Purpose: Multitaper methods for noise power spectrum (NPS) estimation potentially provide reduced variance and minimum bias over conventional periodogram NPS measurement. This is potentially beneficial for spectra that deviate significantly from a uniform white noise spectrum. Here, we compare NPS analysis by multitaper methods to conventional techniques.

Methods: A methodological framework is presented for experimental analysis of the NPS of breast images, including 2D mammography and digital breast tomosynthesis. In conventional techniques, original image data are subdivided into overlapping regions (ROI) and the NPS from each region are averaged to reduce variance in the estimate. In the multitaper approach, the entire image is weighted by several tapers (windows) with the NPS calculated for each. The final multitaper estimate is obtained by a weighted sum of the NPS results for each taper. The summation is adjusted to minimize bias and variance in the estimate. To compare the performance between these two approaches, several mathematic breast phantoms with "anatomic noise" (structures) have been simulated by an inverse power-law spectrum in the form of P(f) = Kb /f^B. Performance of both NPS estimators was assessed in spectrum variance, bias, spectral leakage, frequency resolution and in the accuracy of estimation of Kb and B.

Results: Examination of spectrum variance versus frequency resolution (and bias) indicates that the multitaper approach is superior to single taper methods in the prevention of spectrum leakage and variance reduction. For all breast image cases studied, multitaper method gave a better estimation of Kb and B.

Conclusions: This work indicates the potential of using multitaper method in spectral analysis of breast images. Without any shortening of the image data length, the bias is smaller and the frequency resolution is higher, relieving the compromise in choosing ROI size to balance reducing variance against loss of frequency resolution.

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