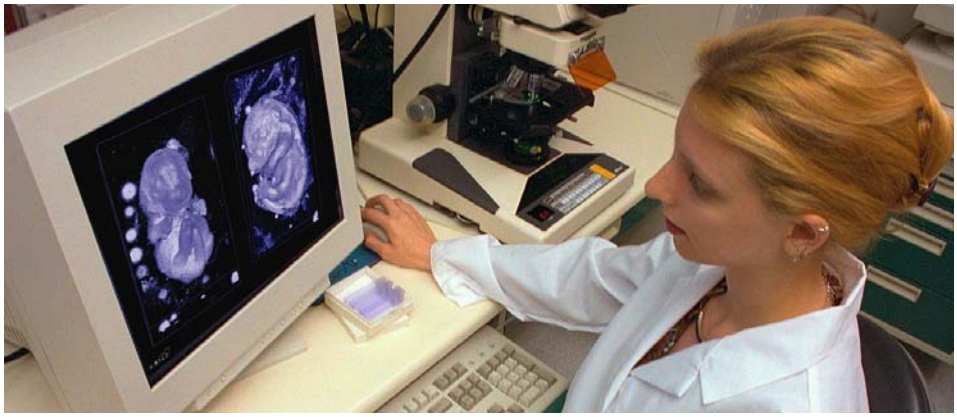
Success Story

The Mouse Imaging Centre at Sick Kids



"We chose SGI as our computing partner because we were looking for a system to process and visualize large 3D image datasets without the complexity of a distributed message passing cluster architecture. The combination of a 64bit operating system, NUMA shared memory, and large texture memory for rendering addressed these needs."

– Dr. John Sled, Scientist, Sick Kids

Improving Medical Research with Advanced Visualization

Put the words "kids" and "mouse" together, and you will likely think of a four-fingered animated Disney character that has entertained children for generations. But put those two words together at The Hospital for Sick Children (Sick Kids) in Toronto, and you'll discover a place dedicated to solving some of the world's most complex medical mysteries.

SGI and the Mouse Imaging Centre (MICe)

At the Mouse Imaging Centre (MICe), housed at Sick Kids, researchers are studying the genetic makeup of these little creatures, hoping that an understanding of the biological changes that occur with certain diseases can prevent similar illnesses in humans. Eventually, the work being done there may allow not just kids, but people of all ages to enjoy a better quality of life.

MICe is one of only 12 institutes in the world engaged in phenotyping, the measurement of behavioral, physiological and biochemical traits. Since this research involves extremely large data sets of scanned mice images and a team of geographically distributed researchers, MICe administrators realized that they needed a system that could provide rapid visualization as well as accommodate remote access and collaboration. Their solution: a Silicon Graphics® visualization system with Visual Area Networking (VAN) technology. While the advanced visualization capabilities of the SGI® Onyx® visualization system enables large numbers of scans to be processed in a minimal amount of time, the VAN technology provides anytime, anywhere access to allow researchers to analyze these scans efficiently.

"We chose SGI as our computing partner because we were looking for a system to process and visualize large 3D image datasets without the complexity of a distributed message passing cluster architecture," explained Dr. John Sled, one of the Centre's scientists, and an assistant professor of Medical Biophysics at the University of Toronto. "The com-

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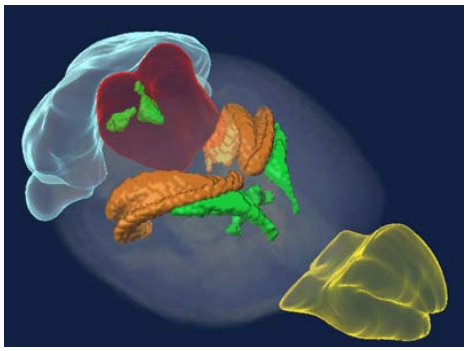

Image analysis, brain

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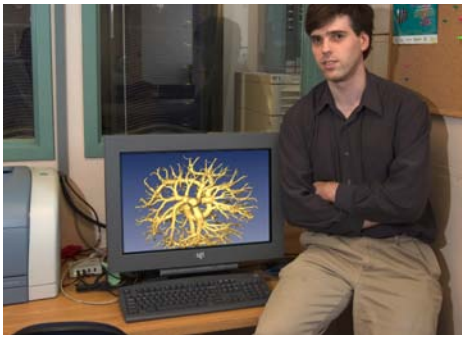
Why Mice?

The mice are studied to learn about human disease because while humans and rodents couldn't look any more dissimilar, the two species actually share an extraordinary amount of genetic code. In fact, 99% of human and mouse DNA is homologous, or shared. Also, since mice are highly inbred, with research some strains mated with their siblings for hundreds of generations, there is much less anatomical variation between animals than in a wild population. This allows scientists to use medical imaging techniques to identify subtle genetic changes as diseases first develop. After inducing a human disease in a mouse, the SGI Onyx visualization system is used to analyze the scans to study changes that take place.

The Phenotyping Process

Mouse brains are scanned using MRI, or magnetic resonance imaging, which gives researchers three-dimensional images of soft tissue. X-ray computed tomography is also used to examine the patterning of blood vessels and structure of bone.

Each mouse scan takes up to three hours to complete and contains 1GB of data. To reduce that time, mice are typically anaesthetized and then scanned in groups of 4-16, generating large multi-gigabyte data sets. To attempt to analyze the information and then construct viewable and highly-complex three-dimensional models with extensive surface detail could take days using standard desktop workstations.



Dr. John Sled, Scientist, Sick Kids

Micro-CT, skull

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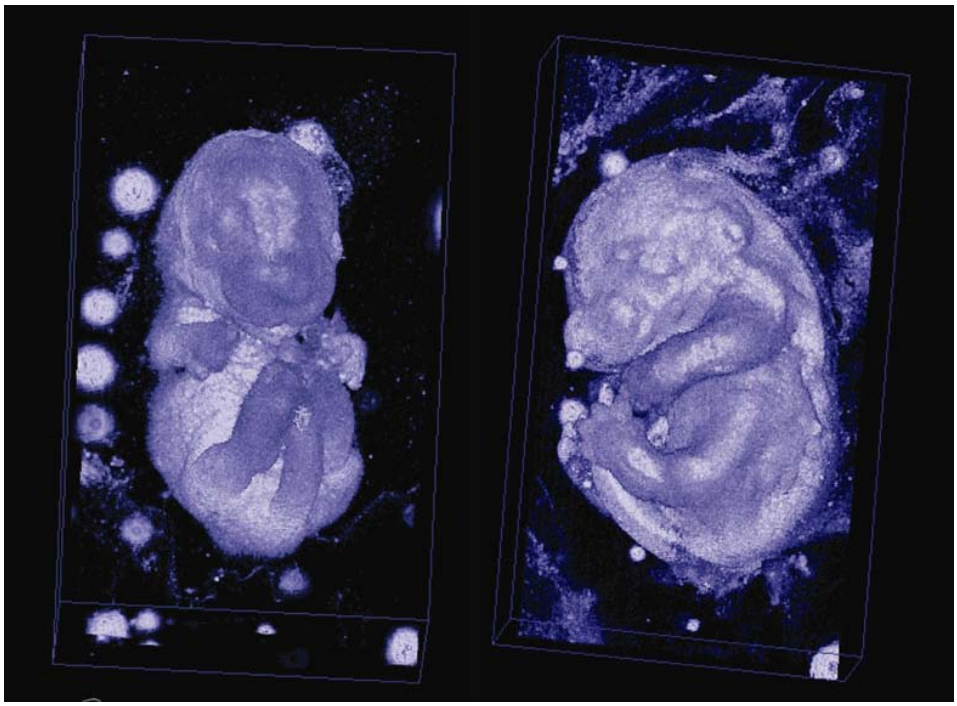

UBM, embryo

Enabling High Resolution Scan Analysis

"We selected the SGI Onyx 3800 to cope with the demands of analyzing thousands of high resolution 3D mouse MRI datasets, said Dr. Sled. The MICe solution from SGI includes an Onyx® 3800 visualization system, with 32 CPUs, 32GB of RAM, 5TB of storage, and the InfiniteReality4™ graphics pipes. The new Onyx solution was installed as an additional part of the hospital's Origin® 3800 cluster located in another part of the facility, a configuration that included 192 processors, 178GB of RAM, and 3 terabytes of storage.

In addition to the Onyx system's advanced graphics capabilities, its NUMA (non-uniform memory access) architecture enables the allocation of memory between physically-separated components to provide the scalability needed to interact with large data sets. It provides high memory bandwidth and low memory latency. Using this approach, bottlenecks between graphics, video, and storage are avoided. One application can drive as many as 16 graphics pipes, creating three-dimensional models in record time.

Leveraging the Power of Networked Visualization

At MICe, researchers needed the ability to view the scanned images and collaborate with colleagues regardless of where their offices were located. By centralizing the location of the Silicon Graphics visualization system, a VAN solution could be used to provide on-demand access to data and visualization resources over the MICe local area network (LAN). Instead of moving data sets and applications between locations, researchers are now able to use thin clients such as laptops, workstations or even wireless tablets to access and control resources remotely.

For its visualization software, the MICe chose the amira solution from TGS, a division of Mercury Computer Systems.

Micro-CT, placenta

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This cross-platform package helps users gain detailed insight into data through the use of interactive segmentation tools that create polygonal models.

With SGI's VAN software software on the visualization system and client, only rendered images are compressed and sent across the network, saving time and bandwidth while providing real-time interactivity with these imaging applications.

"Thanks to the VAN capabilities of our installation, our staff can examine our models in real time, no matter where they are physically located or what type of PC they're using," noted John Cargill, MICe's senior systems architect.

Research, Collaboration and Discovery

Among the studies currently underway, the Mouse Imaging Centre hopes to discover genetic components to heart disease. In collaboration with Dr. Benoit Bruneau at Sick Kids, using optical projection tomography, a technique developed at Edinburgh's Medical Research Council's Human Genetics Unit, three-dimensional models of the fetal mouse hearts are examined for evidence of congenital vessel and organ malformations.

"This study is of particular interest to us," said Dr. Sled. "It suggests a new mechanism for regulating the transcription of genes into protein during heart development. When suppressed, the resulting defects in the mouse heart resemble a type of congenital defect seen in humans."

In addition, the Centre has ongoing studies of various heart malformations, brain cancers, and neurological conditions, including schizophrenia.

"SGI has a very strong presence in the medical community. With an existing SGI installation at Sick Kids, and another at the Montreal Neurological Institute, we joined an active user community," Cargill explained.

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