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Optimization of pre-recontruction restoration filtering for filtred backprojection reconstruction (FBP)

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Abstract

Tomographic reconstruction is the technique underlying nearly all of the key diagnostic imaging modalities since they generated 2D/3D representation from a set of 2D projections acquired by a topographic system. For a long time, and despite the advantages of iterative algorithms, the FBP algorithm was preferred because it was computationally faster and more practical for routine use. However, in clinical practice, the FBP algorithm performances depend on several parameters effecting seriously final reconstruction results: The use of a smoothing filter to reduce the noise results in a loss of resolution and the choice of an optimal pre-reconstruction filter is necessary to provide the best trade-off between image noise and image resolution. A significant improvement in the quality of SPECT images has been demonstrated through the use of 2D pre-reconstruction restoration filtering of the projection images with FBP techniques. However, these filters should be designed to account for the image blurring, the noise level, and the imaged object to obtain the maximum restoration of image quality. In this work, we propose a user-friendly Interface for interactive optimization of FBP preconstruction filtering with emphases on Image-dependent restoration filters. The framework proposes an interactive visual algorithm for implementation of digital smoothing (hanning and Butterworth) and semi-automatically implementation of Metz restoration filters in frequency domain. To more objectively determine the optimum cut-off frequency, the user is assisted in visual feed-back optimization, by displaying the calculated of the power spectrum of both projection and estimated noise, and the filtered reconstructed images. A comparative study using 6464 2D-noiseless-numerical simulated and myocardial perfusion SPECT data, was conducted to investigated the performance of optimized

filters on a pre-reconstruction task using FBP in terms of visual assessment, mean standard deviation and contrast. The reconstruction was done by a conventional FBP method using a ramp filter with no attenuation or scatter correction. Results show that optimized Metz restoration filtering provides reconstructed data with reduced noise without unduly penalizing resolution. It is also giving more improvement in clinical SPECT image contrast than Butterworth and Hanning.