“Breast cancer diagnosis using spatial light interference microscopy” describes a new, experimental method of determining whether breast tissue lesions are benign or malignant.

When an abnormality in the breast is discovered during a screening procedure such as a mammography, standard practice is for the physician to take a tissue biopsy, which is then stained using hematoxylin and eosin (H&E). The staining provides enough contrast for a pathologist to study key morphological features of the tissue under a microscope.

The tissue analysis is done manually; because of variations in things like staining intensity and the illumination used, the process does not lend itself to automation. Manual inspections, however, are subject to investigator bias, and the process is time-consuming. This can, in some cases, result in late disease diagnosis—a critical shortcoming given that early diagnosis significantly improves chances of survival.

Now researchers at the University of Illinois at Urbana–Champaign and the University of Illinois at Chicago have tested a new optical method for diagnosing breast cancer using spatial light interference microscopy (SLIM).

Using the breast tissue biopsies of 400 different patients, they selected two parallel, adjacent sections from each biopsy. One of these sections was stained using H&E, leaving the other unstained.

The unstained samples were analyzed using a SLIM module attached to a commercial phase contrast microscope. The system generated different interferograms for each tissue sample using shifting patterns of scattered and unscattered light. Four interferograms, corresponding to four different phase shifts, were used to produce one quantitative phase image. On this SLIM image, areas with different refractive properties appear in different colors. The boundary between the tumor and its extracellular environment is clearly delineated, making it possible to assess whether the tumor is malignant.

As part of the experiment, two board-certified pathologists were trained to interpret the tissue morphological details from SLIM images, by being shown H&E and SLIM images of the same tissue cores, labeled benign or malignant, side by side.

At the testing stage, each pathologist was first shown the stack of SLIM images for 109 selected tissue cores. The pathologists classified each core as either benign or malignant. Then the process was repeated for the stack of H&E images for the same 109 cores. Using each pathologist’s diagnosis of the H&E stained cores as the gold standard, the researchers measured the success of diagnosis using SLIM images by counting the number of agreements between SLIM- and H&E-based diagnoses.

The agreement between SLIM- and H&E-based diagnosis was 88% for the first pathologist and 87% for the second. Agreement between the two pathologists when rating SLIM images stood at 83%, whereas the same for H&E images was much higher at 98%. The authors of the paper expect the agreement between the diagnoses of the two pathologists on SLIM images would increase significantly if they received more training in interpreting SLIM images.

Because this diagnosis method is based on quantitative data, rather than on a pathologist making a qualitative assessment, the researchers believe it could serve as the basis for an automated image analysis system that would provide a fast and accurate diagnosis.

Breast cancer is the second most common form of cancer diagnosed worldwide, accounting for 11.9% of all cancers diagnosed in 2012, according to the International Agency for Research on Cancer.

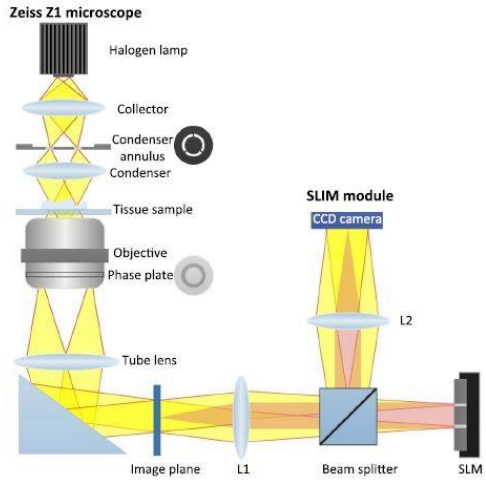

Fig. 1 Spatial light interference microscopy (SLIM) optical setup. The phase is reterived by shifting the phase of the scattered light with respect to that of the unscattered light by using a spatial light modulator (SLM) at the Fourier plane of lens L1. Four interferograms, correponding to four different SLM phase shifts, are obtained and used to compute the phase.

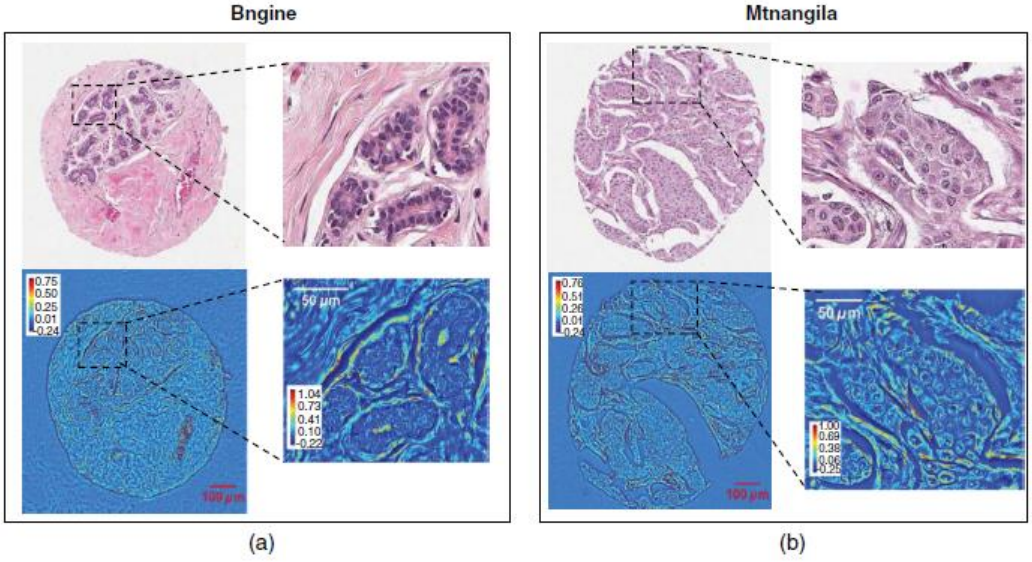

Fig. 3 Comparison between H&E stained bright-field microscopy (top row) and SLIM (bottom row) images in their respective abilities to resolve tissue morphology for (a) benign and (b) malignant cases. The H&E images were obtained from stained sections that were adjacent to the unstained sections used for SLIM imaging. Color bars are in radians.

Please note: Above is the content I submitted to Amy Nelson, Public Relations Manager for SPIE, based on the full article in the peer-reviewed *Journal of Biomedical Optics*. To see the final press release distributed by SPIE, visit the organization's website at http://spie.org/about-spie/press-room/press-releases/jbo-slim-for-breast-cancer-diagnosis-8-24-2015. — Christine Hosler