

 BIOEMTECH

 n-TRACK

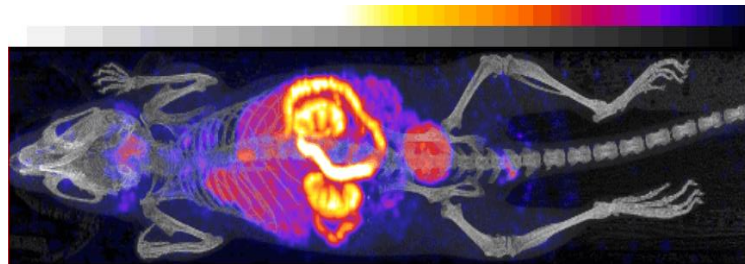
Your Imaging Partner

nTRACK Open Day, Cambridge 30.10.2019

**BIOEMTECH** develops and offers innovative solutions in pharmaceutical and medical research in the **non-invasive *in vivo* imaging**.

We focus on **molecular imaging** and **biomedical engineering**:

- ✓ Design and construction of low-cost benchtop imaging devices
- ✓ Performance of preclinical imaging services in our imaging platform
- ✓ Computational simulations using Monte Carlo techniques



## Loudos Georgios



- 1993-1998: MSc Electrical Engineer, NTUA , Athens
- 1998-2003: PhD Biomedical Engineering, NTUA, Athens
- 2008: Assistant Professor in Department of Biomedical Engineering, TEIA
- 2013: **Co-founder & CEO** of BIOEMTECH

## Georgiou Maria



- 2002-2007: MSc Electrical Engineer, NTUA , Athens
- 2010-2016: PhD, Biomedical Engineering, Medicine School, University of Thessaly
- 2013: **Co-founder and Production Manager** of BIOEMTECH

## Papadimitroulas Panagiotis



- 2003-2009: MSc Applied Physics, NTUA , Athens
- 2009-2011: MSc, Medical Physics, University of Patras
- 2011-2015: PhD, Medical Physics, University of Patras
- 2013: **Co-Founder & Project Director** of BIOEMTECH

## Team includes

- Biomedical Engineers
- Mechanical Engineers
- Physicists
- Radiochemists
- Software Developer
- Software Engineer
- Project Management

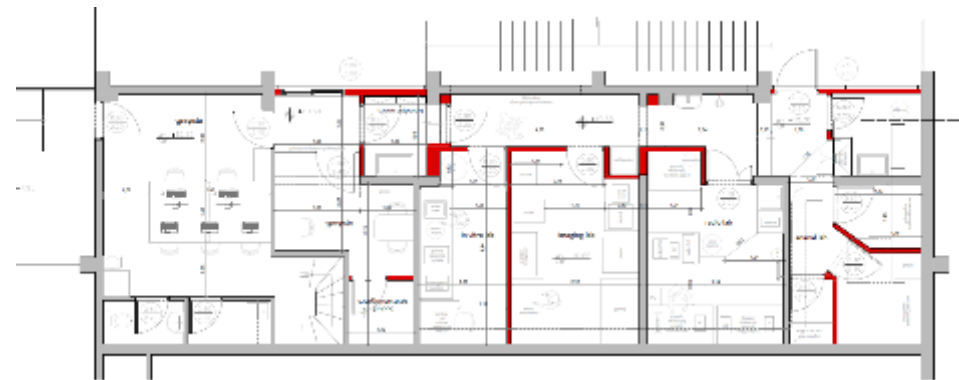
## External Collaborators

- Legal Advisor
- Accountant
- Business Advisor



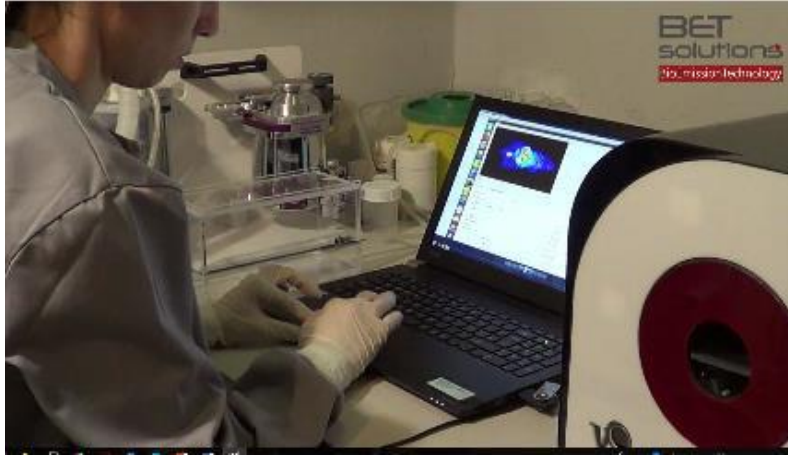
- ✓ **> 110 journal publications**
- ✓ **> 250 conference presentations**
- ✓ **Member of > 10 international networks**
- ✓ **Experience in > 20 international / national projects**

- **BIOEMTECH** was founded in 2013 as **BET Solutions**
- It is the evolution of our research group
- The core group is working together since 2007.
- R&D labs at the Technology Park "**Lefkippos**" in **NCSR Demokritos** since 2017
- Laboratories include: animal handling & hosting, *in vitro*, radiochemistry and *in vivo* imaging equipment.



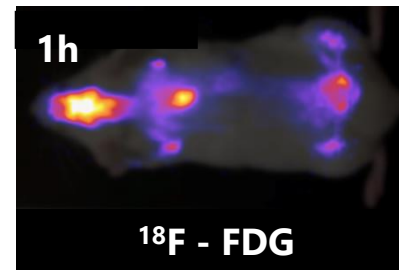


# Two initial products: “eyes” series

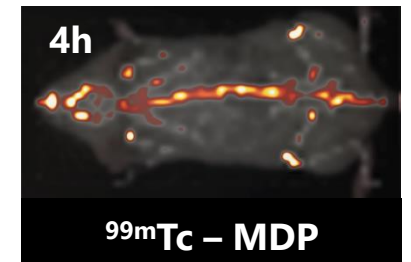


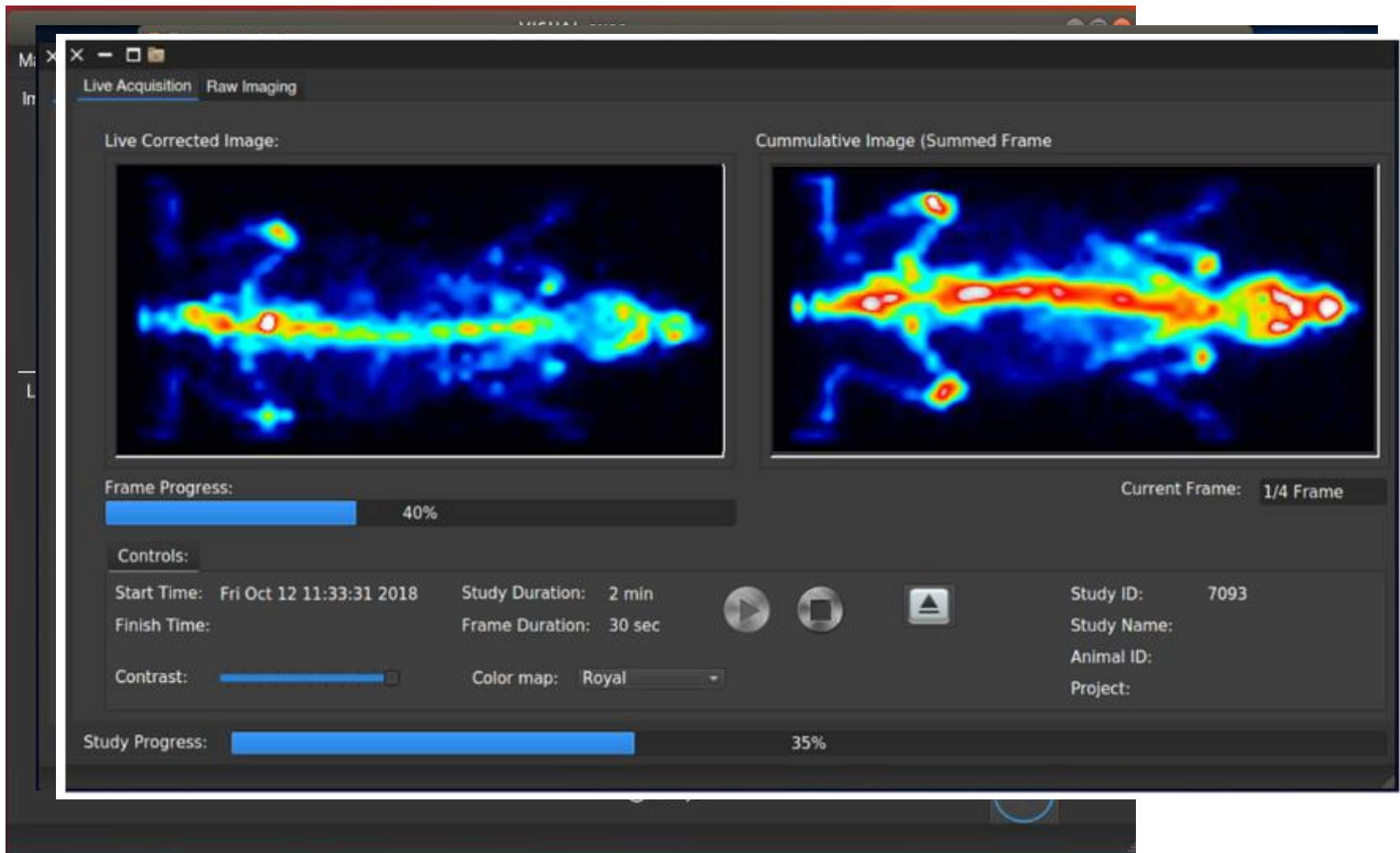
- ✓ 2018: Two unique products on the market
- ✓ The only systems that turns a simple desk into an *in vivo* imaging laboratory
- ✓ Targets all small and medium groups increasing the current market by x10
- ✓ Cost of both systems far lower of the cost of all existing alternatives (>300k€)
- ✓ Easy to buy, use by non-experts

$\beta$ -eye™



$\gamma$ -eye™





# New VC Investment on the eyes



**METAVALLON**

GROWING

INNOVATION

COMPANIES

SUBMIT NOW



## **WELCOME BIOEMTECH – DESIGNING ANIMAL IMAGING SYSTEMS FOR PRE-CLINICAL PHARMA, BIOTECHNOLOGY AND MEDICAL RESEARCH**

 On September 4, 2019

We are excited to announce our latest Pre-Seed investment into Athens-based BioEmission Technology Solutions (BIOEMTECH) specialising in the design and construction of animal imaging systems for pre-clinical pharma, biotechnology, and medical research. Founded in 2013 by George Loudos, Maria Georgiou and Panagiotis Papadimitroulas, BIOEMTECH has its research background stemming from the University of Western Attica [...]

**BioEmission Technology Solutions**

Lefkippos Attica Technology Park – N.C.S.R Demokritos, Greece • Tel: +302130290586 • [info@bioemtech.com](mailto:info@bioemtech.com) • [www.bioemtech.com](http://www.bioemtech.com)



# Our Imaging Platform

# Complete Imaging Platform

From



Functionalization of small molecules and nanoparticles for targeting & imaging



Along with



Able to perform necessary *in vitro* assays



To



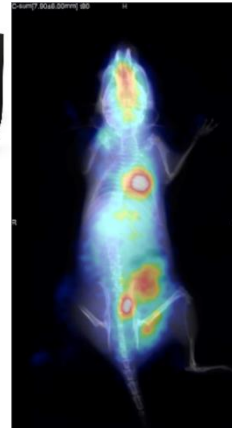
Animal hosting in hygiene and protective environment



Towards

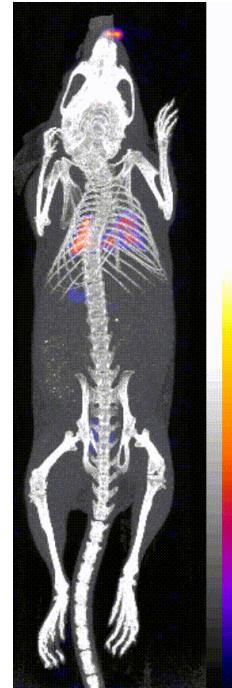
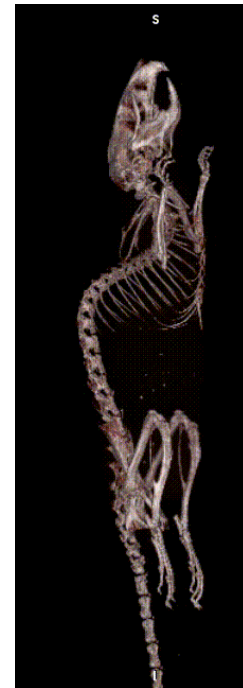


High performance SPECT / PET / X-ray / CT imaging



# Tomographic Systems

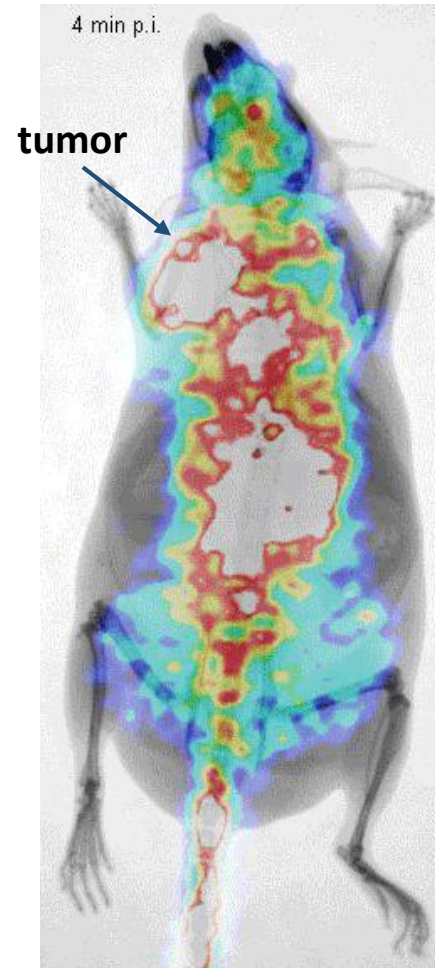
- $\gamma$ -cube and x-cube (MOLECUBES) installed in 2018
- Plan for micro PET and optical imaging system



## Tumor imaging

Tumor bearing mouse i.v. injected with 100  $\mu$ L. 1mCi [ $^{99m}\text{Tc}$ ]Tc-peptide:

- i. Dynamic imaging for the first 2 hrs p.i.
- ii. 3D SPECT imaging @ 4 hrs p.i.

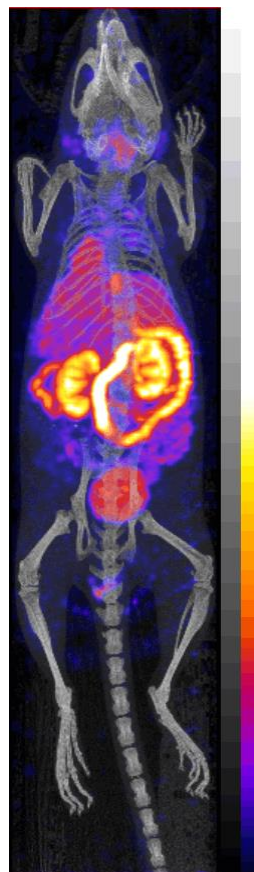


# Imaging examples (II): Cardiology

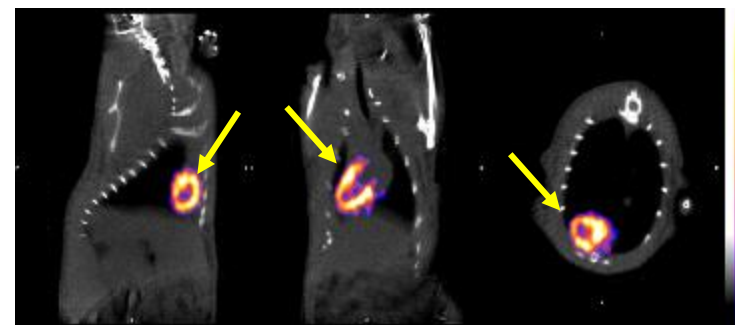
## Heart attack and cell treatment

Imaging with the clinical radiotracer Tc-99m MIBI

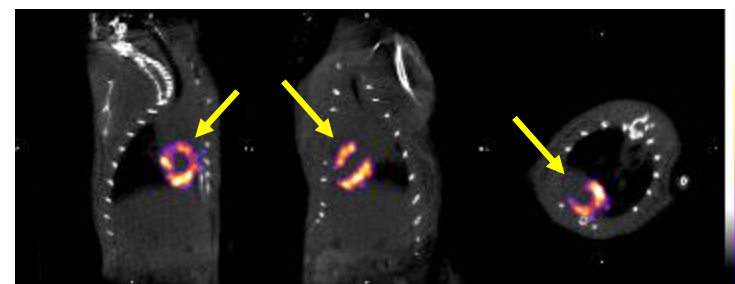
- 7 days prior heart attack
- 7 days post treatment
- 14 days post treatment



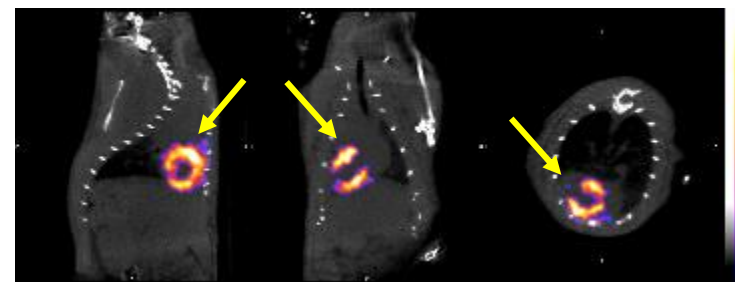
**7 days  
before heart  
attack**



**7 days post  
treatment**



**14 days post  
treatment**





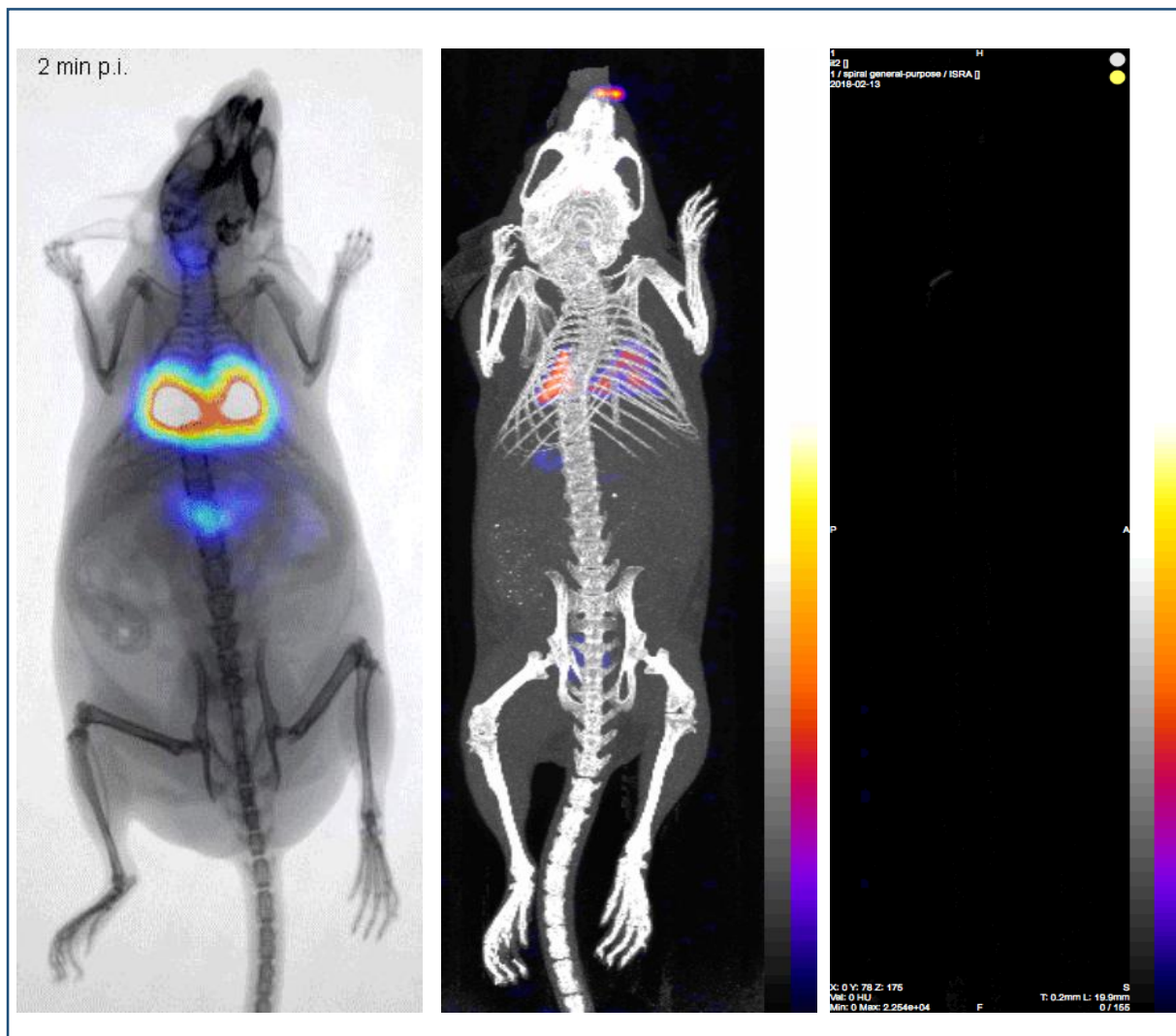
# Imaging examples (III): Lungs

## Lung imaging

Normal mouse and intra-tracheal administration:

a) Dynamic imaging for 1 hr p.i.

b) Imaging @ 1 hrs p.i.

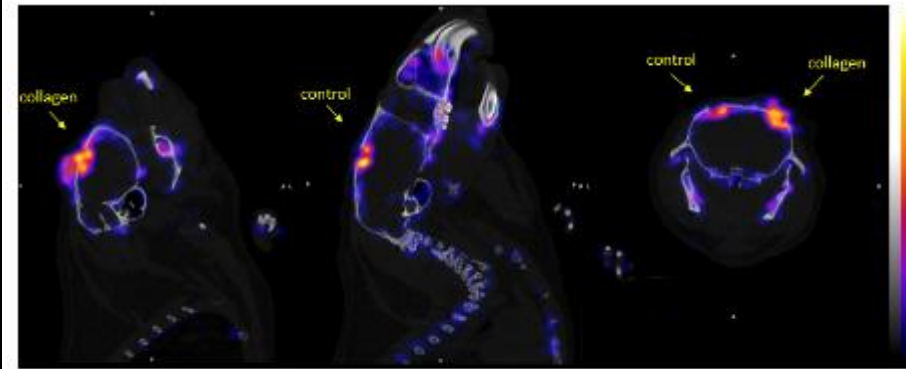
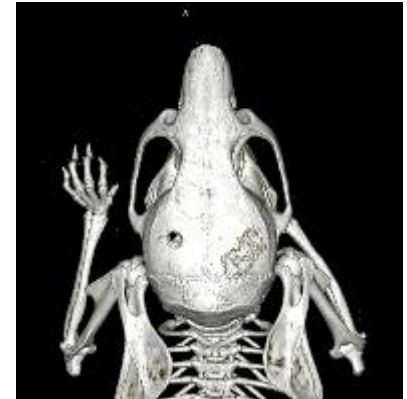
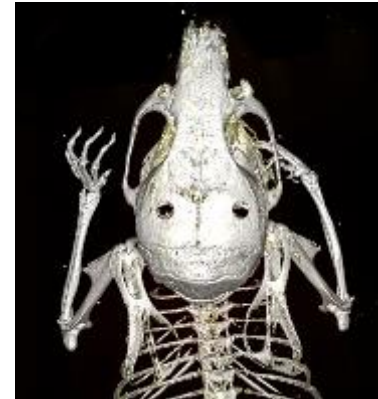


# Imaging examples (IV): Orthopaedics BIOEMTECH

## Whole body in vivo bone imaging

Imaging bone regeneration  
using collagen

Combined micro-CT and  
micro-SPECT imaging  
using [ $^{99m}\text{Tc}$ ]TcMDP



R defect (collagen)  
sagittal view

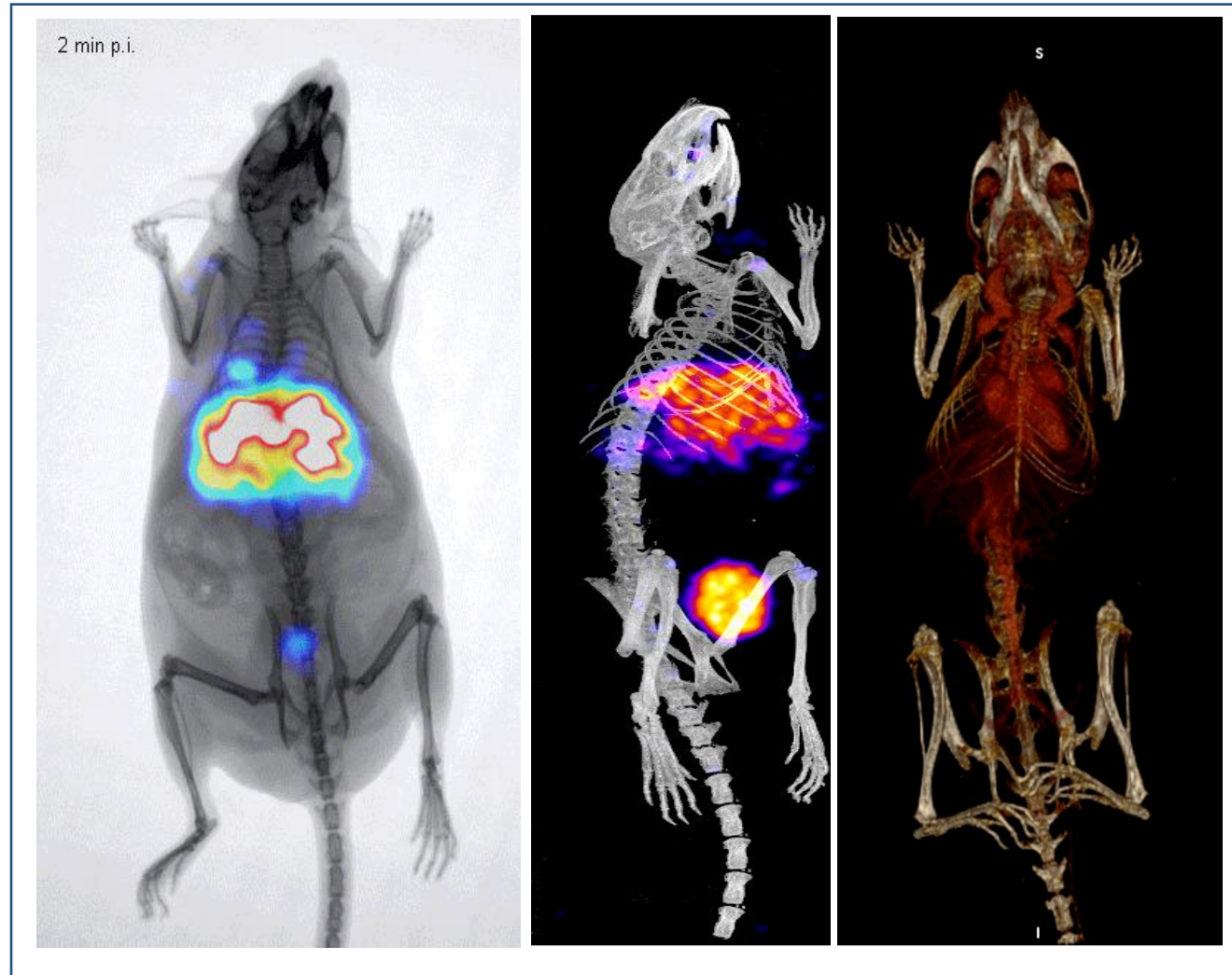
L defect (control)  
sagittal view

Coronal view of both defects

# Imaging examples (V): Nanoparticles BIOEMTECH

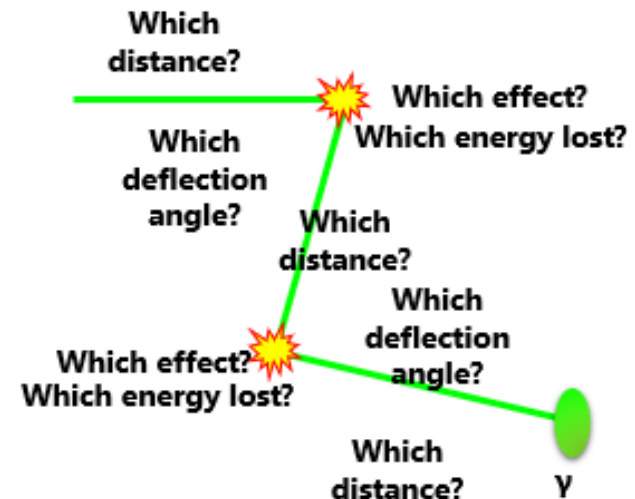
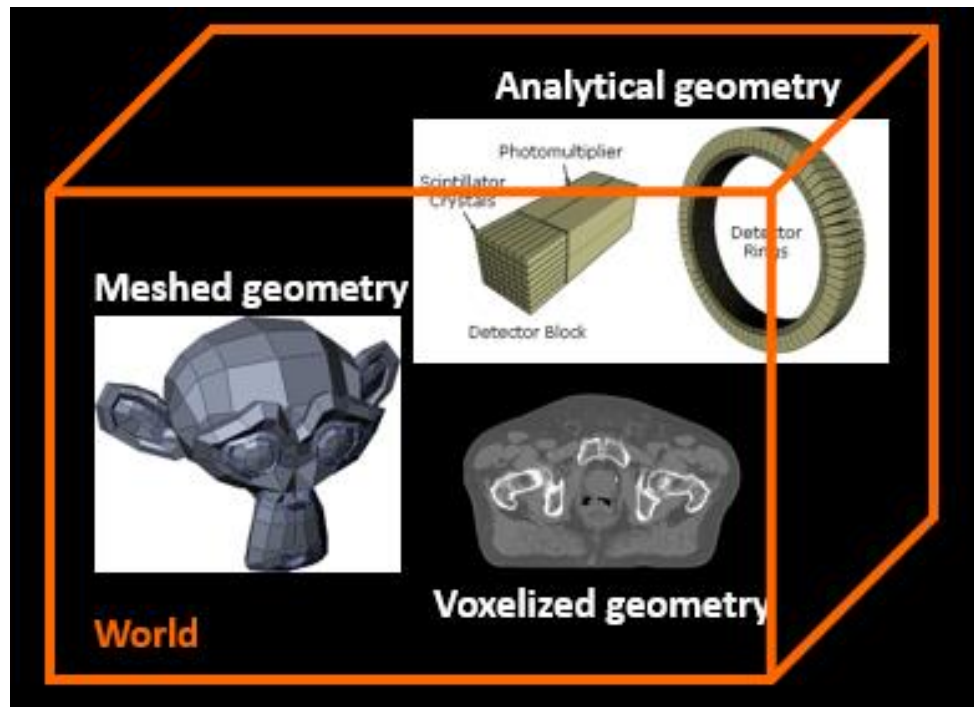
## Nanoparticles

- i. Dynamic imaging of silver NPs
- ii. SPECT imaging of magnetic NPs
- iii. CT imaging of gold NPs



# Simulations - Computational Models

**Monte Carlo method is a statistical approach to solve deterministic problems and define a specified system using random number generators**



Random sample must follow  
the laws of physics



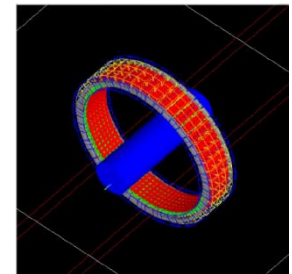
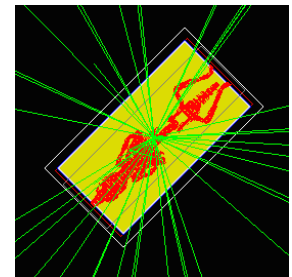
**BIOEMTECH is an official member of the OpenGATE collaboration**

***GATE: Geant4 Application for Emission Tomography,  
Transmission Tomography and Radiotherapy***



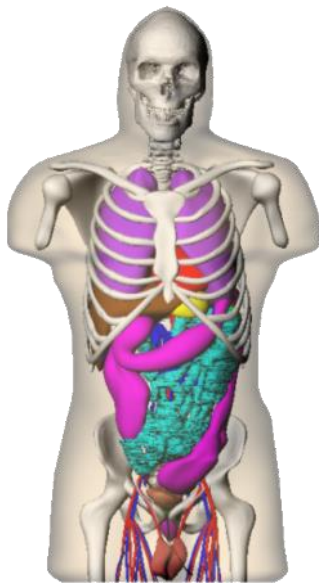
## Broad range of applications

- Detector Design
- Optimization of acquisition and processing protocols
- Assessment of quantification methods
- Optimization of tomographic reconstruction algorithms
- Use of voxelized anthropomorphic models
- Dosimetry

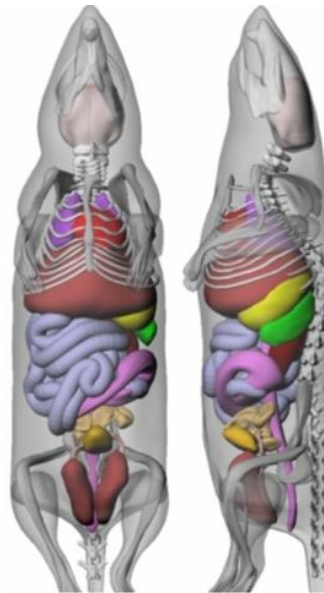


## Use of anthropomorphic and animal models for realistic simulations

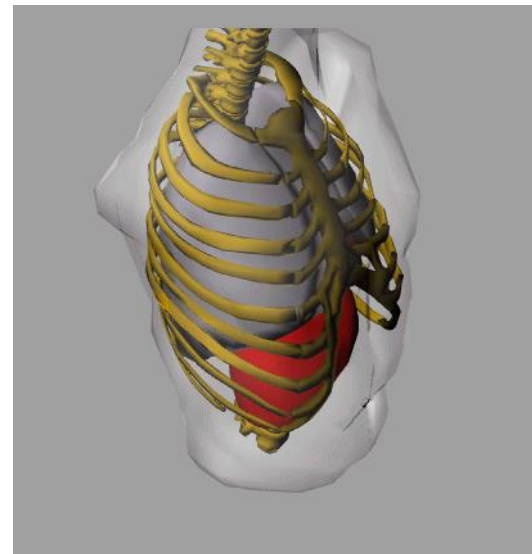
- Real clinical and preclinical data can be inserted in the simulations
- Use of human population phantoms to perform personalized studies
- Use and creation of animal computational models, based on CT/MR data



4D XCAT model



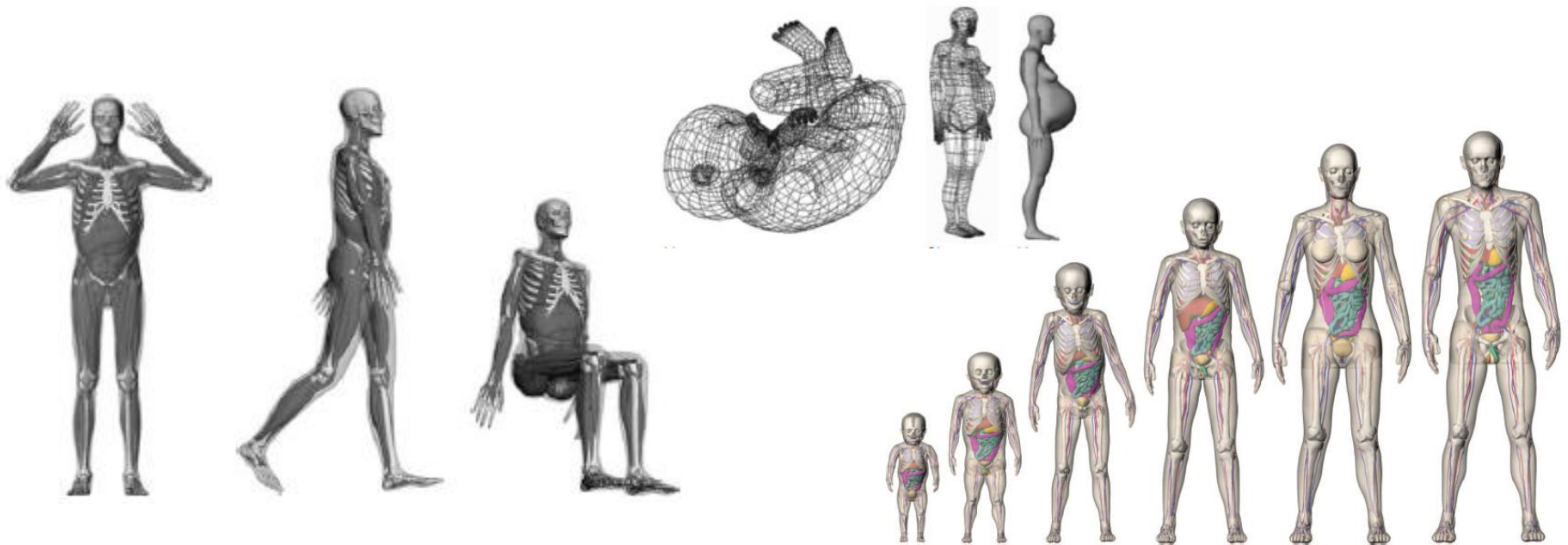
MOBY model



4D thorax model

## Use of anthropomorphic and animal models for realistic simulations

- Real clinical and preclinical data can be inserted in the simulations
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# Research Projects

## 6 H2020 funded projects

<b>Vivomag:</b>	H2020-MSCA-RISE-2014 <i>just ended</i>
<b>ERROR:</b>	H2020-MSCA-RISE-2015 <i>in progress</i>
<b>CUPIDO:</b>	H2020-NMBP-2016 <i>in progress</i>
<b>nTRACK:</b>	H2020-NMBP-2017 <i>in progress</i>
<b>POLYTHEA:</b>	H2020-MSCA-ITN-2017 <i>in progress</i>
<b>B2B:</b>	H2020-FET-2018 <i>in progress</i>

## 3 National funded projects

<b>NAVIGATE:</b>	National <i>in progress</i>
<b>BreastCaRANKL:</b>	National <i>in progress</i>
<b>SEPIA:</b>	National <i>just approved</i>

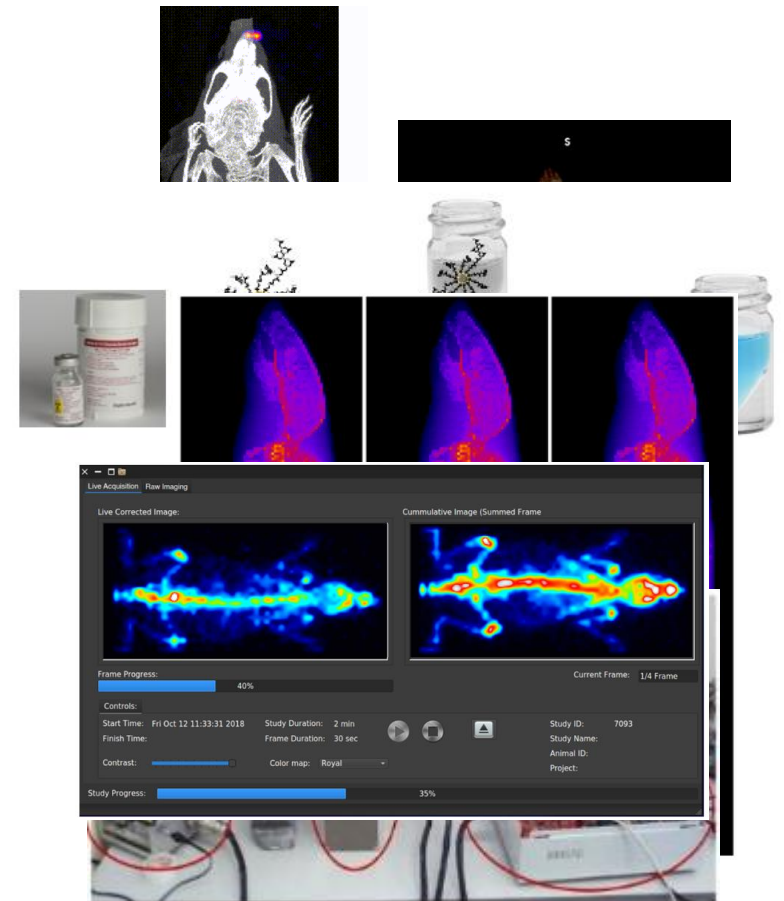
## 2 NEW European projects

<b>RuNNINg:</b>	EuroNanoMed <i>just approved</i>
<b>POPEYE:</b>	ERAPerMed <i>just approved</i>



# Role in the Projects

- ✓ Perform *in vivo* imaging studies (PET / SPECT / CT / X-ray / MR)
- ✓ Study *in vivo* the biodistribution of Nanoparticles (gold, iron, magnetic etc.)
- ✓ Study and analysis / optimization of radiolabeling protocols and stability tests
- ✓ *In silico* studies using MC simulations for diagnosis, therapy and dosimetry protocols
- ✓ Biomedical engineering solutions on radiation detection
- ✓ Development of software solutions



# Our Role to nTRACK Project

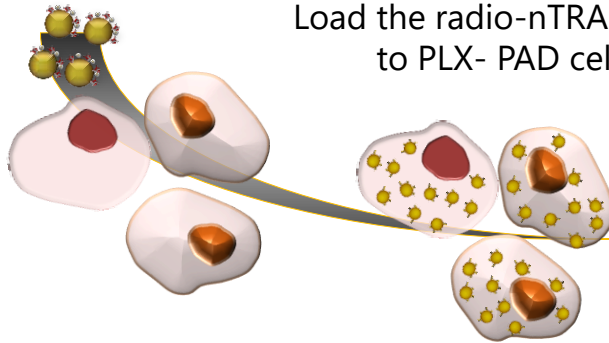
- ✓ Imaging studies in rodents with several modalities:  
CT/ PET / SPECT / MRI and their combinations (multimodal)
- ✓ Optimization of imaging protocols in rodents and scale up for large animals
- ✓ *In vivo* dynamic imaging for the evaluation of the stem cells' biodistribution
- ✓ Simulation studies using computational models:  
mouse / rat / sheep / human
- ✓ Development of Machine Learning algorithms (models) for the cells quantification and early assessment of treatment effectiveness

# nTRACK Imaging Platform

Radiolabeling of  
functionalized nTRACK NPs  
with various radioisotopes



Load the radio-nTRACK NPs  
to PLX- PAD cells



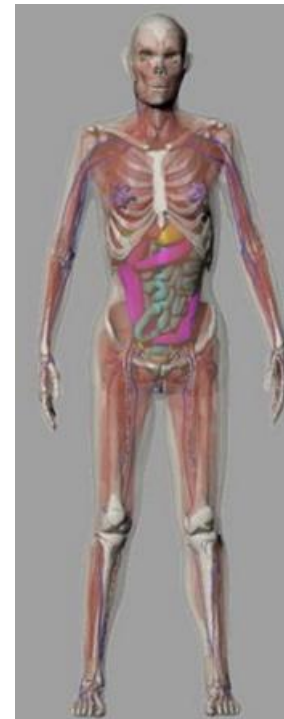
*In vivo* tracking of dual (Radio/Au) labelled  
cells by SPECT/CT imaging. Data processing  
and design of computational and machine  
learning predictive models for human  
translation



Load the nTRACK labelled  
stems cells to rodent  
models through i.m.  
injection towards *in vivo*  
imaging.

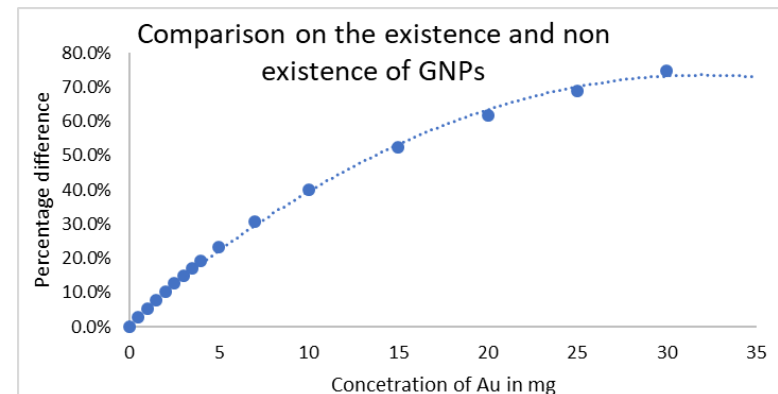
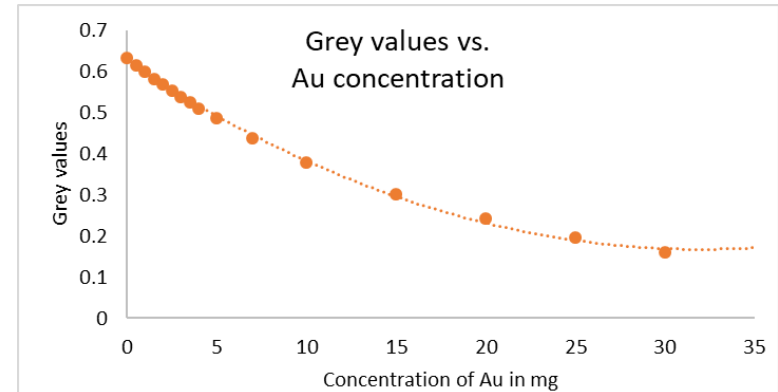
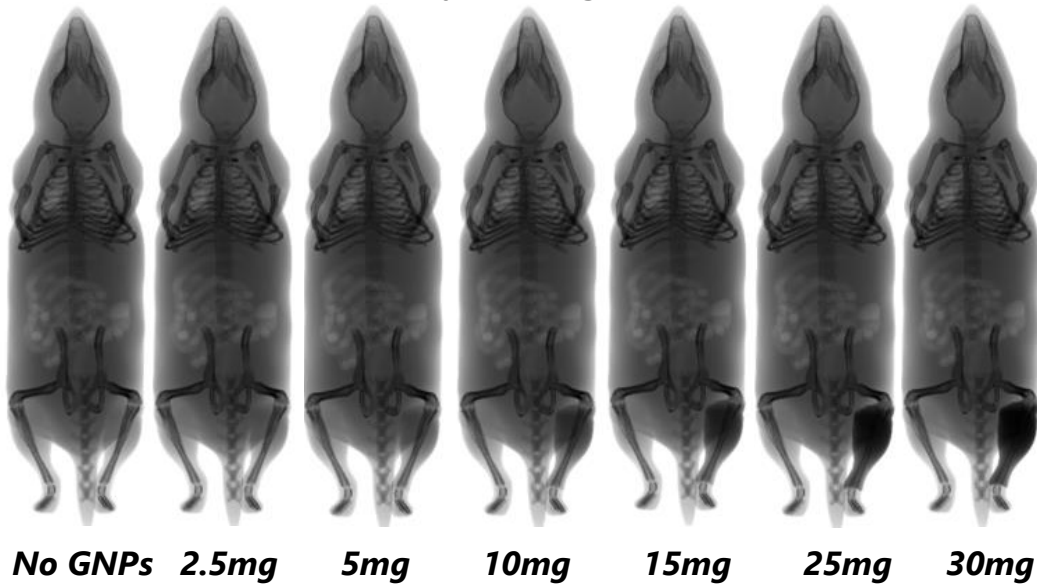


- MOBY mouse model
- ROBY rat model
- Sheep model (MANUALLY created by clinical CT data)
- XCAT human model

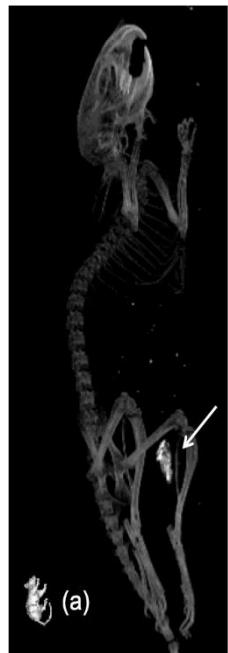




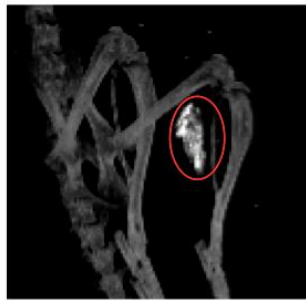
X-rays using different concentrations in leg muscle.



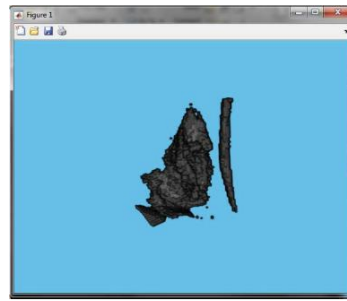
## Flow chart of the several steps acquired for the quantification of number of cells, developed in MatLab



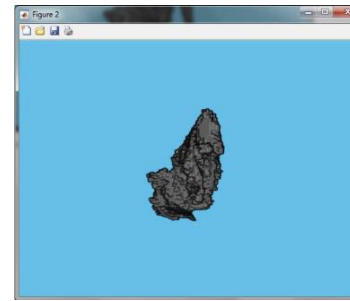
Initial CT image  
50  $\mu$ L of NPs  
solution



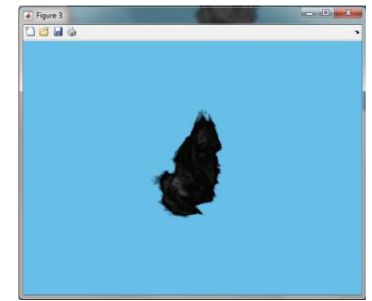
Initial ROI selection  
(manually)



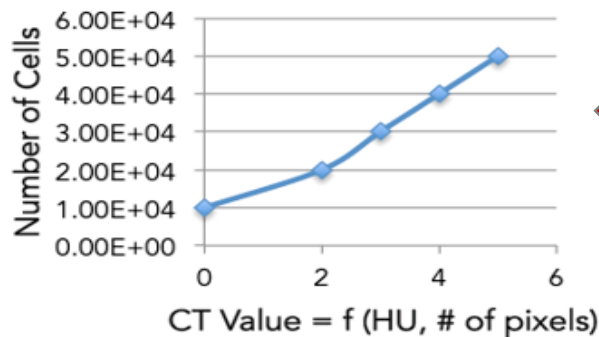
Unsupervised k-means  
segmentation to  
choose voxels with  
GNPs



Pixel connectivity  
filter to discard  
possible bone  
voxels



Final ROI through  
which the CT value is  
calculated



$$\text{CT Value} = f(\text{HU, number of voxels})$$

$$\text{Number of cells (t)} = A * \text{CT Value (t)} + B$$

# For more info contact us!



## BIOEMTECH

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Your Imaging Partner



**THANK YOU**  
FOR THE ATTENTION