

## Press Backgrounder

### **Philips' EchoNavigator live image-guidance tool designed to support the treatment of cardiovascular diseases, including structural heart disease repairs**

#### **Introduction**

One of the strongest and most persistent trends in the surgical treatment of disease is the transition from open surgery to minimally invasive interventions, enabling faster procedures with less patient trauma and better outcomes. Minimally invasive interventions are also allowing the treatment of patients who would not be able to withstand the trauma of open surgery.

Because minimally invasive procedures mean that doctors can no longer directly see and feel the organs they are working on, multi-modality imaging technologies (the combination of different imaging modalities) are key to guiding minimally invasive procedures. They allow visualization of the target organs and tissues, the operation of interventional instruments and the placement of implants, leading to improved chances of therapy success.

In cardiology, the combination of new interventional tools and multi-modality imaging to increase the visibility of heart structure and function is beginning to have a major impact on cardiac care, comparable to that brought about by development of the heart-lung machine.

Heart surgery dates back to the end of the 19<sup>th</sup> century, and despite continuous improvement in surgical techniques during the first half of the 20<sup>th</sup> century, it remained a highly dangerous procedure until the invention of the heart-lung machine in the early 1950s. By taking over the functions of the heart and lungs during an operation, the heart-lung machine allowed a patient's heart to be stopped for longer than a few minutes. This allowed surgeons to perform much more complex and more effective 'open-heart' procedures, one of which was the replacement of damaged heart valves by artificial valves.

In an attempt to minimize trauma, shorten the recovery period and reduce patient risk, minimally invasive techniques to treat specific heart conditions typically access the heart by feeding a catheter into the heart through the patient's major blood vessels via a small incision in the leg, shoulder or neck. Such interventions have already proved highly effective in the catheter-assisted placement of stents to treat blocked coronary arteries as well as in procedures that need to be performed within a beating heart, such as catheter ablation therapy for the treatment of abnormal heart rhythms (arrhythmias).

#### **Structural heart disease**

More recently, catheter-based minimally invasive techniques have been developed to perform structural heart disease repairs. Structural heart disease is generally referred to as any abnormality, or defect, of the heart anatomy like the septum, the wall that separates the top two chambers of the heart, or the heart valves. They may be congenital in nature (birth defects), but may also include abnormalities of the valves and the heart wall that develop with aging of the heart, or through other disease processes.

*Atrial septal defect* is one of the most common congenital heart defects. It is a hole in the septum, the wall that separates the top two chambers of the heart. Another example is *valvular heart disease*, which can affect any of the heart's four valves, i.e. mitral, tricuspid, aortic and pulmonary valve, and can interfere with the normal flow of blood through the heart. A *paravalvular leak* is a complication related to the replacement of mitral and aortic heart valves. It refers to blood leaking through an opening between the structure of the implanted valve and cardiac tissue as a result of a lack of appropriate sealing. A final example is related to the *left atrial appendage*, a small pouch which empties into the left atrium, one of the top chambers of the heart. In patients with heart rhythm disorders, the left atrial appendage may not squeeze consistently, causing the blood inside the pouch to become stagnant and form clots, which may cause a stroke. Closing of this appendage with a plug is a possible treatment, when conventional anticoagulation is not possible.

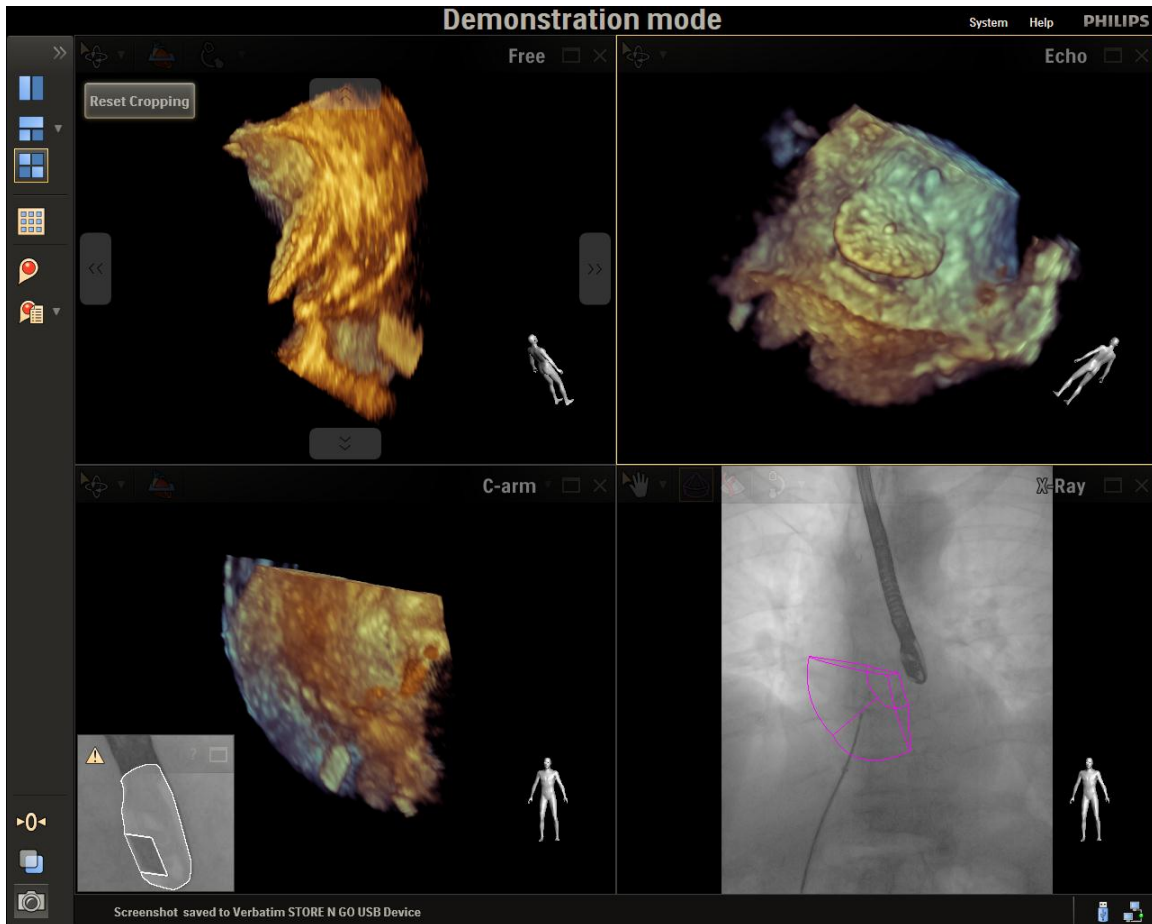
With the increasing availability of new structural heart repair devices, a growing number of these structural heart diseases will be treated using minimally-invasive procedures. The multidisciplinary team performing such procedures generally consists among others of an interventional cardiologist, a cardiac surgeon, an echocardiographer and a cardiac anesthesiologist. There is a clear upward trend towards using both X-ray imaging and 3D cardiac ultrasound imaging (also known as echocardiography, or echo for short) during structural heart disease procedures. Ultrasound imaging provides critical insights into the heart's soft tissue anatomy, while X-ray imaging has particular strengths in visualizing the implanted devices. Accurately recognizing heart structures from cardiac images takes years of training and experience, and echocardiographers and cardiac anesthesiologists bring that experience with them into the interventional suite. However, understanding the composite view requires the team to spend significant time discussing image orientation and location of anatomic structures.

### **EchoNavigator**

Working in close collaboration with University Hospital Zurich (Switzerland), University of Colorado Hospital, Denver (US) and Lenox Hill Hospital, New York (US), Philips designed EchoNavigator to address the unique challenges associated with working with live X-ray and 3D ultrasound images simultaneously, as well as the communication within the multidisciplinary team.

EchoNavigator live image-guidance tool (EchoNavigator) provides an intelligently integrated view of live X-ray and 3D ultrasound images. It automatically registers and aligns X-ray with echo, and enables echocardiographers to identify anatomic targets and mark them so they appear on the X-ray image. The interventional cardiologist can interrogate the 3D echo from any angle, without disturbing what's being seen by the operator of the Philips echo system. EchoNavigator is designed to improve control, appreciation and communication, ultimately helping to save valuable time and enhancing patient care.





*The figure above illustrates a typical screenshot of the EchoNavigator live image-guidance tool during a septal defect closure. The technology allows the integration and alignment of the X-ray image (lower panel right) with the 3D ultrasound (lower panel left) allowing for an easier orientation as well as additional real-time views: the ultrasound view as reconstructed by the echocardiographer (upper panel right) and a free 3D image that can be manipulated by the interventionalist from the table site (upper panel left). Image courtesy of Dr Carroll, Dr Salcedo, and Dr Quaife, University of Colorado Hospital, Denver, US.*

EchoNavigator unites Philips' strengths in interventional X-ray and ultrasound, as well as its strengths in clinical information solutions. Philips introduced Live 3D Trans Esophageal Echo (Live 3D TEE) technology as an industry-first in 2007 on its iE33 ultrasound system. With this technology an ultrasound scan is taken by placing a special miniaturized 3D ultrasound transducer into the patient's esophagus so that it is positioned close to the heart valves. Because space is at a premium in cath labs and hybrid operating rooms, last year Philips introduced its new CX50 xMATRIX - the world's first compact portable ultrasound system to incorporate Philips' Live 3D TEE technology.

As another example of Philips' strength in multi-modality imaging, Philips introduced HeartNavigator in 2011, a procedure planning and image guidance tool optimized for minimally invasive *aortic* heart valve replacements, also known as Transcatheter Aortic Valve Implantation (TAVI). HeartNavigator automatically aligns and overlays pre-operatively acquired CT angiography images onto the live X-ray images. This allows the

interventional team to see the progress of the guide wire, catheter and valve placement in relation to detailed anatomical structures.

### **Outlook**

Minimally invasive structural heart disease repairs are excellent examples of how interventional cardiology - catheter-based treatment of heart disease - is progressing from the relatively straightforward widening of obstructed coronary arteries to electrophysiology to treat heart rhythm disorders to more complex repairs of defective heart structures. In terms of imaging, it highlights the ever-increasing need to merge data from different imaging modalities (for example X-ray fluoroscopy with pre-operative CT, that HeartNavigator provides; or X-ray fluoroscopy with 3D echocardiography (Live 3D TEE), that EchoNavigator provides) in order to provide clinicians with the right functional and anatomical information at the right time.

Once it is shown to be as clinically effective as open heart surgery, the overriding benefit of minimally invasive procedures will be much faster patient recovery, which reflects itself in shorter hospital stays, better use of hospital resources and lower hospitalization costs. As interventional tools and medical devices become ever-more sophisticated, it is therefore logical to conclude that interventional cardiology will continue to play an ever-increasing role in cardiac care.