Google-like process for mammogram images speeds up computer's second opinions

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To help computers provide faster "second opinions" on mammogram images showing suspicious-looking breast masses, medical physicists at Duke University are employing a Google-like approach that retrieves useful information from an existing mammogram database within three seconds.

Rather than comparing the mammogram image in question to every image of breast cancer in a computer database, the new approach compares the mammogram in question to selected images that are most highly ranked for their information content. This is analogous to how a Google search first returns a list of only those websites that it determines to have the most important and useful information on the words entered in the search.

In a pilot study that will be presented in August at the 48th Annual Meeting of the American Association of Physicists in Medicine in Orlando, the approach enabled computers to maintain their high level of accuracy while performing faster analysis. Such speed and efficiency will be important as such image databases rapidly grow larger and more complex.

Knowledge-based computer-assisted detection (CAD) systems compare mammogram images to those of known cases of breast cancer in order to aid radiologists in their diagnosis. However, as clinical image libraries grow rapidly in mammography practice, knowledge-based CAD systems get slower and less efficient.

In efforts to prevent such systems from bogging down, Duke's Georgia D. Tourassi, Ph.D. will present a Knowledge-Based Computer Assisted Detection (KB-CAD) system that analyzes breast masses using the principles of information theory.

When a new, unknown case is presented for analysis, the KB-CAD system compares the case to mammography images in the database. It retrieves cases that are similar, those that share certain visual features and properties. If the unknown case is similar enough to a known case of breast cancer, then this would suggest the presence of cancer.

Although diagnostically accurate, this practice becomes inefficient as the image database increases in size. Therefore, the researchers incorporate an additional approach.

Instead of comparing the new unknown case with all mammography images stored in the knowledge database, the researchers restrict the analysis to the stored cases that are most informative. The selection of the most informative cases is done using an image indexing strategy based on the concept of "image entropy." Image entropy represents a measure of the disorder or complexity in the image. An image that is all black or white has zero entropy. An image of a checkerboard has low entropy--it consists of an equal number of light and dark pixels. Complex images with more uniform distributions of many pixel intensity levels have higher entropy and are considered more informative in the context of the Duke system.

Normal breast tissue "can be as complex as a tumor," Tourassi says. "This is precisely the reason mammographic diagnosis is such a challenging task. Our database inlcudes normal cases as well in the decision-making process."

In the recent pilot study, the Duke researchers applied their technique to

a database of 2,300 mammography images. With entropy indexing, the researchers compared a sample image to the top 600 most informative, cutting down their CAD system's processing time by one-fourth, to less than 3 seconds per query. The researchers expect to launch a larger study in a year to evaluate the clinical impact of this new approach.

Source: American Institute of Physics