Characterization of anatomical noise in mammography, tomosynthesis and breast CT using the slope (beta) of the anatomical noise power spectrum.

INTRODUCTION: Breast cancer screening using mammography is compromised due to anatomical background noise, and tomosynthesis and breast CT techniques have been proposed to overcome this limitation of mammography. This study quantified the anatomical noise in each modality, for the same small cohort of women.

METHODS: Regions of interest were extracted from mammography, tomosynthesis, and breast CT image data from 23 patients. Typical ROI placement is shown in Fig 1, and typical ROI textures are shown in Fig 2. The anatomical NPS(f) was computed, and an example is plotted as log-log in Fig 3. The NPS from a real breast is seen as the line with negative slope (=β), and to help identify the frequency window for quantum noise in the NPS(f), a polyethylene breast phantom (no anatomical noise) was scanned and its NPS(f) is shown as well. The spectra were windowed between frequency windows to reduce the contribution of quantum noise to the assessment of β.

RESULTS: The mean values of β are shown in Fig 4 for the three modalities, for each of the projections used in each modality. There was little variation in β between projections in each modality. The mean value of β for tomosynthesis was statistically identical to that of mammography, however for breast CT the value of β was statistically (p<0.001) smaller than tomosynthesis or mammography. CONCLUSIONS: To the extent that β is a well-established metric which predicts anatomical complexity and lesion detectability (it’s not yet), then the results of this study suggest that tomosynthesis may provide little improvement over mammography, while breast CT has much greater potential to improve cancer detection (of mass lesions) in the breast. This result does not address the issue of microcalcification-based lesions.