PhD Thesis Title:	Optimization based on models of image noise and kerma in air for Computed Tomography

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The aim of this thesis was to estimate optimal alternatives of pixel noise and air kerma levels in Computed Tomography (CT), based on the use of predictive models of both quantities. A Siemens Sensation 64 CT scanner was used. Non-linear models with power functions of their predictors were proposed. The quantitative predictors were projected nominal beam aperture (F_1), tube potential (F_2), tube-current x time product (F_3), exponential attenuation of water-equivalent radius (F_4), field of view (F_5) and slice thickness (F_6). The reconstruction kernels were included as categorical variables. The air kerma indices ($C_{pmma,c}$ in the center and $C_{pmma,p}$ in the periphery) were measured in standard polymethyl methacrylate (PMMA) phantoms. The pixel noise was measured in water phantom images with various diameters. Optimization criteria were defined based on quantum noise values and levels of the area under the ROC Curve (AUC_{ROC}) for studies of patients with cerebrovascular disease. Reference criteria of manufacturer's protocols were defined for abdomen studies and pediatric head studies. As a result, the predictive models of air kerma indices (predictors: F_1, F_2, F_3 and F_4) and noise (predictors: F_3, F_4, F_6 and reconstruction kernels), showed an excellent adjusted coefficient of determination (> 0.98). A linear association between $C_{pmma,c}$ and $C_{pmma,p}$ was identified, allowing the estimation of the remaining dosimetric magnitudes for CT. In addition, the Size Specific Dose Estimator (SSDE) was estimated for head and abdomen studies. Model-based optimization (MBO) allows the identification of multiple alternatives. Just by reducing the F_2 and using more noise-reducing reconstruction kernels instead of standard protocols, noise and SSDE can be reduced by more than 25% and 35% respectively, for head and abdomen studies in pediatric patients and adults.

References to author publications that relate specifically to the dissertation:

1. R. A. Miller Clemente and M. Perez Diaz, "The association of dosimetric quantities from Computed Tomography with operational factors: basis for optimization strategies," NUCLEUS 65, 28-31 (2019).
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3. R. A. Miller Clemente, M. Perez Diaz, M. Lores Guevara, O. Ortega Rodriguez, R. Nepite Haber, O. Griñan Hernandez and A. Guillama Llossas, "Optimization of a protocol in pediatric Computed tomography with automatic exposure control," Imagen Diagnóstica 5, 10-16 (2014).
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