

3D Printed Arteries: Making Cardiovascular Anatomy Tangible & Accessible

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The Process

Utilizing the 3D printing technology available in the Ginsburg Health Sciences Library's Innovation Space, the Innovation Space team assisted a cardiology fellow from Temple University Hospital in printing a patient's CT scanned coronary artery for use in instruction. Using 3D printed models of coronary arteries from real patients like this, instructors are able to demonstrate how the vessels look from different angles and perspectives, a skill key to understanding coronary angiography (an examination of blood or lymph vessels by x-ray) for new cardiology fellows.

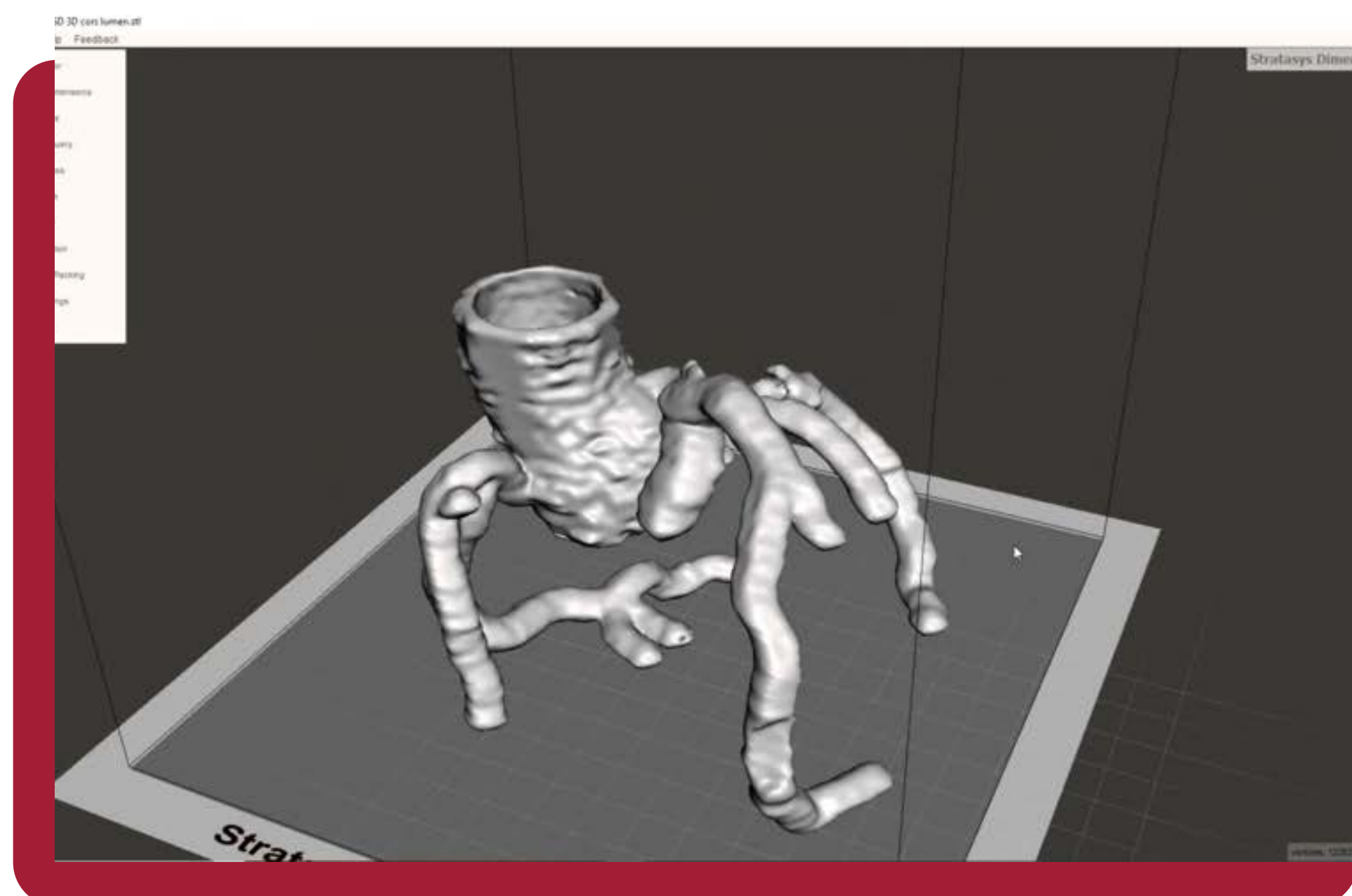


Figure 1. Patient's coronary artery model in Meshmixer

A combination of Blender and Meshmixer software was used to clean up the STL file from the CT scan (figure 1) and get it ready for printing in the space's FormLabs 3BL resin printer by removing stray artifacts from the scan and correcting errors that may have affected stability. The team also modeled a stand for display purposes (visible in figure 3).

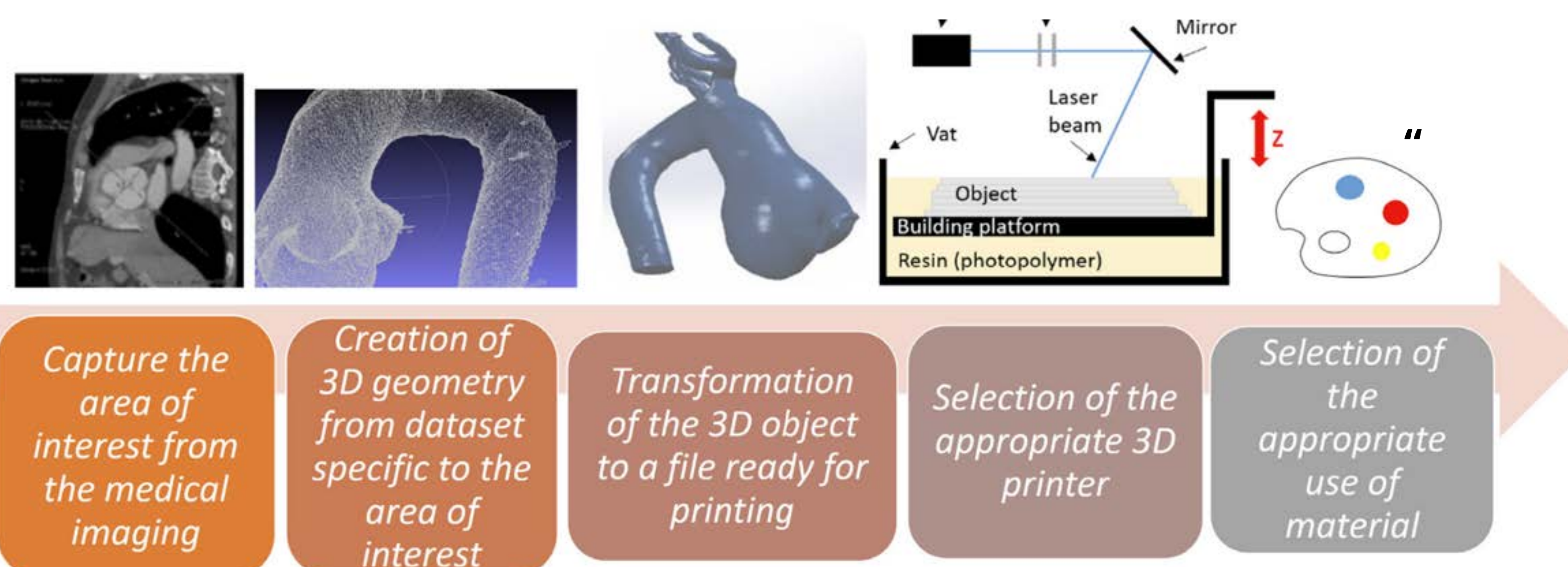


Figure 2. Steps required in the creation of a 3D printed model in healthcare education. (Garcia et al. 2018) |

Pedagogical Potential



Figure 3. Completed coronary model

Research on the benefits of 3D printed medical models during presentations and demonstration abounds in the academic sphere, but often they are limited to basic, more readily scannable anatomical models like bones and larger internal organs. As CT technology evolves, however, so do the capabilities to 3D print the resulting intricate models with minimal materials. These coronary artery models exist as a tangible reference that anyone can grab to explain a perspective of the arteries to another fellow or explore on their own. The educational potential of this project lies in the accessibility and the ease with which these models can be printed, scaled, and edited by those with even a basic understanding of 3D modeling and printing. The costs of material, too, are relatively minimal, which increases our ability to share these models with medical students and others who may not have had the same opportunities and privileges as their peers.

The "limitations of 2D imaging create challenges for cardiology fellows learning the basics of coronary angiography" (Haroian et al., 2020), so the use of shadowgrams—essentially a shadow puppet of the angiography—and other rough models have been well documented in various sources. "Using a 3D model to simulate a coronary angiogram outside the lab could shorten the learning curve and improve understanding of the procedure" (Haroian et al. 2020). The models printed for the fellows function in a similar way to simple shadowgrams, only the tangibility and physicality of our demonstrated model allows for a more well-rounded and interactive educational experience.

"Using a 3D model to simulate a coronary angiogram outside the lab could shorten the learning curve and improve understanding of the procedure"

(Haroian et al. 2020)

Moving Ever Forward

Work on further models for the cardiology department at Temple University Hospital is ongoing in the Innovation Space, including printing a geometric left ventricle model in four pieces connected by magnets and painted with dry erase paint for the instructor to mark up as needed. A large model of a scanned aorta, too, is currently in the works. With these models (and more) now in the catalog, the Innovation Space team can continue to print them for further instructors and students as needed, thus increasing accessibility to these tools as well as interest in the space's available technology and services for the entire Temple University community.

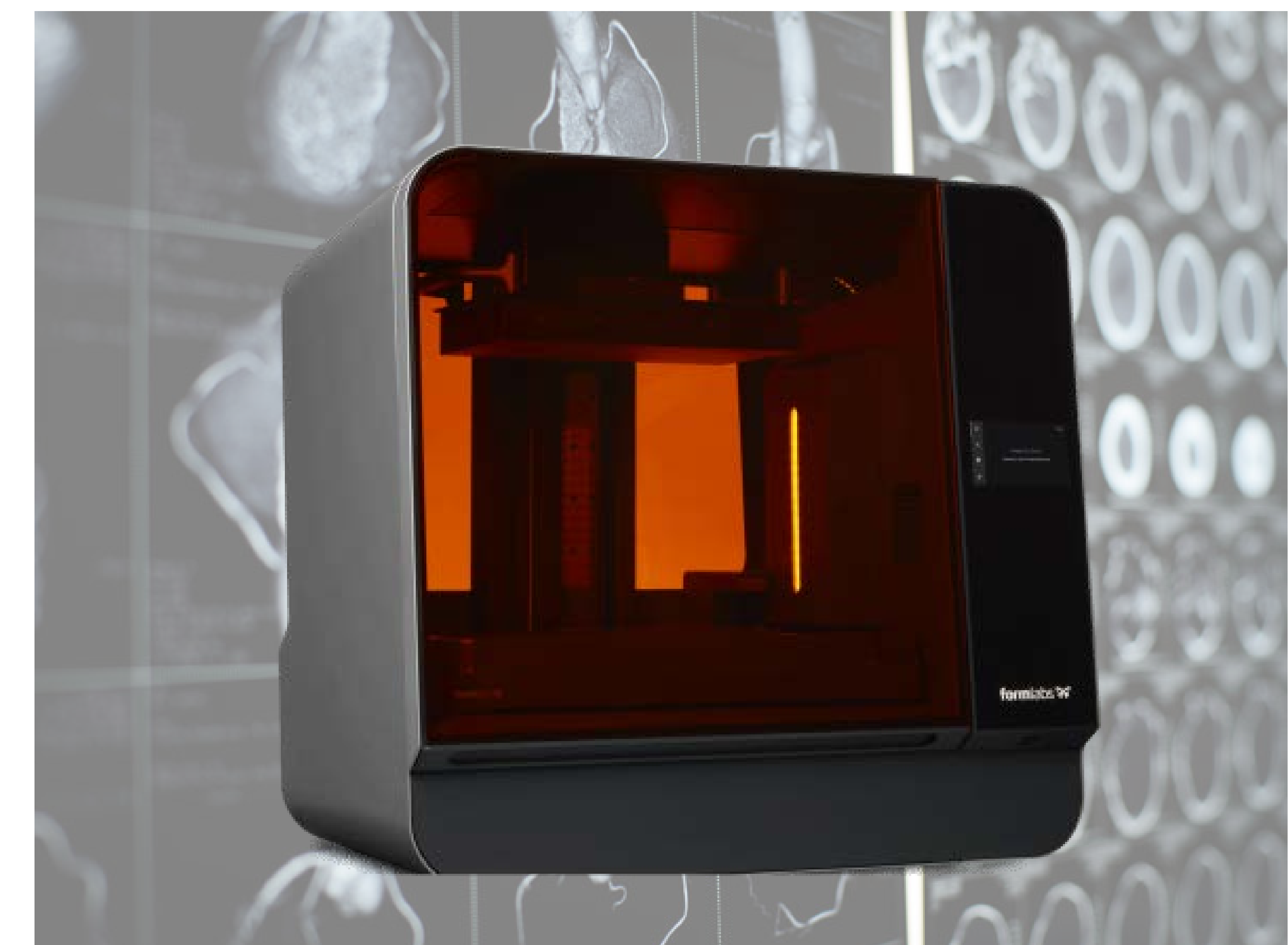


Figure 4. Formlabs 3BL resin printer with cardiology xrays as a background

Find Out More:

Contact the Ginsburg HSL's Innovation Space for individual or class bookings to learn the basics of 3D printing and modeling or commission a project.

List of cited references: <https://bit.ly/3EMH5B5>

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