

## Case Study: Live in 3D

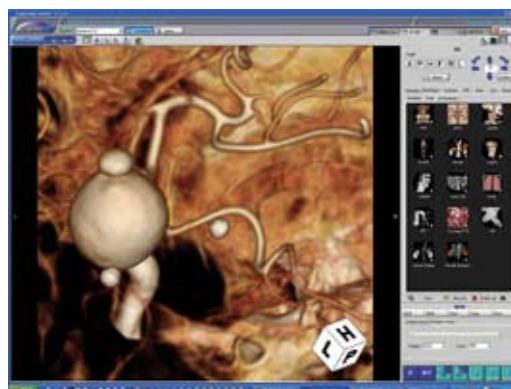
By Desiree Mitchell

### Kettering Medical Center makes 3-D imaging a modality

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Charles F. Kettering Memorial Hospital (also known as Kettering Medical Center), part of Ohio's Kettering Medical Center Network, is one of more than 300 medical centers in the United States that has implemented a dedicated 3-D imaging server to deliver interactive 3-D imaging and advanced clinical applications to its radiologists and physicians, wherever they are, at any time. According to Kettering Medical Center physicians, 3-D images enable radiologists to better diagnose patients and resolve physicians' and patients' problems quickly. In fact, in less than a year, Kettering's radiologists are so impressed by the performance of the AquariusNET™ server from TeraRecon Inc., San Mateo, Calif., that even orthopedic physicians are starting to use the system to aid in improved patient diagnosis.

“For years we had acquisition technologies in place to do 3-D imaging, we saw the benefits, but we didn't use them very often because there was always that one missing piece: an efficient clinical workflow solution,” says Bilal Ezzedine, PhD, program director of imaging research, department of radiology, at Kettering Medical Center. “We did not have the correct technology to handle the workflow, and there wasn't anything available on the market to help solve this problem.”



*Volume rendering is performed on the central server with results streamed interactively to multiple independent remote clients concurrently.*



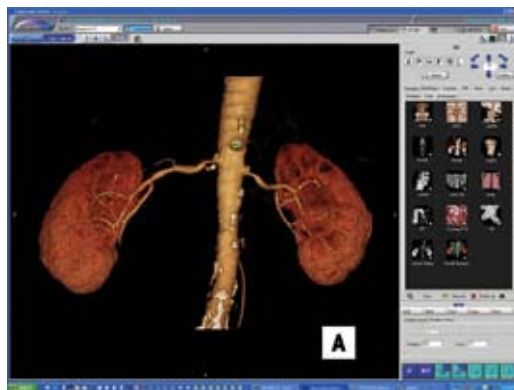
*Tibial plateau fracture rendered simultaneously in four different volume rendering modes.*



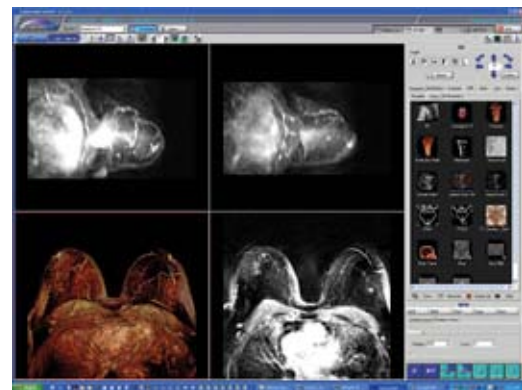
*Tibial plateau fracture rendered simultaneously in four different volume rendering modes.*



*For coronary CTA review, the thin Client software provides a set of appropriate templates, to be used with curve editing and cutplane tools. Vessels can be investigated in detail by performing a curved planar reformat (CPR) view as illustrated here in the right-hand window.*



*CTA of the renal arteries can be reviewed with color volume rendering as illustrated here, after freecurve editing has been used to remove incidental structures and non-relevant vasculature.*



*The thin-client application can be used to load multi-phase, time-dependent MRA acquisitions with hundreds of slices, to a regular PC. Real-time 3-D rendering and MIP imaging can then be applied, and time-density curves calculated to investigate the uptake and washout of contrast medium.*

Many organizations using large thin-slice CT and MR studies and 3-D imaging can relate to Ezzedine's frustrations and the issues he and his organization experienced with post-processing and clinical workflow issues.

Ezzedine explains that using 3-D workstations would slow down the regular work pattern of Kettering's radiologists because they would have to leave their work area to view the source scans at a single workstation on the floor, rather than being able to pull up the scans and review them from their location.

"Leaving your workstation to view a patient's image at a single workstation on the floor would take 20 minutes by itself," says Ezzedine. "It just didn't make sense for the physician or patient waiting."

### **The Age of Aquarius**

In May 2004, Ezzedine and his team discovered the solution they needed to support their imaging needs: a 3-D enterprise server and thin-client solution with integrated 3-D processing tools and optimized clinical workflow all in one system. This technology is the AquariusNET server.

AquariusNET employs a central shared server/thin-client approach using regular networked PCs and special purpose real-time volume rendering engines called VolumePro. A hospital can use its existing personal computers (PCs) networked to the central server to deliver 3-D applications anywhere. A license for unlimited use is included, so any PC and/or any number of PCs can operate as a free client on the network.

AquariusNET integrates a suite of advanced 3-D applications and processing tools into the hospital's existing clinical workflow and can operate within any existing PACS, using any large thin-slice CT or MR equipment available on the market.

"The technology is unique in that post-processing can be done quickly and easily," says Ezzedine.

In addition to the combination of enterprise server technology and thin-client PCs used by the radiologic technologists, Kettering has a radiologist with an extensive background in anatomy dedicated to image post-processing prior to the physician receiving them – a key to making their 3-D imaging program a success.

"Thousands of CT images are pushed to the server by our super-technologist," says Todd Smiley, manager of medical imaging at Kettering. "This enables our radiologists to visualize, manipulate and analyze

the 3-D images, eliminating the need to ship the images to a destination workstation to look at them. Instead, all of the images reside on the server and any physician or radiologist has access to review these images from any PACS workstation or regular PC – even from home over a DSL or cable modem connection."

The system allows any authorized physician at Kettering to download the thin-client application over the Internet since the application file residing on the PC desktop is only about three megabytes. No other software is needed since images are processed on the server, and only the results are streamed to the remote PC, based on incoming PC mouse commands. Physicians at home or at other facilities use a virtual private network connection to access the central server from wherever they are located.

According to Ezzedine, one of the major benefits is having the whole-volume CT angiography (CTA) and MR angiography data set available on the server so the radiologist or physician can look at the static axial images, as well as interactively manipulate the original slices or volume data remotely in any plane. Oblique reformats, 3-D volume reconstructions, slab maximum intensity projections, sagittal, axial and coronal reformats are supported in multiple screen formats. A physician can easily take a closer look at a particular heart chamber, small vessel or region of interest by segmenting the vessels and arteries



*For neuroradiology applications, fast, efficient 3D visualization is a key tool for understanding an examination and reaching a diagnosis with confidence.*



*By using the AquariusNET server, the MIP processing can be performed on-the-fly in real time, providing the radiologist with complete control and removing the need for time-consuming additional processing at the scanner by the technologist.*

with just one click of the mouse. Multiple PC clients can connect to the central server and conduct interactive sessions concurrently. These concurrent user sessions are restricted only by the limit of available server computer resources.

Kettering is only one of a few hospitals in its network using the AquariusNET server technology to interactively view 3-D images. Other Ohio-based hospitals include Grandview Hospital and Medical Center and Southview Hospital, Dayton. These hospitals are recognized as some of the best in Ohio, especially for stroke care, respiratory disorders and overall clinical excellence, in part, by the use of the best imaging technology available. In fact, Kettering has had 3-D technology and workstations for many years to help better diagnose patients and resolve physician and patient problems.

### **Go with the Workflow**

Super-technologist Tom Kracus, RT(R), 3-D reconstruction imaging specialist at Kettering, is the brains behind the scenes, similar to the wizard behind the curtain in "The Wizard of Oz." His primary responsibility is to review the images sent to the server, perform post-processing and push the images back to the server for the physician to access. He also has the ability to interactively manipulate the images and send them to the PACS archive. At Kettering, Kracus has a set protocol workflow so the radiologists can receive the images almost immediately and manipulate them for review.

"We have the workflow down to a science and the system is very fast," says Kracus. "When I am finished doing what I need to with the images, the radiologist can review the images quickly and continue with their reading volume." This standard workflow reduces the physician's interruption so that he/she can focus on reviewing scans.

"We began with the server system by using it to zero in on vascular work," says Kracus. "We do a carotid CTA instead of a carotid angiogram, which only takes about five minutes. Now, a patient leaves the hospital within 15 to 20 minutes versus six hours. And the patient leaves with a band-aid instead of having a more invasive procedure."

According to Ezzedine, he and his team encountered only one problem with the technology, but it was simple to fix. "The physicians and radiologists within the network of hospitals needed to be sold on the utilization and value of the system," he explains. Kettering Medical Center's physicians knew the technology was worthwhile, but they dealt with workflow problems in the past. "I got in a marketing mode to get the physicians up to speed with the improved 3-D imaging system. And now, the orthopedic physicians are even beginning to use the system. We are also looking to install workstations in surgery and the ER. The utilization of the system is now selling itself," Ezzedine says.

### **Working in Real Time**

Other benefits the central server system brings are its real-time speed and easy access of information. According to Ezzedine, correlating all CT and MR images is important but the PACS system is not built to handle all of the slices coming off the

scanners. The enterprise server/thin-client technology is able to handle thousands of slices acquired from a CT, even multiphase or gated studies. It can handle hundreds of megabytes per study and store them without difficulty.

"A typical run-off is 800 to 900 slices from a 16-slice scanner," says Ezzedine. "In the past, it was impossible for a radiologist to browse through these axial slices [one at a time] because the system and reading room would become backed up. Now the technology is finally available to handle enormous amounts of slices."

In addition to streaming the image results from the server over the network, the images can be burned onto a CD. "There are times when a patient leaves to go out of state to have surgery and he or she may need to bring their images with them," says Smiley. "We can easily download and burn all of the patient's images to one CD so that the patient can take it with them and give it to the next physician. We can also burn CDs for situations like network access failures or to help support clinical studies and white papers."

## Selling the Idea

In the beginning, Kracus and Ezzedine had to help market the system internally to Kettering Medical Center Networks' physicians and radiologists, and this included the word the industry most dreads: training.

According to Steve Sandy, vice president of marketing, TeraRecon, "The client interface itself is a simple and easy-to-use tool. We purposely created an intuitive interface that is extremely user-friendly. The physicians require interactive tools that are easy to understand and simple to use, without having to read a user manual – one of the key goals when we created AquariusNET. It's a mouse-driven interface without drop down menus, which people get comfortable using after regular use."

According to Sandy, there are physician/technologist 3-D imaging workshops offered monthly by the University of Florida – Shands in Jacksonville. These four-day hands-on training workshops are dedicated to teaching advanced clinical applications and the efficient use of 3-D post processing tools, including the AquariusNET server-client system.

Sandy recommends that physicians and technologists new to CTA, MRA and post-processing techniques go through this hands-on training course because it gets them out of the hospital setting so they can focus on understanding advanced 3-D post processing techniques and efficient methods for reviewing CTA and MRA studies.

## User Friendly

Easy installation also adds value to the system. "Installation was virtually seamless," says Ezzedine. "I believe we were installed within two days, and then Tom was off and running with his part by the third day. Plus, any scanner can be used to push data to the server, making the system user friendly with all manufacturer imaging systems."

Recently, Kettering Medical Center linked their MR system into the enterprise server, adding onto its current CT 3-D imaging capabilities. The product was developed for post-processing of CT and MR data, but you can virtually view other modalities too such

as ultrasound, computed radiography, digital radiography and PET and nuclear medicine. "Physicians have been ordering angiograms for 50 years, so we were starting 10 cases a week – and now we are up to 40 cases a week, says Kracus."

"One thing that is nice to hear is that the physicians at Kettering Medical Center are treating 3-D imaging like any other modality and not as an accessory," Kracus continues. "That's where other institutions struggle because they treat 3-D imaging as an accessory to a CT or MR."

Smiley agrees. "I think this is one of the main reasons why Kettering Medical Center is so successful," he says. "Until now, we were proven wrong about 3-D technology. We always knew that

3-D imaging was the way we wanted to go, but we didn't have the support nor did we have the technology. Now, we have both."

Desiree Mitchell is a Washington-based freelance writer. Questions and comments can be directed to [editorial@rt-image.com](mailto:editorial@rt-image.com).

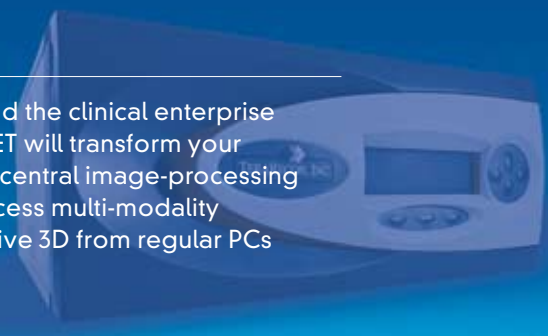
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# AquariusNET

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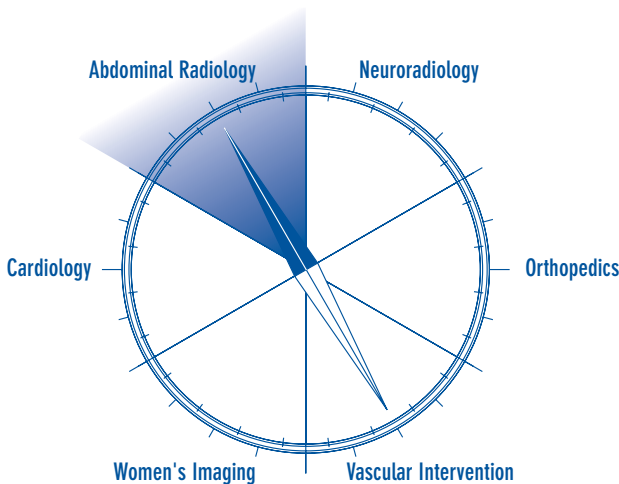


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