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Image shuffling: A better way to read mammography

IBM Watson Health Imaging

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Thanks to advancements in treatment and detection, the prospects for those fighting breast cancer are better than ever. Widespread screening in the U.S. has resulted in an increase in the number of early stage breast cancers that are detected, and those diagnosed with early stage breast cancer typically live longer. According to the National Cancer Institute, the five-year survival rate for women with breast cancer confined to the primary site is 99 percent, compared with 85 percent for women whose cancer has spread.[1]

Some of the improvements in screening can be attributed to a variety of technological advances that are designed to increase diagnostic accuracy in mammography. For example, most medical practices now use full-field digital mammography instead of screen-film mammography, and many sites have transitioned to tomosynthesis, which may increase detection rates and may decrease callbacks.

Yet, breast cancer is still a significant cause of cancer mortality. Approximately 12 percent of women will be diagnosed with female breast cancer at some point during their lifetime, based on 2013–2015 data.[1] Seeing as there is still room for improvement, what else can be done? Helping radiologists read images more effectively and efficiently is an area of great potential.

With images, perception is everything

"Detecting suspicious mammographic findings is a bit like looking for a needle in a haystack."

Michael Trambert, MD, Director of Radiology Research, Cottage Health System

According to the National Cancer Institute, screening mammograms do not detect about 20 percent of breast cancers that are present at the time of screening.[2] Many of these errors are caused by perception/detection errors, according to Michael Trambert, MD, Director of Radiology Research at Cottage Health System in California. So it stands to reason that improving the reading experience may enhance accuracy.

"Detecting suspicious mammographic findings is a bit like looking for a needle in a haystack," said Trambert. "Firstly, most mammograms are normal, with cancer detected through screening mammography in approximately three out of every 1,000 patients. Secondly, mammograms are very unstructured images, with all kinds of shadows, densities and textures."

To compare images, radiologists typically view the current exam images and previous exam images on adjacent monitors — a carry-over from film screen days, when current and prior mammographic views were physically hung next to each other for comparison. They focus on the current image and look for calcifications, masses, asymmetries and architectural distortions, then readjust their gaze to examine the prior exam image, glancing back and forth between the current and prior exam images to search for differences. "It's difficult, because you are looking at an unstructured image with all kinds of texture, and when you move your gaze over to the other image, you make a comparison in your mind's eye to try to identify any important differences," Trambert said.

This method of viewing images may lead to "change blindness" — a failure to detect differences between two successive images.[3] "Every time you move your eyes to examine two different images, you change your gaze position, perhaps even move your head. There's a great deal of distraction involved with this methodology," said Trambert.

Image shuffling caters to our visual strengths

An alternative viewing method, however, could help reduce this change blindness. Instead of viewing exams side-by-side, which requires readers to move their eyes and readjust their gaze back and forth, image shuffling allows radiologists to "flip" between current and prior same-view registered images on the same monitor in a virtual stack. Moving the mouse wheel up or down causes the current and prior images to flip back and forth, without readers having to move their gaze between views to compare. The images move, rather than the readers' gaze.

As the images alternate, most of the content is static, so changes attract immediate attention as motion. This ability to identify changes through motion detection was the basis for the blink comparator, a device used by astronomers to rapidly toggle between two views of the same patch of sky, which led to the discovery of Pluto. This technique is also used by the military to assess satellite imagery.

Motion detection is a skill that comes quite easily to most people. "We as humans have evolved to be really good at motion detection," Trambert said. "In prehistoric times, humans had to be aware if a predator in the distance was coming toward them. Quick reaction to motion meant you didn't get eaten. Our minds, our eyes, our visual cortex, our neural networks are all extremely adept at motion detection as a survival skill. We can take advantage of this capability to read faster and more sensitively with mammography."

A recent study put methods of image viewing to the test by comparing image shuffling with conventional side-by-side viewing.[4] The study required 23 participating radiologists to view 10 studies including a prior and current exam, five in each viewing mode.

The image-shuffling method revealed advantages over the more traditional side-by-side method. Radiologists achieved 75 percent accuracy when viewing in the image-shuffling mode, compared to 69 percent accuracy in the side-by-side mode. While this difference was not statistically significant for this small study, further studies may validate the accuracy advantage provided by image shuffling.

Another potential advantage of image shuffling was revealed as well: When radiologists completed the task in shuffling mode, they came to a clinical conclusion 15 percent faster than when using the side-by-side method. Trambert noted that image shuffling was a brand new methodology for most of the readers in this study, and he believes the increase in reading speed would be much larger with more shuffling experience.

Greater efficiency, without sacrificing accuracy, may greatly benefit radiologists and healthcare organizations by:

- Enabling radiologists to examine more cases in the same amount of time
- Relieving some of the constant time pressure and allowing radiologists to focus on difficult cases
- Facilitating more reasonable work days for radiologists, which may improve quality considering evidence shows that diagnostic accuracy in radiology decreases at the end of long work days[5]

While image shuffling was developed as a means to improve the breast image reading experience for mammographers, the method also has significant applications for other medical imaging tasks. "Image shuffling can be applied to other modalities very effectively. For instance, it can be used to detect or compare the size of lung nodules, liver lesions, adrenal masses or any mass lesion in CT, MRI or PET/CT exams," said Trambert. "Change in lesion size appears as motion, with a lesion appearing to either shrink or expand as you shuffle the slice pairs. There is much less confusion on whether there is truly a change in a lesion."

Adding image shuffling to the workflow

To adopt image shuffling into a practice, the method needs to naturally fit into the radiologist's workflow. The image shuffling viewing function built into Watson Health's Merge Unity™ is patented and designed to help increase efficiency, speed and accuracy for reading physicians. Shuffling is accessible via a hot key, voice command, mouse click, as well as an optional default modality preference.

Because image shuffling is incorporated into Merge Unity's integrated reading and reporting system, there is no need to read and archive breast imaging studies on a separate system. Trambert shared how this simplified workflow has facilitated the adoption of image shuffling at his own practice at Cottage Health.

"There was definitely some initial resistance — some radiologists simply wanted to hang on to the viewing method that they had grown accustomed to. But the practice's radiologists all came around very quickly to fully embrace image shuffling in a matter of weeks," he said.

"What I can tell you is that, in my group, radiologists feel efficient and empowered reading mammography with image shuffling and are surprised that it's not the universal industry standard."

To find out more about image shuffling and other features of Merge Unity, visit ibm.com/marketplace/merge-unity

About Watson Health Imaging

Watson Health Imaging, a segment of IBM Watson Health, is a leading provider of innovative cognitive computing, enterprise imaging and interoperability solutions that seek to advance healthcare. Its Merge branded enterprise imaging solutions facilitate the management, sharing and storage of billions of patient medical images.

With solutions that have been used by providers for more than 25 years, Watson Health Imaging is helping to reduce costs, improve efficiencies and enhance the quality of healthcare worldwide.

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75 Binney Street
Cambridge, MA 02142

Produced in the United States of America
March 2018

UPAX-8478 Rev 2.0

1. Cancer Stat Facts: Female Breast Cancer. National Cancer Institute. April 2018.
2. Mammograms Fact Sheet. National Cancer Institute. December 2016.
3. Change blindness. Trends Cognit. Sci. 1997 Oct;1(7):261-7.
4. Image toggling saves time in mammography. Journal of Medical Imaging 3(1), 011003 Jan–Mar 2016.
5. Long radiology workdays reduce detection and accommodation accuracy. J. Am. Coll. Radiol. 2010 Sep;7(9):698-704.