UAB SAIF ISSUE 6 2020
SMALL ANIMAL IMAGING FACILITY

NEWS & UPDATES

IMAGE ANALYSIS

Qualitative and quantitative image analysis assist with helping researchers to interpret their data in a detailed (through color-scaled representations of signal emission/intensity) and structural (through conversion of visual data into charts and normalized time-activity curves) manner. Multimodality imaging techniques ensure diversified data production and detailed interpretation through both qualitative and quantitative image analysis. Qualitative image analysis can provide researchers with a visual reference that can be used to assess qualities and characteristics without reliance on numerical comparisons. Quantitative image analysis can allow adjustments to be made to visual data based on computed processes, which permit statistical inferences to be made relative to measurable phenomenon. Together, both methods of analysis can aid in data interpretation in molecular imaging studies. The **Small Animal Imaging Facilty** offers a number of instruments that can provide relevant data for various biological processes on molecular and cellular levels.

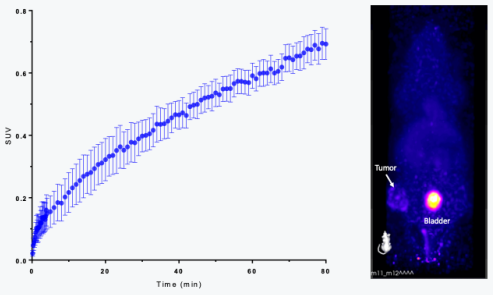


Figure 1: Time-activity curve for [18F]FLT in a mouse bearing MDA-MB-231 xenograft tumor.

An instrument that is frequently used due to its ease of operation and short acqusition times, the IVIS LUMINA renders data in the form of semi-quantitative pseudo-colorization on two-dimensional images. Signal intensity is influenced by fluorochromes or luciferase-initiated enzymatic reactions, which can help investigators to efficiently monitor drug-response, tumor development and disease progression, along with cellular activities including distribution and accumulation. Once images are acquired, tools are provided within the acquisition program that allow users to modify visualization of signal without changing any quantifiable attributes. The program computes emitted signal in the form of calibrated units such as radiance (photons, luminescence) and radiance efficiency (fluorescence), and generates background-corrected signal that can be compared between different images. User-specified regions-of-interest (ROIs) can also be drawn to collect data relative to signal being emitted in isolated regions.

The GNEXT PET/CT and GAMMA MEDICA XSPECT/CT systems acquire data dependent on the detection of radio-compounds as they circulate and bind to certain tissues within a subject. After acquisition, a reconstruction program uses computed algorithms that create a quantifiable visualization of signal distribution. Reconstructed images undergo co-registration with corresponding CT images to correct for signal attenuation and assist with colocalization of signal emission. Following co-registration, these images are analyzed using specialized software (i.e., VivoQuant, MATLAB, or Image J) and signal quantification is normalized to a known reference of activity and/or according to standard uptake value (SUV) calculations. Data points can then be generated based on outlined ROIs and SUVs calculated from the weight and administered dose in those regions. Depending on the method of acquisition, data points can be collected to create "time-activity curves" (TACs) that can be used to observe volumetric values based on dose-accumulation in tissues (**Figure 1**). Tissues of interest are often isolated during image analysis based on the pharmacokinetics of the radio-compound that was used. [1,2]

Capable of generating both two-dimensional and three-dimensional images, magnetic resonance imaging (MRI) depends on magnetic properties of hydrogen nuclei in water molecules to create detailed images. Multiple images of varying contrast levels are acquired of the subject for qualitative assessment. Qualitative MR images are useful for high-resolution studies of tissues, such as brain imaging and locating, counting, or measuring the size of cancerous and non-cancerous masses. Quantitative MRI requires acquisition of multiple images (more than qualitative MRI), and allows for the estimation of quantitative tissue parameters which can be tracked longitudinally and compared between animals. Some quantitative parameters include Apparent Diffusion Coefficient (ADC) from diffusion-weighted imaging (DWI), and T1 and T2 measurements from sets of T1 and T2 images. Measurements can be made on qualitative MR images to determine sizes or volumes, using image analysis software. A series of two-dimensional images can be used to find the summation of voxels (volumetric pixels) for a specified area; or parameter estimations can be made on a set of images using custom code written in MATLAB. ROIs can be drawn on several images and applied to a parametric map to obtain a single measurement for an animal (i.e. measure of tumor ADC at a certain timepoint). An example of this analysis method is pictured above in **Figure 2**.

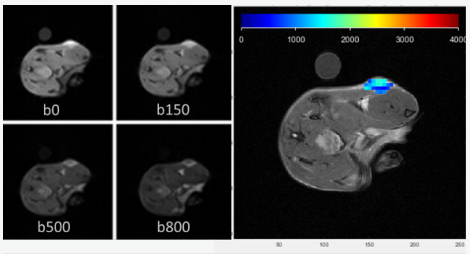


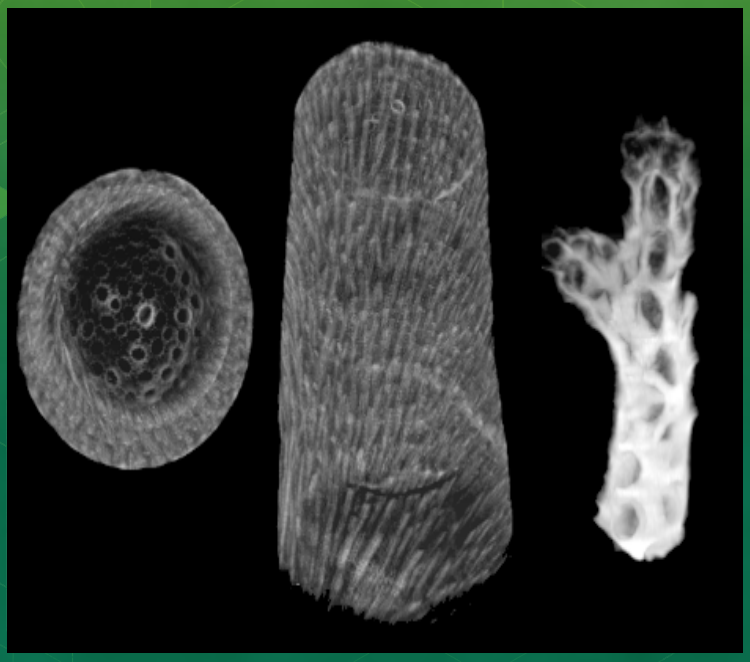
Figure 2: Example set of 4 mouse diffusion weighted images and resulting quantitative tumor ADC overlaid upon T2-weighted anatomical image.

Quantitative and qualitative image analysis methods can also be used through coordination of molecular and optical imaging technologies with biodistribution procedures, ensuring a better understanding of therapeutic responses and underlying disease processes.

1 Yoder, K.K. Basic PET Data analysis techniques. Book: Positron Emission Tomography - Recent Developments in Instrumentation, Research and Clinical Oncological Practice.
2 W Lu et al. Computerized PET/CT image analysis in the evaluation of tumor response to therapy. Br J Radiol. April 2015; 88(1048): 20140625.

If you have received services through the SAIF core for grants and publications, please acknowledge support by citing UAB Comprehensive Cancer Center's Preclinical Imaging Shared Facility Grant P30CA013148. For published data obtained with the IVIS Lumina III systems, please cite S10 instrumentation grant 1S10OD021697.

FEATURED IMAGE OF THE QUARTER



CT IMAGE OF CORAL SAMPLES

Coral cores were extracted from tropical areas and scanned using the GNEXT PET/CT to obtain a 3D computed tomography (CT) image. The goal was to evaluate if climate changes affect the skeleton structure and porosity of coral.

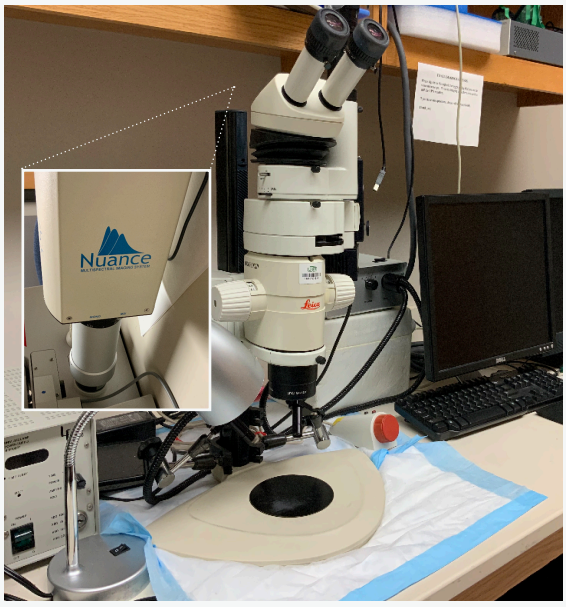
Computed tomographic assessment of the breakdown and accretion of the skeletal structures of coral reefs can improve research on ecological impacts and the effects of shifting marine composition on indigenous aquatic species.

IMAGE CREDIT: Dr. Dustin W. Kemp

FEATURED INSTRUMENT

CUSTOM LEICA MICROSCOPE WITH NUANCE CRI SPECTRAL CAMERA

The **NUANCE CRI SPECTRAL CAMERA** provides multi-spectral fluorescent microscopy between a range of 380 to 750 nm. The spectral camera is suitable for both fluorescent and brightfield forms of microscopy, which can be used to observe immunohistochemistry samples and cellular viability and processes. It can also be used for *in vivo* imaging and investigative studies. With the help of multispectral analysis, multiple fluorophores can be observed and used to identify cellular components and tissues with a high degree of specificity. Using the Nuance system's unmixing capabilities, composite and spectrally unmixed images can be adequately compared and specified fluorescent signals can be localized in specimen, even in the presence of autofluorescent interference.



USEFUL LINKS

↗ PRE-CLINICAL IMAGING CALENDAR
Check for any available time slots for imaging modalities.

↗ TRAINING FORMS
Download training material for submission prior to scheduling imaging.

↗ PERKIN ELMER RESOURCES
Educational material related to the IVIS Lumina III.

↗ DEPARTMENT OF RADIOLOGY
Homepage for UAB's Department of Radiology.

↗ O'NEAL COMPREHENSIVE CANCER CENTER
Homepage for O'Neal Comprehensive Cancer Center at UAB.

↗ O'BRIEN CENTER
Homepage for O'Brien Center for Acute Kidney Injury Research.

↗ UAB CYCLOTRON FACILITY
Homepage for UAB's Cyclotron Facility.

DID YOU KNOW?

IMAGING MODALITIES CAN HAVE FUNCTIONAL OR ANATOMICAL CAPABILITIES.

Imaging modalities can be categorized based on the type of visual data that they generate. Functional modalities (such as PET, SPECT, gamma camera) can provide information about biochemical processes and metabolic activities that take place within certain organs in the subject. Anatomic modalities (such as CT, X-ray, MRI) can help with visualization of the structural integrity of various bone and tissue regions. Oftentimes, images taken from both functional and anatomic modalities are co-registered to combine their advantages and implement additional details that ensure conclusive observations with strong, visual and statistical support.

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Volker Hall Laboratory
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IMAGING FACILITIES

WTI Imaging Suite
WTI 630D

MRI 9.4T Imaging Suite
LHL B15, 934-0265

Volker Hall Imaging Suite
VH B21A, 975-6466

SAIF MODALITY PRICING

*Labor charges are $40 per hour (for each personnel), when assisted during imaging.

Prices effective 11/1/2018.

*Training is available on some modalities, free of charge.

MODALITY	COST	INSTRUMENT
Bioluminescence	$7/mouse OR $55/hour (re-agent dependent)	IVIS Lumina III
Fluorescence	$55/hour	Custom Leica microscope with Nuance CRI spectral camera
		IVIS Lumina III
Ultrasound	$75/hour	Vevo 660
MRI	$125/hour	Bruker 9.4T
SPECT/CT	$100/hour + dosing	XSPECT system
PET/CT	$200/hour + dosing	Sofie GNEXT PET/CT
Gamma Camera	$20/hour + dosing	Picker Camera with Numa computer
Specialty Fluorescent Imaging	$100/hour	Li-Cor Pearl Impulse
		Luna/SPY Systems
Staff Image Analysis	$40/hour	

*NON-CANCELLATION POLICY:
If user is not present at scheduled appointment time without prior notification of cancellation, user will be charged an hourly-use fee for that instrument.

IMAGE SUBMISSIONS

Submit images that you would like featured in the newsletter to erikanmc@uab.edu. Please include PI's name, modality, brief experiment summary, and species.

PUBLICATION REFERENCE

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