The "Child Mummy" Project

A collaborative effort between Silicon Graphics Inc., Stanford University, the Stanford-NASA National Biocomputation Center, Medical Modeling LLC and the Rosicrucian Egyptian Museum & Planetarium

Background Information

August 3, 2005

Photo courtesy the Rosicrucian Egyptian Museum & Planetarium

Medical Modeling LLC has teamed up with researchers at Stanford University Hospital (Palo Alto, CA), Stanford-NASA Biocomputation Center (Palo Alto, CA) and Silicon Graphics (Mountain View, CA) to find out more about a mummy with an unknown past. The mummy, belonging to the Rosicrucian Egyptian Museum & Planetarium in San Jose, Calif., is believed to be that of a four to six year old child who lived around the time of Christ. Researchers have spent the last several months working on unraveling key details about the child mummy named Sherit, an ancient Egyptian name that means "little one", a name given to the mummy by the museum's curators. Today at Silicon Graphics' headquarters in Mountain View, Calif. the findings are being announced with an immersion into the data which allows for an unprecedented look at this ancient artifact.

On May 6th 2005 the mummy, long owned by the Rosicrucian Egyptian Museum and Planetarium, traveled to Stanford University Hospital to be imaged using computed tomography (CT) and other non-invasive medical imaging techniques. Researchers at Stanford took over 60,000 images of the mummy in one day, what is believed to be the largest series of scans ever performed on a mummy. Since then researchers at Silicon Graphics have been working to unravel some of the unknowns surrounding this mummy, still wrapped after 2000 years.

Medical Modeling LLC was contacted by Drs. Stephen Schendel and Paul Brown, of the Stanford-NASA Biocomputational Center, to take part in the project. Using the high resolution CT scan data the company has produced a series of life sized models that serve several purposes including: 1) a basis for forensic facial reconstruction by the group at Stanford and 2) providing a physical complement to the dazzling computer graphics generated by SGI. Two main types of models have been produced. The first shows the mummy's skull and allowed the forensic team to add clay to the model creating a likeness of what the young girl might have looked like in life. This model allowed for the most accurate facial likeness to be sculpted based on the bone structure revealed through CT imaging. The second, more elaborate model combined data from the CT scans as well as high-resolution digital photographs to incorporate the external appearance of the cartonnage, in full color, along with the mummy's bone structure yielding a striking view of the mummy's skull within the layers of wrappings. This model took unique advantage of full-color printing, something only recently possible with advanced manufacturing machinery.

sgi

ROSICRUCIAN EGYPTIAN MUSEUM & PLANETARIUM

MEDICAL® MODELING

Medical Modeling LLC
17301 West Colfax Avenue, Suite 300
Golden, Colorado 80401
Toll Free: 888/273-5344
Phone: 303/273-5344
Fax: 303/277-9472
Web Site: www.medicalmodeling.com
E-mail: info@medicalmodeling.com

The "Child Mummy" Project

A collaborative effort between Silicon Graphics Inc., Stanford University, the Stanford-NASA National Biocomputation Center, Medical Modeling LLC and the Rosicrucian Egyptian Museum & Planetarium

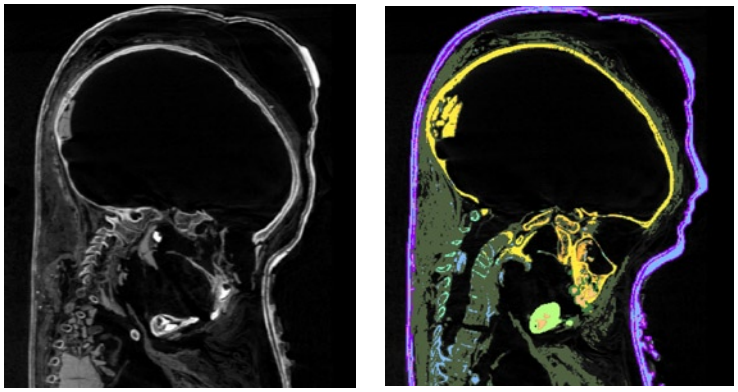
Step 1: Data Imaging

August 3, 2005

For the project, radiologists at Stanford University School of Medicine used an AXIOM Siemens scanner, one of only five CT scanners in the world capable of producing such high-resolution images. Stanford Radiology's state-of-the-art scanner generated 2D slices as thin as 200 microns – several times thinner than the 750-micron slices used to create the popular 3D visualization of King Tutankhamen's mummy. In fact, at 92GB, Stanford Radiology's child mummy scans generated nearly 35 times more information than the scans conducted on King Tut.

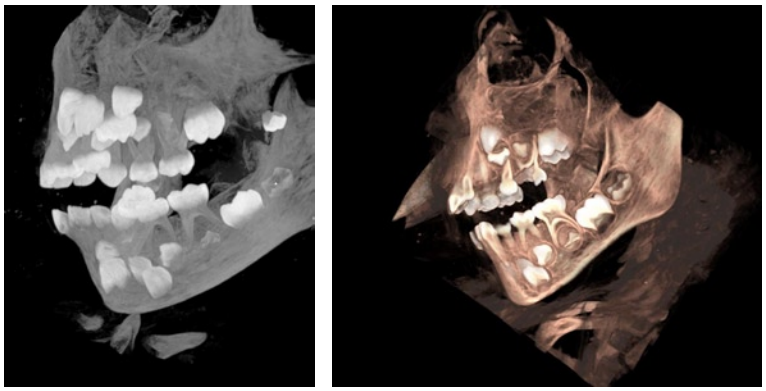
A portion of the CT data was sent to Medical Modeling where advanced computer design tools were applied to design unique physical replicas. Further processing of the images was carried out for identification of various anatomical structures shown in the CT data. This task was performed by biomedical visualization specialists at Medical Modeling and Stanford.

The images below show portions of the CT data in both 2D and 3D format.



Sagittal "slices" through the mummy show bone, wrappings, soft tissue and the outer mask. The image on the right shows the selection process using color to define boundaries of objects. Image courtesy Medical Modeling LLC.

A volumetric 3D reconstruction of the sliced images. Image courtesy Stanford University.



Two volumetric 3D reconstructions with particular focus on the teeth. Image courtesy Stanford University and Silicon Graphics, Inc.

A volume render of the mummy's bone structure. Image courtesy Medical Modeling LLC.

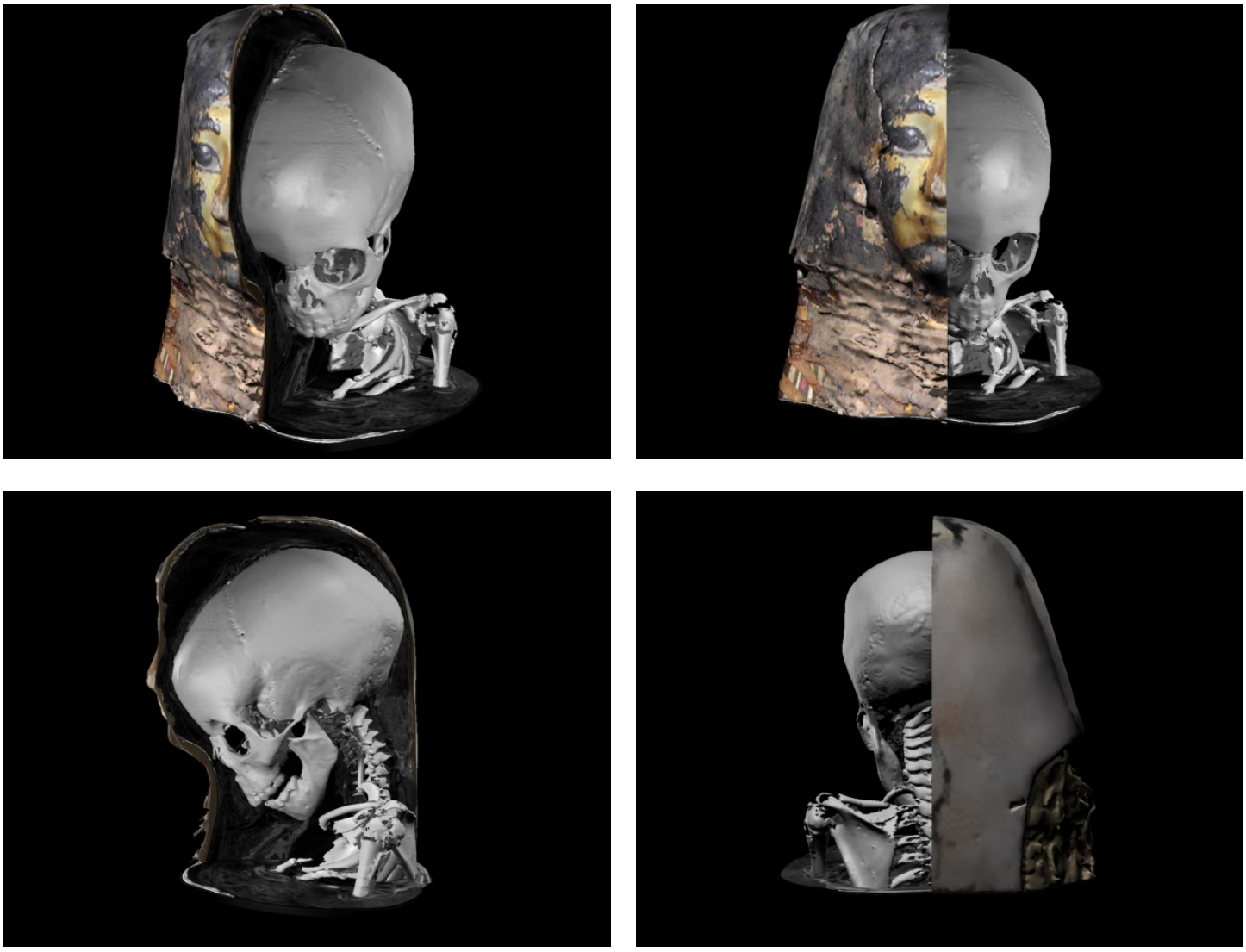
The "Child Mummy" Project

A collaborative effort between Silicon Graphics Inc., Stanford University, the Stanford-NASA National Biocomputation Center, Medical Modeling LLC and the Rosicrucian Egyptian Museum & Planetarium

Step 2: Virtual 3D Modeling

August 3, 2005

After processing the CT scan data for selected features such as bone, wrappings and the cartonnage mask, specialists at Medical Modeling utilized sophisticated 3D software to create virtual replicas of the mummy's anatomy. Actual photographs of the mummy's outer wrappings and mask (provided by the Rosicrucian Egyptian Museum & Planetarium) were "wrapped" around the virtual model on screen to create an accurate likeness on the exterior surface. The final model incorporates the outer mask, selected "slices" from the CT scan, hard tissue anatomy and portions of the wrappings (see images below).



Virtual 3D renders of the mummy model. This same model will be used in the next step to create a physical color model for public viewing. Renders courtesy Medical Modeling LLC.

The "Child Mummy" Project

A collaborative effort between Silicon Graphics Inc., Stanford University, the Stanford-NASA National Biocomputation Center, Medical Modeling LLC and the Rosicrucian Egyptian Museum & Planetarium

Step 3: 3D Printing

August 3, 2005

Key to Medical Modeling's involvement in the project was a new piece of equipment, a Z510 Spectrum 3D printer from Z Corporation (Burlington, MA). This printer allowed the company to three-dimensionally print, in full color, a model designed using computed tomography and photographic data of the mummy. The life sized model of the mummy's bust integrates color from the mummy's outer wrappings in addition to the bone structure imaged within.

This form of rapid prototyping uses inkjet print heads to print layers of liquid binder on plaster powder. After each layer is printed a thin layer of new powder is spread over the surface to allow the next layer to be printed. Thousands of layers are stacked this way to produce the final model (see illustration below). The printed models are then processed to add stability and bring out the color for a more sharp and vibrant appearance.

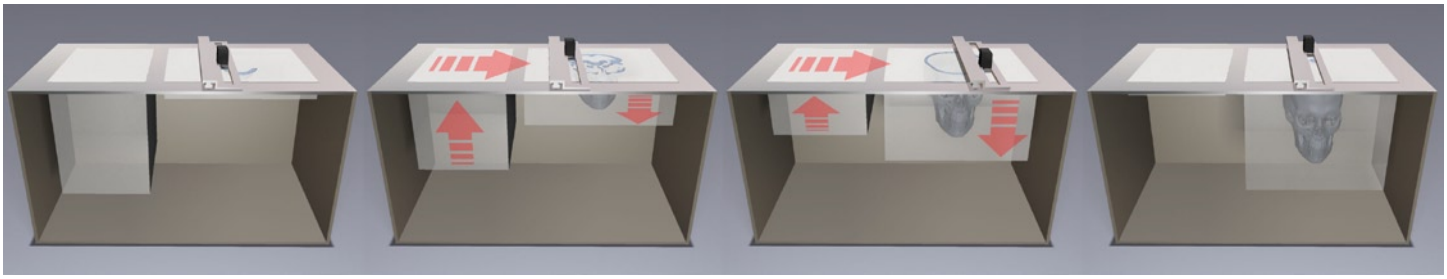


Illustration of the 3D printing process as occurs with Z-Corp 3D printers (Z Corporation, Burlington, MA). Illustration courtesy Medical Modeling LLC,

Photographs of the Finished "Child Mummy" Model. Photographs courtesy Medical Modeling LLC.

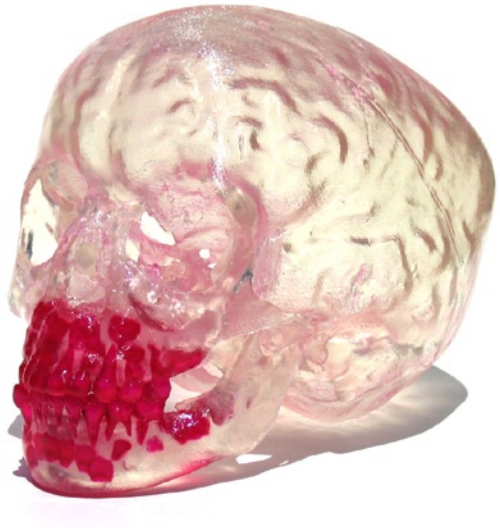
The "Child Mummy" Project

A collaborative effort between Silicon Graphics Inc., Stanford University, the Stanford-NASA National Biocomputation Center, Medical Modeling LLC and the Rosicrucian Egyptian Museum & Planetarium

Additional Model Photos

August 3, 2005

Left and right views of the final mummy models. Photos courtesy Medical Modeling LLC.



ClearView® Stereolithography model of the mummy's skull with selective coloration of the teeth. Photo courtesy Medical Modeling LLC.

OsteoView® 3D printing model of the mummy's skull. Photo courtesy Medical Modeling LLC.