

# DESKCAT

**Transforming** today's **Students** into tomorrow's **Clinical** Practitioners

DeskCAT™ is a state-of-the-art multi-slice optical CT scanner designed especially for science teachers to demonstrate the principles of medical imaging in an educational setting.



Each scanner comes with an unlimited software license, phantoms and 3 beginner lab exercises\* developed by Modus Medical Devices Inc. in collaboration with imaging and educational experts from the London Regional Cancer Program and Western University.



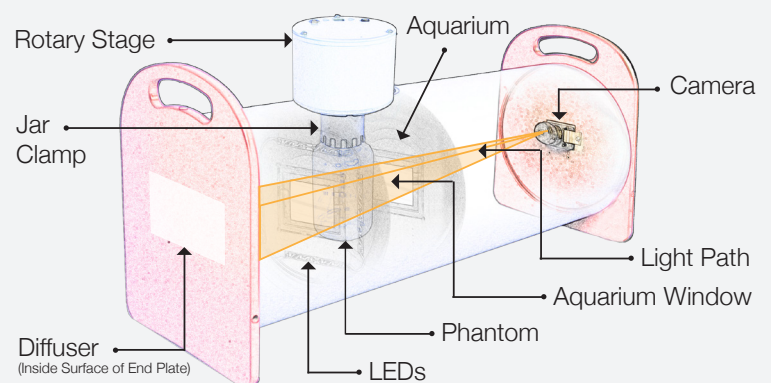
## FEATURES

- ▶ Safe, accessible and portable multi-slice optical CT scanner
- ▶ Operates without the use of potentially harmful x-rays
- ▶ Acquire, review and reconstruct 3D CT images
- ▶ Performs quantitative CT scans in real-time
- ▶ Enables simulation of imaging artifacts
- ▶ Hands-on, intuitive and interactive software
- ▶ Effectively teach principles of medical imaging
- ▶ Includes phantoms, lab exercises and software

The DeskCAT™ scanner weighs 10 kg and measures 63 cm long, 23 cm wide and 33 cm high. It uses cone beam geometry, a CMOS camera and an LED light source. Phantom materials are translucent and rotate 360 degrees when attached to the rotary stage. The scanner connects to a computer (not included) and integrates with the DeskCAT™ software and lab exercises.

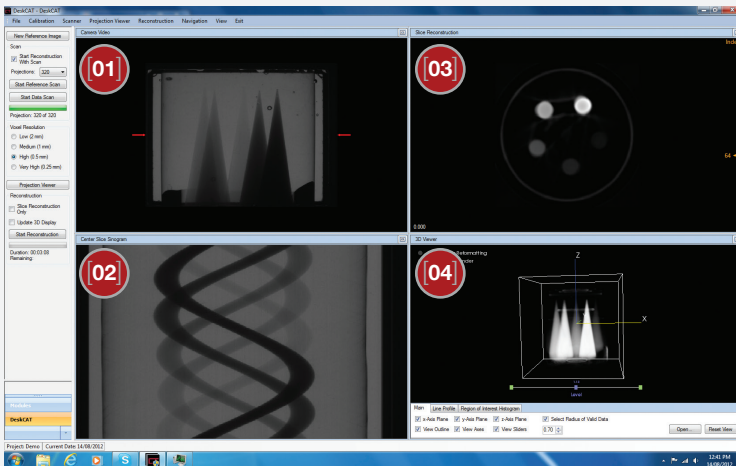
## INTERACTIVE LEARNING

The DeskCAT™ scanner, software and phantoms are made for students in mind to make it easy for them to learn about the principles of medical imaging in a classroom or laboratory environment by enabling students to acquire, review and reconstruct CT images without the use of potentially harmful x-rays.



## USER-FRIENDLY SOFTWARE

The screenshot below shows the software layout, which includes 4 windows that display different views of the data. Each window can be enlarged to analyze specific results as necessary.



### [01] Camera View

Displays the live projection images of the scanned phantom inside the aquarium.

### [02] Centre Slice Sinogram

Displays the central sinogram of the scan and is updated for each projection angle during a scan.

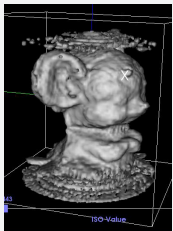
### [03] Centre Slice Reconstruction

Displays the reconstructed central slice and updates in real time for each projection angle.

### [04] 3D View

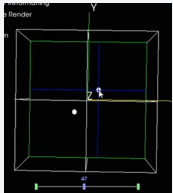
Allows the student to observe and analyze the reconstructed images interactively in 3D.

## INTRODUCTORY & BEGINNER LAB EXERCISES (Included with scanner purchase)



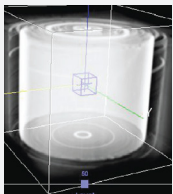
### Lab 0: Introduction to DeskCAT™

In this lab exercise, students gain an understanding of fundamental concepts in Computed Tomography (CT). Students (or the demonstrator) scan a simple 3D object (i.e. a mouse phantom) to become familiar with data capture, image reconstruction and 3D image display. Interactive tools in the user interface allow students to view the reconstruction of CT images in real time. This exercise introduces students to the physics of CT scanners in general and more specifically to the operation of the DeskCAT™ scanner. In addition, it allows exploration of images using visualization tools that are similar to those used in medical CT scanners.



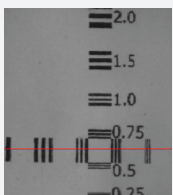
### Lab 1: Introduction to Medical Imaging – 3D Localization

In this lab exercise, students explore the geometry of medical imaging. Students make geometric measurements of the 3D position of fiducial markers embedded in a cylindrical phantom and gain experience with measurement, manipulation and display of 3D images. Measurements are made on radiographic projections, as well as on a 3D CT image. Students compare and contrast the two imaging modalities with calculations of coordinates using each method.



### Lab 2: System Linearity

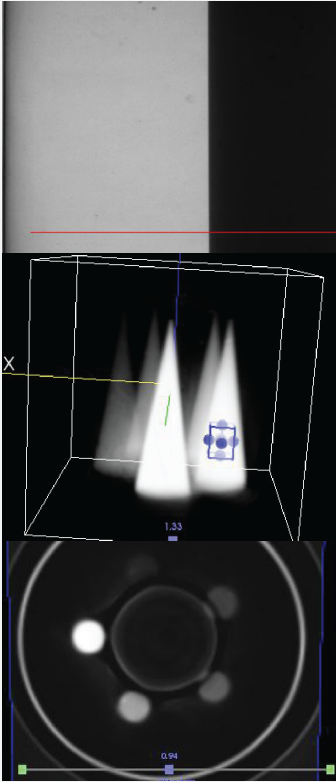
In this lab exercise, students learn how to measure the linearity of response of a CT scanner. Students evaluate the linearity of the DeskCAT™ scanner by acquiring a series of scans with increasing optical attenuation. Optical attenuation is adjusted by adding known amounts of black dye to a water filled jar. The linearity of the scanner is evaluated by plotting the measured attenuation coefficient against the concentration of dye.



### Lab 3: Spatial Resolution and Modulation Transfer Function (MTF)

In this lab exercise, students assess the spatial resolution of projection and 3D CT images using the DeskCAT™ scanner. Students acquire 2D and 3D images of a bar pattern phantom. The shape of the MTF is determined by plotting the contrast of the line pairs (modulation) vs. spatial frequency. This exercise introduces students to the concept of MTF, its practical implications and a commonly used method of measuring it.

## INTERMEDIATE LAB EXERCISES



### Lab 4: Edge Response, Point Spread Function and MTF

In this lab exercise, students learn a Fourier transform based technique to determine the MTF of a CT scanner. Students image a step-edge phantom and plot attenuation profiles (edge response) across a high contrast edge. Students analyze edge response profiles and perform Fourier transforms to calculate and plot the MTFs for different reconstruction resolutions. MATLAB® code is provided as one method for calculating the Fourier transforms. Students compare their results with the results obtained from Lab #3.

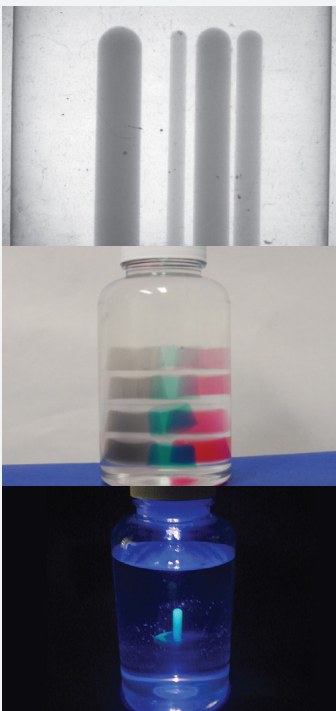
### Lab 5: Contrast to Noise Ratio

In this lab exercise, students learn the importance of contrast and noise in the context of low-dose imaging. Students decrease the contrast to noise ratio of acquired images by adding Gaussian noise. This is analogous to lowering the contrast to noise ratio by lowering the imaging dose. Students measure contrast to noise ratio in images of a phantom with cone-shaped fingers of different optical density. In these images, students assess the ability to resolve low contrast fingers as noise is increased (dose is decreased). This is an important topic in view of the “Image Gently” ([www.pedrad.org](http://www.pedrad.org)) approach used in medical imaging.

### Lab 6: Image Artifacts due to Faulty Detectors and Missing Projections

In this lab exercise, students learn to recognize artifacts in CT images that are caused by incorrect or incomplete projection data. Students manipulate scan data to introduce bad pixels or missing projections. These input errors are similar to incorrect data sometimes found in medical CT scanners. Students observe the resulting artifacts (e.g. rings, streaks) in sinograms and reconstructed CT images.

## ADVANCED LAB EXERCISES



### Lab 7: Fan Beam vs. Cone Beam CT

In this lab exercise students observe important differences between fan beam and cone beam CT imaging. Using apertures of different width, students scan a finger phantom which contains fingers of different diameter and the same density. From the reconstructed images students measure attenuation coefficients in the fingers and observe how the values differ as the aperture changes from wide cone to narrow fan.

### Lab 8: Dual Energy CT

In this lab exercise students learn how Dual Energy CT can be used to discriminate structures and objects according to their absorption characteristics at various imaging energies. Students use light of different wavelengths (energies) to scan and measure the attenuation values of colored objects in a phantom. This exercise helps students understand the importance of the energy dependence in medical imaging.

### Lab 9: Emission CT

In this lab exercise students investigate emission CT and the density corrections that are applied based on transmission CT images. Students work with an emission phantom which contains neutral density objects and an object which fluoresces under UV light. A transmission scan (red light) of the phantom is performed followed by an emission scan of the same phantom under UV illumination. The results of the transmission scan are then used to correct emission values in the emission CT image.

## INTERMEDIATE LAB EXERCISES

For students looking to further advance in a career in Medical Physics, we offer 3 intermediate level lab exercises.

## ADVANCED LAB EXERCISES

For advanced level students, we offer 3 lab exercises to meet requirements set forth by the CAMPEP accredited programs in Medical Biophysics.

## PERFORMANCE

Resolution Setting	Voxel Size (mm)	Reconstructed Image Size (MB)	Acquisition & Reconstruction Time (min)*
Low	2	0.25	<1
Medium	1	2	1
High	0.5	16	2
Very High	0.25	128	3

**Above:** \*Results based on x64 Windows 7 8GB RAM 2 Core @2.66GHz



### DELIVERABLES

- ▶ Scanner
- ▶ Phantoms
- ▶ Empty Jars (3)
- ▶ Food Coloring (Dye)
- ▶ Syringes (20mL and 5mL)
- ▶ Cables
- ▶ Power Supply



### DOCUMENTATION

- ▶ Software CD
- ▶ User's Guide
- ▶ Student Lab Exercises

## ORDERING INFORMATION

- 100-2020 DeskCAT™ Optical CT System, includes:
- ▶ Scanner with Rotary Stage and Jar Clamp
  - ▶ Lab Exercises 1, 2 & 3
  - ▶ Software CD & Documentation
  - ▶ Phantoms:
    - Fiducial
    - Resolution
    - Blank Silicone
  - ▶ Empty Jars (3)
  - ▶ Food Coloring (Dye)
  - ▶ Syringes (20mL and 5mL)
  - ▶ Cables:
    - USB-A to USB- mini B
    - USB-A to USB-B
  - ▶ Power Supply (Elpac Power Systems 50W switching power adapter model FW C5024F: 110 - 240 V~, 50 - 60 Hz, 1.0A; Unit input: 24Vdc, 2.1A.)
  - ▶ Auxiliary Power Cable (3.5mm audio connector)

## ADDITIONAL ORDERING INFORMATION

- 500-2100 Lab Exercises 4, 5 & 6  
500-2105 Lab Exercises 7, 8 & 9

## SPECIFICATIONS

- ▶ Dimensions: 63cm x 23cm x 33cm (25" x 9" x 13")
- ▶ Weight: 10kg (22lbs)

## RECOMMENDED SYSTEM REQUIREMENTS

- ▶ **Operating System:** Windows 7, 8 or 10
- ▶ **RAM:** 2 gigabyte (GB) or more
- ▶ **Components:** .NET framework 4.0 or greater
- ▶ **Peripherals:** 2 USB ports
- ▶ **Software:** Acrobat Reader to view PDF files

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