Computer-aided diagnosis (CAD) is a promising field that has the potential of improving the diagnostic interpretation of medical images by providing a consistent and reproducible second opinion to radiologists. A CAD algorithm may consist of several modules that either operate independently or are cascaded so that some modules provide inputs to others. The first module in the cascade is usually an algorithm that automatically detects suspicious lesions on radiographs and alerts the radiologists to these regions. Other modules can extract image features of a suspicious lesion, which may be used alone or in combination with other diagnostic information, to estimate its likelihood of malignancy. Some other modules can merge radiologist-extracted image features and other patient information for the same purpose. Both the computer-detected suspicious lesions and the computer's estimate of the likelihood of malignancy of these lesions may be used by radiologists as a second opinion in the detection and diagnosis processes.

Our research group at the University of Michigan has been developing CAD methods for the analysis of medical images. Currently, our major effort is devoted to the analysis of breast images for breast cancer detection. Computer programs for the detection of masses and microcalcifications on digitized mammograms have been developed. A number of image processing techniques have been designed and evaluated for the image enhancement, segmentation, feature extraction, and classification processes in the CAD algorithms. For the characterization of masses and microcalcifications, we have developed feature extraction and selection methods and evaluated the ability of different classifiers to differentiate malignant and benign lesions.

Researchers in our department are investigating new imaging techniques for the diagnostic workup of suspicious lesions. These techniques include three-dimensional ultrasound scanning of breast masses and dynamic magnetic resonance imaging of the breast. The feasibility of computerized analysis of the images in each modality has been studied and promising preliminary results have been observed.

We will describe the techniques used in our CAD algorithms for breast cancer detection, provide an overview of our recent progress, and discuss the potential of CAD for improving breast cancer diagnosis.

Learning Objectives:

1. To learn some image processing techniques for computer-aided diagnosis.
2. To learn the utility of computerized analysis in mammography, ultrasound, and breast MRI.
3. To learn the potential of CAD for improving breast cancer diagnosis.