"Gold standard of data" offers hope to cervical cancer patients

A data-based "multimodal" system improves image interpretation.

It may not be long before medical workers without access to a lab can get a diagnosis for cervical cancer by dialing it in—literally. Xiaolei Huang has been working on computer-imaging software that would make the reading of cervical images available to a clinician possessing nothing more than a cell phone.

Cervical cancer afflicts more than half a million women globally each year. Early detection and treatment greatly decrease the mortality rate, but women in less-developed areas of the world often do not have access to adequate medical resources.

What Huang has created not only automates the review of images used in cervical screenings, but appears to enhance accuracy as well.

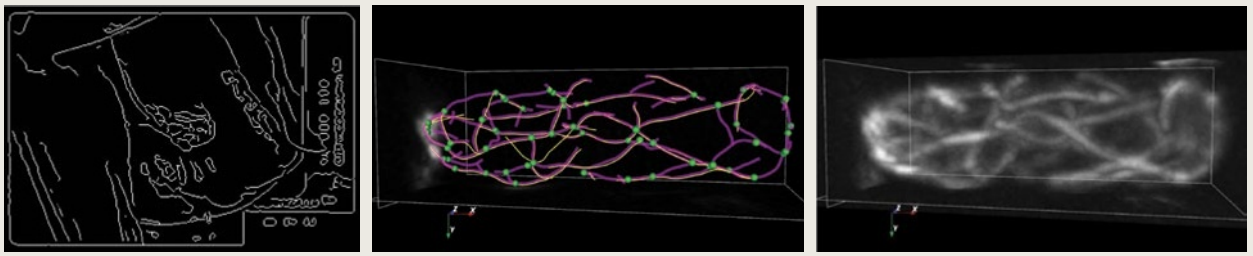
Currently, a doctor who examines a patient with an abnormal or atypical Pap smear can take a picture of the cervix after applying a mildly acidic wash. This procedure, known as aceto-whitening, highlights potential precancerous tissue. The characteristics of these areas, however, can be inconsistent.

Huang sidesteps this obstacle by using a data-driven approach. Rather than a more orthodox reading of the cervical image, in which a doctor seeks to characterize potential pathological features, Huang has devised an algorithm that assigns a signature to the image based on its visual characteristics. The image is then compared to images with similar signatures in the NLM's database to determine whether the signature later proved to be a harbinger of cancer.

By setting aside a portion of the images from the original database and using the software to analyze them, Huang has been able to measure her results against the diagnoses of known cases in the NLM database. The comparison shows significantly better results for the algorithmic tool; about 66 percent of the diagnoses based on Pap smears turned out to be accurate, versus 82 percent for the algorithmic image-interpretation tool.

Huang and her team have also developed a system that makes a diagnosis decision based on images, Pap smear, HPV test, age and pH. This "multimodal" system improved the accuracy of the image-interpretation tool.

The new tool is fully automated. In the future, says Huang, medical personnel will be able to take a cervical image with a camera and send the photo to a server via a mobile network to obtain a diagnosis.



Huang's algorithm assigns a signature (left) to a cervigram from NLM's database based on the image's color and texture. With Vavylonis, Huang developed a program that extracts the geometry and topology of actin cytoskeleton (middle) in yeast cells imaged by confocal microscopy (right).

Huang, an assistant professor of computer science and engineering, was invited by the National Library of Medicine, a division of the National Institutes of Health, to utilize NLM's vast, anonymous database of cervigrams and diagnostic information from more than 10,000 women who were followed over multiple years.

"This is the gold standard of data," says Huang, "and that's why I was really excited about this." The National Cancer Institute is also participating in the project.

In another project, Huang and Dimitrios Vavylonis, associate professor of physics in Lehigh's College of Arts and Sciences, are tracking the actin meshwork in yeast cells. Actin, a protein, forms into filaments that create the cytoskeleton—or structural framework—of yeast cells. The latticed meshwork is quite dynamic, as the actin filaments are constantly growing and disassembling.

Since actin proteins play an important role in cell division, learning more about them could help the search for drugs that block the division of cancerous cells. Huang and Vavylonis have received a five-year, $1.3 million grant from NIH to support their research.