evaluated using computational anatomical breast phantoms and their corresponding density maps. MGD conversion coefficients based on layered tissue distributions were also determined experimentally using measurements of thermoluminiscent dosimeter (TLD) placed in a layered phantom and compared against Monte Carlo calculations.

An additional extension of the method with the aim of removing the non-glandular fibrous tissue present in the fibroglandular density maps was included. The segmentation method proposed makes use of textural feature analysis and is based on the differing morphological characteristics of glandular and fibrous tissue.