New scanner takes images inside and out

May 24 2011, By Krishna Ramanujan

From fossilized brachiopods, fish lungs and iPhones to mouse hearts and habanero chilies, Cornell's micro-CT (computer tomography) scanner provides spectacular and colorful 3-D datasets from the inside out.

Researchers investigating tumor growth in mouse lungs, for example, can scan their mice every four to six weeks and quantify the development of those tumors. Scientists can similarly study processes related to fat deposits, bone density and structure, or hearts in animals. The machine can image objects up to about 3 inches across and up to about 8 inches long, with a resolution as fine as 25 microns, or the width of a human hair.

This new breed of micro-CT scanners allows researchers to quickly and safely get complete 3-D color images of the inside of live small animals, for example, using a computer and low-dose X-rays. In the past, researchers could obtain such data but the animals would often die or be damaged in the process.

Acquired in 2008 through a consortium including Boyce Thompson Institute for Plant Research, and Cornell's Colleges of Veterinary Medicine and of Engineering, the $500,000 scanner was the first one to be used at a university; it became part of the Cornell University Life Sciences Core Laboratories Center early this year.

The scanner is available to the public, academics and the general public across the globe for a fee of $40 to $75 per scan, with preference given to Cornellians.

"One of the very interesting things we can do with this machine is visualize inside a 300 million-year-old rock fossil of a brachiopod and see inside the structures that were previously unseen," said Mark Riccio, research engineer and Micro-CT facility director, of the internal rib-cage-like feeding apparatus within such a fossil. "I didn't appreciate so many things in nature until seeing them through the micro-CT."

Researchers studying habaneros can now quantify exactly where the capsaicin oil is secreted in a whole pepper, and scientists can better understand the evolution of swim bladders in fishes by viewing fish lungs from the inside out.

"To study structures that are internal and delicate, this machine is unbelievable, there is just no other way to get the kind of data that we have been getting, and it's beautiful and aesthetic at the same time," said Amy McCune, Cornell professor of ecology and evolutionary biology.

To collect data, a specimen is placed on a scanning tray, which then moves into the lead-encased machine the size a small shed. Inside, an X-ray and detector rotate 360 degrees around the object. At every angle, a digital projection is collected and sent to a computer, which reconstructs the data into a 3-D dataset in as little as two minutes. Users may then request tailor-made datasets of images with 25 or 50 micron slices cut away throughout a specimen, view through the length of a bronchial or arterial tube or see a specimen melt away from the outside to reveal what lies beneath the surface.

The X-ray can be set as weak as a medical X-ray for soft tissue, or strong enough to view through rocks and fossils, while the lead encasing ensures that background radiation does not leak into the room.

"I hope that everyone at Cornell will come in and see what this machine is all about," said Riccio.