

AbstractID: 9806 Title: Developments in Digital Stereomammography

Stereoradiography is one of several techniques that address the tissue superposition problem inherent with single projection radiography. A key advantage of stereo radiography over other 3-D techniques, such as CT and tomosynthesis, is its low cost. The first description of stereo radiography was published by Elihu Thomson in 1896. Although stereo radiography was initially very popular, its use diminished over time due to concerns about the increased radiation dose associated with taking 2 films (for the stereographic pair) instead of 1, and due to its qualitative nature. The advent of computer technology and digital imaging has rejuvenated interest in stereoradiography. Computer-based stereoscopic displays of DSA stereo image pairs have been found to be valuable in diagnosis, surgical planning and surgical guidance. Stereotaxic mammography is used routinely for core biopsies of suspicious breast tissue. We have been investigating digital stereo mammography imaging. Our research has concentrated on stereo technique optimization, the use of stereo mammography for assessing the margins in breast biopsy samples, the development of virtual 3D cursors for measuring depths in stereo mammograms, and the development of an automated stereo spot mammography method. We have found that the accuracy of depth discrimination of fibril simulating objects in stereo mammograms increases with increasing stereo angle, exposure, and fibril depth separation. Under conditions of high noise (low dose) and small depth separation between the fibrils, depth discriminations are significantly better in stereo images acquired with geometric magnification than in images acquired with a contact technique and displayed with or without zooming. Magnification mammography also provides the highest accuracy for depth measurement with a virtual cursor, whereas display zoom does not improve accuracy. For two experienced observers with excellent stereo acuity, the best depth accuracy that was achieved using the virtual cursors was 0.2-mm for a +/-6 degree stereo shift angle and geometric magnification of 1.8. Preliminary results comparing stereo vs. conventional mammographic imaging assessment of biopsy samples have been inconclusive with one observer showing improvements in their accuracy of estimating the likelihood of malignancy (from $Az= 0.72$ to 0.74) and increased confidence in judging margin clearance ($p<0.00001$), and the other observer showing reduced accuracy in estimating the likelihood of malignancy (from $Az= 0.76$ to 0.70) and reduced confidence in judging margin clearance ($p<0.03$). Ongoing studies with more observers will further evaluate these assessments. For the automated spot project, we performed a study to determine the agreement between regions in digitized mammograms that radiologists and a CAD program selected for spot imaging. The averages of the largest overlaps between the regions selected in 200 images ranged from 74% to 95%. We also designed and built a stepper motor controlled spot collimator. More details of our studies will be discussed.

Educational objectives

To learn:

1. about the principles of stereo radiography and virtual cursors
2. how depth perception varies with stereo imaging conditions.
3. how depth perception affects observer evaluation of mammographic lesions
4. how depth measurement accuracy varies with stereo imaging and display conditions
5. about advantages and disadvantages of stereo radiography.