AbstractID: 2754 Title: Tone mapping operators for contrast enhancement of mammograms

Purpose:
To investigate the effect of different tone mapping operators in contrast enhancement of mammograms. A concave piecewise linear operator is proposed and is compared to a convex (logarithmic) and linear operator.

Method:
Tone mapping is performed prior to contrast enhancement to elevate the lower intensities that mainly correspond to the skin-line zone. However, this leads to a loss in contrast due to compression of the gray levels. Gaussian band-pass filtering is then performed to enhance the contrast of the mammogram. Filtering highlights the structure of breast while suppressing noise and the slowly varying high-density structure. The filtering is done in the frequency domain and the image is mirrored and tiled prior to taking its Fourier transform to minimize edge effects. The tone mapping operators studied are logarithmic, linear and piecewise linear. The logarithmic operator has an adaptive base, the linear operator has constant slope in the intensities corresponding to the skin-line zone, and the piecewise linear operator has varying slope in those intensities.

Results and Discussion:
The enhanced images were viewed on a calibrated Dome C5i display. The logarithmic operator compresses the intensities near the threshold excessively which results in substantial loss of information. The linear and piecewise linear operators do not compress to the same extent. The piecewise linear operator compresses more in the range where there is not much information than in the range where there is more information. Also, tone mapping decreases the magnitude of the intensity step-change from the breast region to the background. This reduces the ringing artifacts that result from the filtering operation

Conclusion:
The tone mapping operation improved the visual characteristics of the mammograms. Piecewise linear operator performed the best. The linear operator is comparable to the piecewise linear operator in most cases, though not as consistent. The logarithmic operator fared poorly.