The Virtual Rat

National Biocomputation Center,Stanford University **Center for Bioinformatics, NASA Ames**

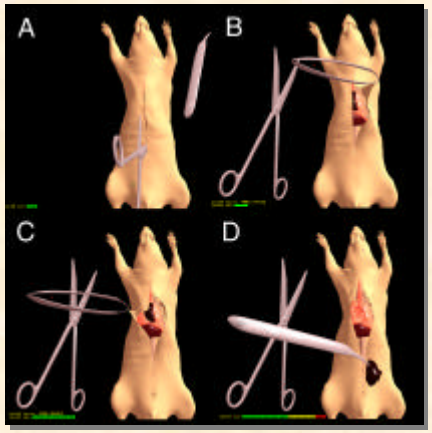
Cynthia D.Bruyns; Kevin Montgomery; Simon Wildermuth

Introduction

The International Space Station will be expanding its research capabilities over a number of years to support a wide variety of scientific and technological experiments. The biological experiments performed within this facility will require the tissues to be of the highest quality in order to increase the scientific return from each mission.

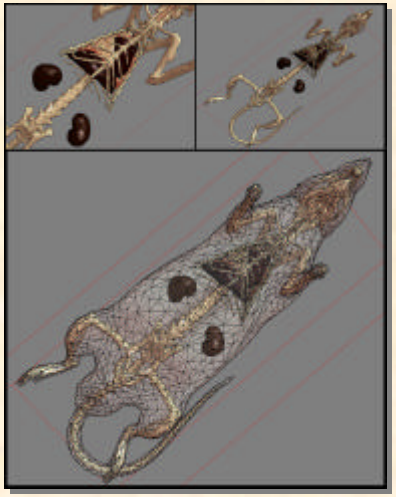
We have developed a virtual environment that can be used to simulate rat dissection training. Within a *virtual* environment, many scenarios can be presented to the user and allow for training in any remote environment both before launch and during flight. Scenarios, such as changes to the original protocol, emergency procedures and experimental countermeasures can be simulated in such an environment. Moreover, specific animal characteristics such as species, strain, gender, age and pathologies can be varied and presented within the simulation without requiring the actual specimen.

Interaction



The reconstructed anatomy of the rat is represented as deformable objects within physically-based simulation system developed at the National Biocomputation Center at Stanford University. Within the system virtual objects are assigned behaviors and properties that mimic the real-world object. The image to the left shows a user interacting with the virtual rat in order to retrieve an organ specimen. The simulation is able to operate on very complex meshes and still maintain interactive rates. This is because the system utilizes novel processing techniques and optimized real-time interaction techniques.

Data Acquisition / 3D Reconstruction



Data Acquisition

A multidetector computer tomography (MDCT) was performed under 'in vivo' conditions in an anesthetized rat (2x0,5mm collimation, rotation time 0.8s, FOV 11x11cm, 512x512matrix). The animal was scanned in the supine position and embedded in foam material to prevent motion during imaging.

3D Reconstruction

Using iodinated intravenous contrast material allowed the segmentation and reconstruction of the small internal organs, and to create corresponding high resolution polygon surface models. The resulting mesh of the skin, internal organs and bones consisted of over 6 million triangles. This mesh was then simplified, resulting in a mesh of under 100,000 polygons, which is more reasonable for interactive simulations.

Simulation System

The system supports a number of interface technologies. The user can interact with the system using specially wired real instruments or haptic devices, which extend common interactions in order to give the impression of the compliance of each tissue. These devices are connected to an embedded processor (Intel Pentium-based dedicated PC) and communicate via 100Mbps Ethernet to the server running the physical simulation. In this way the system naturally lends itself to remote capable multi-user collaboration, which reduces the need to transport people and equipment to specific training locations. We plan to incorporate additional procedures and animal models as this software is able to model several life science experiments.

For additional Information please visit virtualrat.stanford.edu