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3D Printing with Nicklaus Children's Hospital

"Our new engineer segmented it. He hit the "go" button on Simpleware AS Cardio and then added the base and supports. It is very quick."

Thomas Haglund, Biomedical Engineer with the Cardiovascular Surgery Advanced Projects Laboratory at Nicklaus Children's Hospital

Thanks to:

Nicklaus Children's Hospital

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Highlights

- The Cardiovascular Surgery APL team at Nicklaus Children's Hospital uses 3D anatomical printing with Synopsys Simpleware software in their regular workflows
- Simpleware AI-enabled tools help create models rapidly and with great precision
- High-quality 3D anatomical models are printed on a Stratasys J750 Digital Anatomy printer

Overview

3D anatomical printing offers many benefits to clinicians, including enhancing visualization and measurement of pathologies to support planning of both standard and complex surgeries, while also incorporating medical devices, when applicable. The Cardiovascular Surgery Advanced Projects Laboratory (APL) at Nicklaus Children's Hospital is using a range of technologies, including holomedicine 3D visualization and 3D printing to help enhance surgical planning and the patient experience. One of the first institutions in the United States to apply 3D printing technologies for surgical planning and education, Nicklaus Children's Cardiovascular Surgery APL has printed more than 500 models of hearts, brains, spines, extremities and other organs.

Nicklaus' Robert Hannan, MD, Thomas Haglund and Muhanad Shraiteh collaborated with the Synopsys Simpleware Product Group to develop solutions for converting patient imaging data into models suitable for Stratasys 3D printers. The resulting 3D anatomical models help clinicians plan pediatric cardiac surgeries. In the example highlighted in this case study, the Cardiovascular Surgery APL team employed Simpleware software's powerful Artificial Intelligence (AI) tools to help speed up the workflow of creating a heart model for a teenage patient.

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Patient-Specific Challenges

The team at Nicklaus Children's needed to plan a complex operation for a teenage patient with an anomalous origin of the left coronary artery from the right sinus of Valsavla with intramural, interarterial course. Due to the complex nature of the pathology, it was decided that a 3D CT scan (DICOM format) of the patient's heart was necessary, and that a 3D printed model would help the surgical team visualize the pathways of the heart to plan for the surgery. Therefore, Simpleware ScanIP Medical software was used to convert the DICOM image data into a 3D print-ready model.

Automated Segmentation and Print Preparation in Simpleware Software
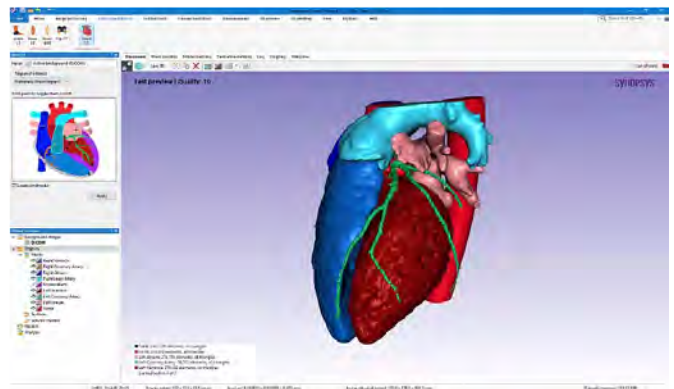
The patient's heart CT scan data was loaded into Simpleware ScanIP Medical and the automated segmentation module, Simpleware AS Cardio, was used to allow segmentation and landmarking to be completed with just a click of a button. This process significantly eases one of the most common bottlenecks for preparing 3D image data.

*Automated segmentation of the heart using Simpleware AS Cardio: shown here is the time difference between using typical off-the-shelf segmentation tools versus Simpleware AI products. Watch Video.*

In addition, the 3D printing toolkit in Simpleware ScanIP Medical was used to complete the additional tasks needed to prep the model for the 3D printer, including adding support structures, a base platform, and embossed text for labeling. Completing the above workflow using average off-the-shelf software would have required about 2 hours of work by a biomedical engineer with experience in heart segmentation. However, when using Simpleware ScanIP Medical software with the 3D printing toolkit and the Simpleware AS Cardio module to automate much of the segmentation, **this process was concluded in just 15 minutes**. The same workflow can also be used to create 3D models for surgical planning in virtual reality.
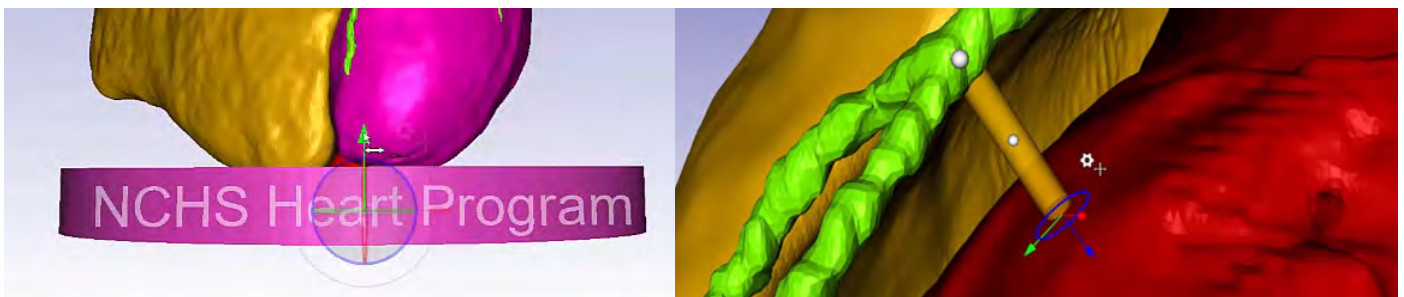
Using the 3D printing toolkit within Simpleware ScanIP Medical: adding a platform and embossed text, as well as support structures. Watch Video.

3D Anatomical Printing with Stratasys Printers
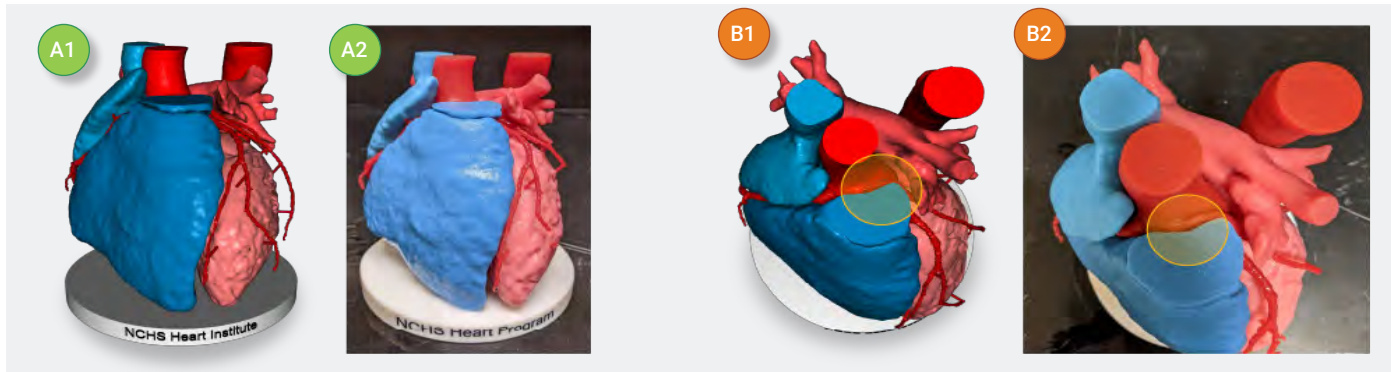
Lateral View (A1) and Transverse View (B1) of the 3D print-ready model in Simpleware software, and resulting 3D printed anatomical model from Stratasys J750 Digital Anatomy printer (A2, B2) with the pathology encircled in orange.

The segmented image data was 3D printed using a Stratasys J750 Digital Anatomy 3D printer, incorporating different colors to help clinicians better visualize individual regions of the heart. Recently, a Stratasys J5 MediJet printer was installed in the Cardiovascular Surgery APL, which can also be used to print 3D models. In addition to helping surgeons better understand a patient's anatomy in three dimensions, 3D printing also helps the clinical team communicate treatment plans to patients and their families. The Stratasys printers are particularly well-suited for printing 3D models for all types of anatomy, due to their capability of creating models with mechanical properties that simulate soft-tissues and muscle structures.

Conclusions

The work being carried out by the team at Nicklaus Children's demonstrates the value of using advanced healthcare technologies, including 3D printing. The Cardiovascular Surgery APL now routinely uses scale models of patient hearts for surgical planning and education of patients. In addition, augmented and virtual reality medical platforms are used to add another option for planning cardiovascular surgeries.

Synopsys Simpleware software's 3D printing-focused tools and AI capabilities offer a straightforward process for converting 3D imaging data to create high-quality models for Stratasys 3D printers. This workflow helps the Cardiovascular Surgery APL continue to increase anatomical model applications, speed up surgical preparation and, most importantly, continue to enhance clinical care and the patient experience.

Learn More

- Watch our Webinar 3D Printing the Future at Nicklaus Children's Hospital
- The Cardiovascular Surgery Advanced Projects Laboratory
- Simpleware AI Segmentation Solutions
- Simpleware for Point-of-Care (POC) 3D Printing
- Stratasys J750 Digital Anatomy Printer

Any Questions

Do you have any questions about this case study or how to use Simpleware software for your own workflows? Please contact us at simpleware@synopsys.com.