A LIGHT FOR SCIENCE

NEW TOOL FOR EARLY DIAGNOSTIC OF BREAST CANCER

Scientists from Finland, Germany and the ESRF have developed a new X-ray technique for the early detection of breast cancer. This allows a 3D visualization of the breast with a high spatial resolution and is extremely sensitive to alterations in the tissue, such as those generated by cancer. This technique is likely to be developed in the next years for use in hospitals. It may help doctors to detect tumours with greater precision than is possible using current X-ray mammography.

Although thistechnique is currently the most widely used tool in diagnostic radiology, it fails to identify about 10 to 20% of palpable breast cancers. This is because some breasts, especially in young women, are very dense. Therefore, on mammograms, glandular tissues can mask cancer lesions.

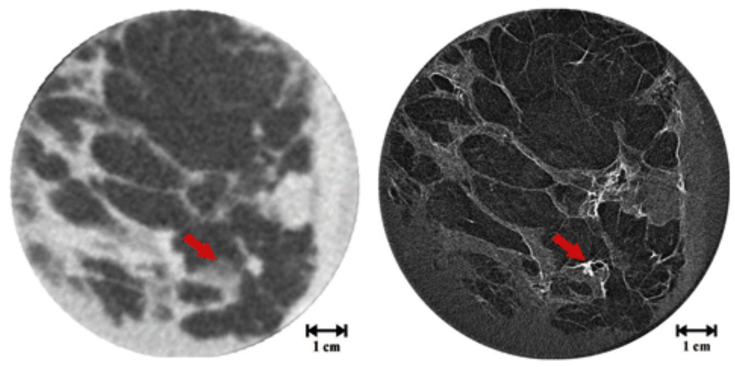
Better results are obtained using X-ray computed tomography (CT). CT imaging could produce accurate 3D images of the entire breast, improving the detection of early diseases in dense breasts. However, its use in breast imaging is limited by the radiation dose delivered.

A new CT technique has allowed scientists to overcome this problem. The teams from the Helsinki University Hospital, Turku University Hospital, the Radiation and Nuclear Safety Authority (Finland), the University Hospital of Grenoble (France), the European Molecular Biology Laboratory in Hamburg (Germany) and the Biomedical beamline at the ESRF have managed to visualize breast cancer with an unprecedented contrast resolution and with clinically compatible doses.

The researchers used the technique, called Analyzer-Based X-ray Imaging (ABI), on an in vitro specimen at the ESRF, using a radiation dose similar to that of a mammography examination. The dose corresponded to a quarter of that required for imaging the same sample with conventional CT scanner, and the spatial resolution of the ABI images was seven times better.

For the experiment, researchers chose a particularly challenging specimen. It consisted of a breast invaded by a lobular carcinoma, the second most common form of breast cancer, which is very difficult to visualize in clinical mammography.

The results showed that high-spatial-resolution ABI-CT makes visible small-size and low-contrast anatomic details that could otherwise only be seen by



An image of a breast using CT scan (left) and of a breast using the new ABI technique (right). The arrow shows the location of the tumour. Courtesy of J Keyriläinen et al, Radiology, 2008.

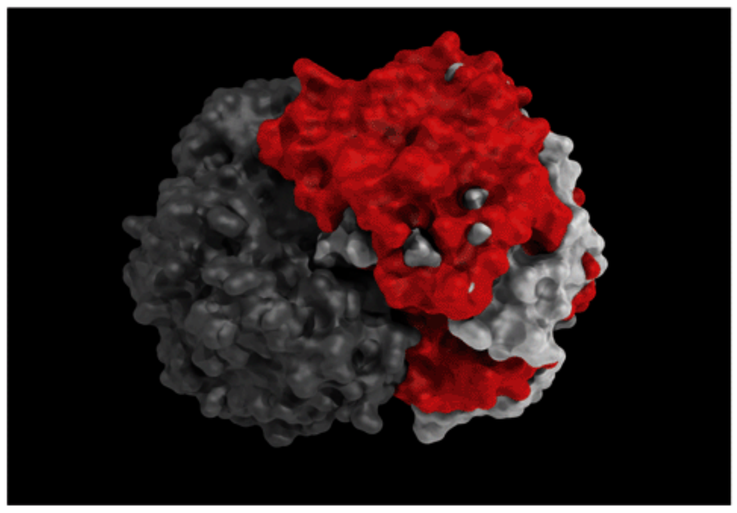
histopathology. Despite having studied only in vitro samples, the team is very optimistic that the technique will be applied in the future in clinics. Scientists hope that current worldwide development of compact, highly intense X-ray sources will enable the clinical use of this technique.

Keyriläinen et al, 2008, Radiology; 249: 321-327.

PROTEINS IN ACTION UNVEILED IN THEIR NATURAL HABITAT

Until today, scientists have managed to observe proteins' actions on crystals of the proteins by using time-resolved protein crystallography or optical spectroscopy. These techniques work relatively, although the crystals are arranged so close together that the protein cannot move freely when it changes as in real life conditions.

Scientists from ESRF, Italy, USA and South Korea have developed a new approach using SAXS-WAXS to study proteins while they carry out their function. The key of this new method is that the proteins are in solution, which is very similar to their natural habitat. The big challenge for the team was to measure small changes in a system that doesn't have the ordered structure of a crystal.



In red the structure before and in white after the transition. The part of the protein that doesn't move significantly during the transition is in dark gray. Credits: M.Cammarata.

Hemoglobin, responsible for the release of oxygen in our blood and therefore crucial for the functioning our body, was the first protein used to test this new technique. Thanks to the high photon flux available at ID09B, the team could determine the structural changes that occur from the relaxed structure of the protein to the tensed structure. They used a laser pulse to excite the protein and followed its changes with a nanosecond resolution. They surprisingly realized that the transition between one state to the other happens in 2 microseconds. This is ten times faster than what had been previously proposed through optical spectroscopy measurements.

Cammarata et al, 2008, Nature Methods, doi:10.1038/nmeth.1255.

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