University of Virginia speeds up cardiac imaging with IBM.

Overview

- ***Challenge***
  Support compute- and data-intensive biomedical engineering research at one of the world's leading academic institutions
- ***Solution***
  Deploy high-performance Linux® clusters based on IBM @server® xSeries® and pSeries® with IBM software and consulting
- ***Key Benefits***
  Enhanced research productivity in modeling biological systems; lower IT support costs for server and storage infrastructure; scalable IT environment to meet future needs; increased utilization of servers with grid computing model

Cardiac MRI researchers at U.Va. are fighting heart disease with an innovative diagnostic technique developed with IBM hardware and Linux.

A patient comes into the emergency room (ER) complaining of chest pain. In minutes, the attending physician views a real-time, high-resolution image of the patient's beating heart and diagnoses a heart attack in progress. The patient is rushed to the operating room — and a life is saved.

Innovative diagnostic techniques are just one research area at the University of Virginia (U.Va.). Founded in 1819 by Thomas Jefferson, U.Va. is recognized as one of the world's top academic institutions.

"Combining deep scientific understanding and IBM's expertise in information technology, IBM Healthcare and Life Sciences helped us design a system to handle our data-intensive applications."

– Dr. Thomas C. Skalak, Chair of Biomedical Engineering, the University of Virginia

IBM @server Cluster 1350.

U.Va.'s Department of Biomedical Engineering is quickly earning a reputation as a leader in the emerging new field of biomedical engineering. The department has been awarded numerous grants from the National Institutes of Health and other organizations to develop diagnostic techniques for diseases that cause millions of deaths each year.

Poised at the intersection of biology, medicine and computer science, biomedical engineering depends on sophisticated computing to model and render images of biological systems. To boost U.Va.'s research capabilities, the School of Engineering and Applied Science and the School of Medicine recently undertook a multiphase upgrade of the departments' information technology (IT) infrastructure, partially funded through IBM's Shared University Research program, which awards equipment to promote research in areas of mutual value and interest to IBM and universities. The IT infrastructure now features clustered Linux servers, researcher workstations, a storage area network (SAN) and a two-tiered storage sub- system, all based on IBM technology. "Our IBM-powered infrastructure is absolutely vital to the success of U.Va.'s biomedical engineering research," says Dr. Mitchel C. Rosen, chief technology officer for the School of Engineering and Applied Science.

> *"We rely on the performance that we get from our IBM infrastructure to perform our compute-intensive biomedical engineering research."*
>
> *–Dr. Mitchel C. Rosen, Chief Technology Officer, School of Engineering and Applied Science, the University of Virginia*

Real-time cardiac imaging to save lives

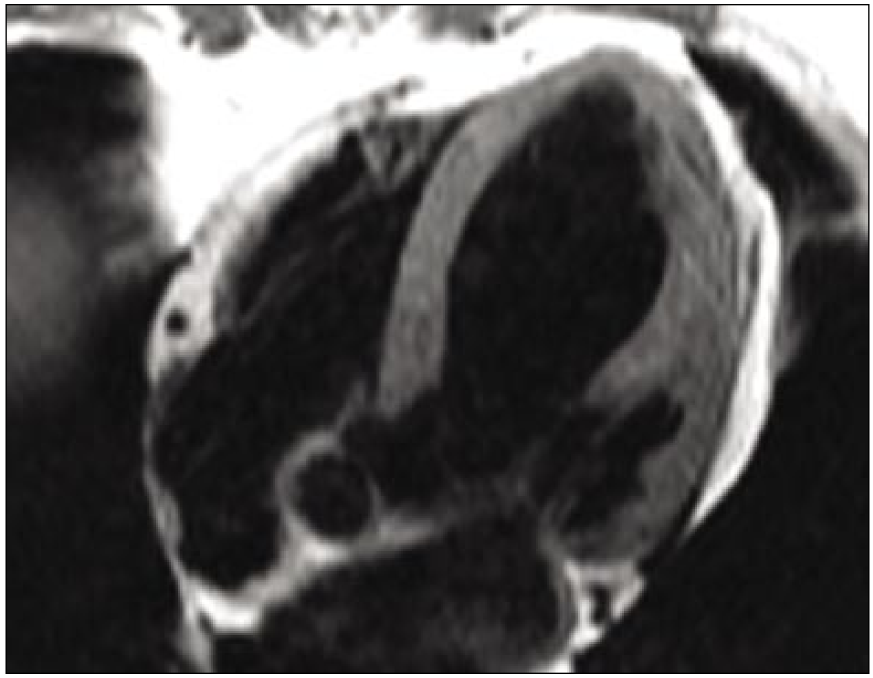
Taking on humanity's major killers is a challenging task, and no one knows that better than Dr. Thomas C. Skalak, chair of the Biomedical Engineering Department at U.Va. "Our research focuses on cardiovascular disease, inflammation, diabetes and cancer," says Skalak. "Sophisticated modeling and imaging algorithms are required to understand these disease processes, which is necessary in order to develop diagnostic techniques and more effective treatments."

U.Va.'s research has been particularly successful in real-time cardiac imaging using cardiac magnetic resonance (CMR). Using the basic technology of magnetic resonance imaging (MRI), CMR is targeted for more time-critical and portable applications. According to Dr. Christopher M. Kramer, M.D., Associate Professor and division head for Cardiac Magnetic Resonance Imaging in U.Va.'s Department. of Radiology, "Real-time cardiac imaging shows great promise in the ER because of its higher resolution and shorter imaging times. It can detect small heart attacks affecting just a fraction of the heart muscle. CMR works better with patients who may not be able to hold their breath or remain still for long periods as required with traditional MRIs."

U.Va. is one of the first locations worldwide to install high-performance computing clusters dedicated to image reconstruction for 32-channel MRI, a technique that contributes to more accurate diagnoses and treatments. Building a practical CMR device requires a huge leap in the ability to move, store and process data. CMR achieves its high resolution by using 32 or more data detectors compared to just four in standard MRI devices. Handling this greater than eight-fold increase in the volume of data is the central challenge of real-time cardiac imaging. Since mainframes are not practical in ERs and rescue vehicles, U.Va.'s researchers instead are experimenting with parallel computing using multiple smaller servers. That's why U.Va. turned to IBM.

Benefiting from IBM's investment in life sciences

Skalak points to the strong commitment IBM has made to life sciences as a plus for U.Va. "IBM sends some of their most experienced people from all around the world to survey the state of research in compute-based life sciences," Skalak says. "Combining deep scientific understanding and IBM's expertise in information technology, IBM Healthcare and Life Sciences helped us design a system to handle our data-intensive applications."



Four-chamber long axis MR image of the heart. The heart muscle of the left ventricle (the major pumping chamber) is gray and the blood is black on this image.

Move to Linux computing creates challenges and opportunities

Just as biological systems respond to changes in their environment, so do computer users. Over the past 10 years, the department has experienced an evolution in its computing infrastructure as more and more faculty members and graduate students embraced Linux for its high availability and lower cost. However, individual procurements had created a heterogeneous mix of workstations, servers and software distributions that was expensive and time-consuming to support. "We decided to standardize our server and workstation platforms on IBM @server xSeries and Red Hat Enterprise Linux to simplify support while providing the performance our researchers needed," says Rosen.

An infrastructure for the demanding needs of biomedical engineering

The IT infrastructure features a total of 34 IBM @server x335 servers clustered with IBM Cluster Systems Management for Linux. Six @server x345 servers manage the clustering and storage. IBM General Parallel File System (GPFS) for Linux manages the clustered file system. U.Va.'s xSeries servers are based on Intel® Xeon® processors. "The x335 servers deliver a great deal of computing power in a small form factor, perfect for our tight space," says Rosen.

Researchers in the Department of Biomedical Engineering now exploit the multiprocessor computing power of IBM IntelliStation® Z Pro 3D workstations to run their data acquisition and analysis applications. "The IBM IntelliStation Z Pro 3D workstations give us the local processing power needed to render large images of biological systems," Rosen says.

To meet the department's voracious needs for storage space, the schools of Engineering and Medicine installed a SAN with an IBM 2109 Fibre Channel Switch and IBM TotalStorage® FAStT 500 Storage Servers. Data from the on-campus data center is backed up to an IBM TotalStorage 3584 L32 Tape Library and mirrored at a disaster recovery site featuring an IBM TotalStorage 3584 D32 Tape Library. Both sites use IBM Tivoli® Storage Manager to manage backup and restore operations.

Leveraging IT investment through grid computing

With the new infrastructure in place, U.Va. is moving to the next phase, which includes a grid computing model. Grid computing will benefit U.Va. by increasing the utilization of computing resources across the university. For example, the MRI lab has eight xSeries servers to handle the high data-throughput requirements of real-time image acquisition. However, image acquisitions take up a small fraction of the average day, so most of the time, these servers are lightly used. By making them available to other biomedical engineering researchers over the grid, U.Va. will significantly increase their level of utilization.

The future of biomedical engineering at U.Va.

"Engineering That Makes a Difference" is the motto of U.Va.'s School of Engineering and Applied Science, and the Department of Biomedical Engineering is living up to it with help from IBM. IBM is working closely with U.Va. on a second phase that will double the department's computing power and help the university establish a radiology/cardiology center of excellence. Whether developing a prototype of a handheld ultrasound machine or performing multicell modeling of the formation processes for new blood vessels, U.Va. researchers depend on IBM. According to Rosen, "We rely on the performance that we get from our IBM infrastructure to perform our computer intensive biomedical engineering research."

For more information

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