

# PERFORMING IMAGE REGISTRATION AT FLORIDA HOSPITAL WITH THE CARTOMERGE™ IMAGE INTEGRATION SOFTWARE MODULE

*As more electrophysiologists use the CARTOMERGE™ Image Integration Software Module, they are refining the registration process to suit their particular techniques. This is one in a series of White Papers that have been prepared to share the experts' methods.*

At the Florida Hospital in Orlando, Florida, Dr. Scott Pollak of the Central Florida Cardiology Group has been using the CARTOMERGE™ Module since early 2005. After exploring various registration methods, he and his group now routinely use the aorta for initial registration in most patients.

Dr. Pollak gains access to the aorta through the femoral artery. Starting at the level of the valve, he pulls back the catheter, acquiring approximately 20 to 30 surface alignment points with the CARTO™ XP System at disparate locations on all walls of the ascending and transverse aorta. He sets a landmark flag on a structure in the aorta, typically at the level of the valve or at the transverse aorta (at the takeoff of one of the great vessels). After setting each landmark flag on the CARTO™ XP System, he sets the flag in the corresponding area on the CT scan. Following the acquisition of surface alignment points and the placement of landmark flags, he clicks Visual Alignment on the CARTO™ XP System toolbar, causing the CT image to be superimposed over the CARTO™ XP System image. Clicking Surface Registration rotates the two images congruently, where their registration can be checked visually on the display. "This is where I notice the advantage of using the aorta," Dr. Pollak said. "It's easy to see if the curves on the aorta match up."

After saving the map of the aorta and removing the images from the screen, Dr. Pollak maps the left atrium with the CARTO™ XP System, where he acquires another 20 to 30 disparate points. He also puts a tag at the ostia of all of the pulmonary veins that can be visualized with the intracardiac ultrasound, for later validation of the registration process. He then opens the CT scan of the left atrium and displays it with the CARTO™ XP System image of the left atrium. Surface registration is then performed on the CARTO™ XP

System and CT images of the left atrium. Although the aorta was used for visual alignment, it is not necessary to display it to perform surface registration of the left atrium. He looks at the surface registration statistics and the tags on the pulmonary ostia determined by intracardiac ultrasound to validate the registration.

Therefore, Dr. Pollak does not rely on the displayed statistics alone. "We also use intracardiac ultrasound for validation, looking at how closely the tags at the ostia of the pulmonary veins match up with the corresponding areas in the CARTOMERGE™ Module image. This provides an independent external reference to validate the accuracy of the registration," he said. He recommends validation of the accuracy of each registration using intracardiac ultrasound, fluoroscopy, electrograms, angiograms, or impedance measurements at known anatomic locations.

## **Alternatives to Aortic Registration**

The aorta is not an appropriate site for initial registration in all patients. "We use aortic registration in younger patients, aged 20 to 50 years," Dr. Pollak said, "and in patients who appear to be at low risk for having vascular disease." An initial transesophageal echocardiogram is performed on all patients to look for disease in the ascending aorta; if any sign of plaque or calcification is observed, another method is used. Dr. Pollak estimates that he can safely perform aortic registration in about 80% of patients. "We've had no complications," he added.

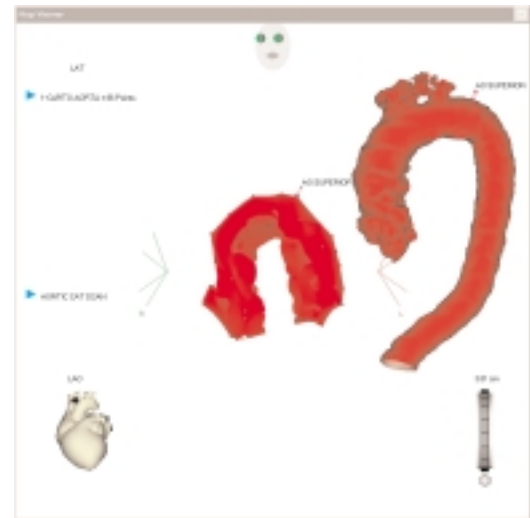
When aortic registration is not appropriate, Dr. Pollak often uses the left atrium for registration, setting the CARTO™ XP System and CT landmark pairs at the ostia of the veins. He also places tags there for intracardiac ultrasound validation. After clicking Landmark Registration, he obtains 20 to 30 points in the left atrium

and clicks Surface Registration. Dr. Pollak noted that his technique for left atrial registration is probably similar to that used by many other physicians.

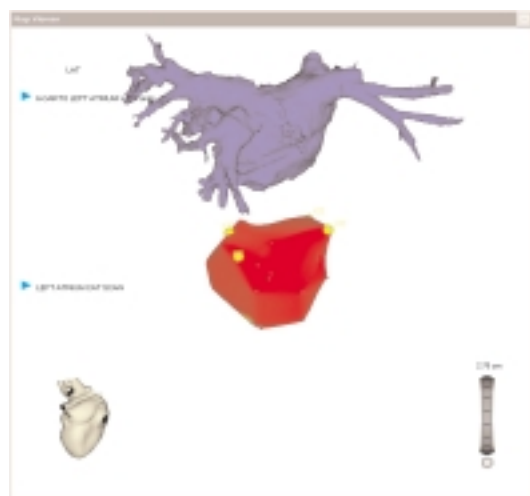
A third approach to registration is to use the pulmonary artery for landmark registration. Dr. Pollak acquires points from the main pulmonary artery and from the left and right trunks of the pulmonary artery in a process similar to that used in aortic registration. "We do landmark registration in the pulmonary artery, then import the left atrium and acquire points, and finally do surface registration," he summarized. Dr. Pollak's group is conducting a study to identify the most accurate registration method. The aortic, atrial, and pulmonary arterial registration methods are used and compared in each patient in the study.

Dr. Pollak offered additional tips for efficient registration. "The ridge between the left atrial appendage and the superior pulmonary vein is an easy structure to identify," he noted. "If you have your catheter on the ridge and you advance it anteriorly, the catheter slips into the appendage, while pulling it posteriorly puts it into the vein. At that point, you can easily compare your position to the CT image," he said. "I'd also advise people not to repeat surface registration in the same area," he continued. "Too high a density of points in one area can adversely affect accuracy of the overall map."

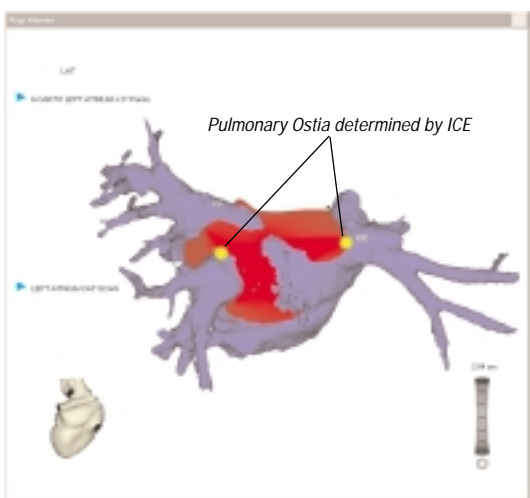
The CARTOMERGE™ Module helps to define the anatomy and integrate that definition into clinical procedures, Dr. Pollak said. Having the anatomy displayed is particularly useful between the left superior pulmonary vein and the atrial appendage, in the area between the superior and inferior veins, and in defining the carina between the middle and superior or middle and inferior veins. "You know where you are in the anatomy," he concluded.



*CARTO™ XP System Map and CT of the Aorta*



*CARTO™ XP System Map and CT of the Left Atrium pre-registration*



*Registered CARTO™ XP System Map and CT of the Left Atrium*