

AbstractID: 4409 Title: Image Science and CAD: In Pursuit of a Fundamental Theoretical Basis for CAD Development

Computer-aided diagnosis is still a very immature field, with very little theoretical framework upon which it is based. This is a major limitation in both developing systems and in evaluating them in a meaningful way. It is clear that in the future CAD will play a greater role in radiology, both as secondary reader and as a primary reader. The current clinical implementation of CAD is as second reader to radiologists. This will shift to CAD being used by a physician assistant and CAD as the primary reader and the radiologist as the secondary reader. Ultimately, CAD will be the only reader, at least for a subset of cases.

However, to increase the development and adoption of new CAD systems, the field needs a better fundamental foundation. This foundation will come from several areas. First, as we gain a better understanding of human observers, we can use this information not only to develop more accurate CAD algorithms, but also importantly, to design CAD systems that can be integrated into the radiologists' workflow more fully. Second, models of CAD techniques need to be developed. In analogy to modeling ideal observers and human observers, much can be gained from modeling CAD schemes. Third, a thorough understanding of the interaction between the image and the CAD technique is needed. For example, if the shape of the NEQ curve of the image receptor changes, can we predict how the performance of the CAD technique will change.

Medical imaging technology is rapidly changing. The current paradigm for developing CAD systems – try different techniques on hundreds of images – cannot keep pace with these changes, especially as new imaging systems are developed, where clinical images are scarce. Our goal should be to develop the field to the stage where it will be possible to model the imaging system's characteristics and then, guided by models of human observer performance, select from an array of image processing, artificial intelligence and pattern recognition techniques a group of techniques that will produce the optimum CAD system.

This talk will present my vision for the future of CAD and what is necessary for the field to make rapid progress.

Educational Objectives:

1. Discuss future roles of CAD as both a secondary and the primary reader.
2. Explain the fundamental limitations of CAD development.
3. Discuss one possible approach to overcoming the limitations in the future.