Kern: This is a production by the National Institute of Biomedical Imaging and Bioengineering, part of the National Institutes of Health.

Boone: A long time ago, I was thinking about how we could better det ect breast cancer. If you really wanted to improve contrast resolution for detecting breast cancer, CT would be the way to go.

Kern: You're listening to NIBIB grantee Dr. John Boone, Vice Chair of Radiology and Professor of Radiology and Biomedical Imaging at the University of California, Davis. Boone has spent the past decade developing a dedicated breast CT scanner that allows radiologists to view the breast in three dimensions.

Boone: Rather than acquiring just two images which is what a mammogram is, we actually have an apparatus that rotates around the breast 360 degrees and it acquires 500 images around the breast, and that provides the data set necessary to put that information into a computer and it comes out with a three dimensional set of images of the breast.

Kern: The new technology could help radiologists detect hard-to-find tumors, especially in women who have dense breasts, which is commonly seen in younger woman. Dense breasts have higher percentages of connective and glandular tissue and when looking at a two dimensional x-ray of the breast, it can be difficult to view small tumors which may be located behind many layers of dense tissue. A CT scan which takes x-rays from many different angles could potentially reveal these tumors.

Boone: With breast CT, because we generate a 3D volume data set, the radiologist can scan through the images and that allows you to eliminate some of that overlying tissue and have a higher probability of detecting cancer we think.

Kern: So why aren't women currently offered a CT scan for routine cancer screening? The issue is that a conventional CT scan of the chest requires a hefty dose of radiation.

Boone: If you look at a whole body CT scanner, it scans the patients with the patient lying on the table and the x-ray tube and detectors go around the entire patient's chest which means and that means you have to turn up the dose levels to penetrate the woman's entire thorax.

Kern: When Boone first announced his intention to build a CT scanner for detecting breast cancer, his colleagues were skeptical. They said there was no way he could screen for breast cancer using CT at a radiation dose comparable to mammography. But Boone was determined, and he began to design a novel CT scanner that didn't require x-rays to pass through the chest.

Boone: The first step towards reducing radiation dose is to design a scanner that scans only the breast.

Kern: In Boone's scanner, a woman lies prone on a large table with her breast hanging through a hole in the middle. The scanner rotates just around the breast taking hundreds of x-rays without passing any through the chest.

Kern: In 2001, using a computer simulation, Boone demonstrated that his proposed breast CT scanner would deliver a radiation dose comparable to standard mammography. In 2004, his lab became the first to image humans using dedicated breast CT. Since then, Boone has scanned over 600 women in a series of clinical trials and results from these showed that breast CT is significantly better at revealing tumors than traditional mammography.

Kern: As an added bonus? Boone's scanner doesn't require compression of the breast.

Boone: Most women who have had mammograms recognize that the breasts are fairly aggressively compressed. In some women it's very painful and in others it's just sort of painful. We eliminate compression with breast CT.

Kern: With support from NIBIB over the year, Boone has continued to develop his dedicated breast CT platform by incorporating additional imaging capabilities such as positron emission tomography also known as a PET scan

Kern: In PET imaging, a patient is given an injection of a radioactive sugar molecule which quickly accumulates at tumor sites due to their increased rates of metabolic activity.

Boone: On our device, we actually do the CT scan and that gives a high- resolution anatomical picture of the breast. And then we do the PET scan and that picks up the emissions that are given off by the tumor that's accumulated this agent. Usually we color that and lay it onto the grey scale breast image and it provides a pretty dramatic image of the tumor if there's c a tumor there.

Kern: Boone is also collaborating with the University of Chicago to develop computer aided-detection software in order to help radiologists view the hundreds of images generated by a CT scan.

Boone: We're essentially asking radiologists to move from looking about two images per breast to looking at about 500 images per breast and radiologists are busy people and that would in general preclude any realistic deployment of such a device.

Kern: Their goal is to produce software that uses algorithms to automatically detect tumors and then classify them as benign or malignant, a process that could both save time and improve the accuracy of diagnoses.

Kern: Though dedicated breast CT is currently only approved for research purposes, Boone believes it won't be too long before breast CT makes it into the clinic.

Boone: There are several companies around the world that are developing breast CT scanners. They have to go through the approval process which is quite lengthy but it would be realistic to think that breast CT technology will be available in perhaps 5-8 years in the United States.

Kern: Until then, Boone and his lab will continue to improve the breast CT platform. They are currently focused on ways that CT could be used to provide real time image guidance for biopsy needle placement and minimally invasive tumor ablation.