

## Product Design Specification – V2.0

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**Project Title:** An open-source imaging platform for small animals

**Team Members:**

Jay Sekhon (Leader)  
Jon Seaton (Communicator)  
Whitney Johnson (BSAC)  
Sarah Springborn (BWIG)

**Client:**

Dr. Robert Jeraj	rjeraj@wisc.edu
Dr. Rock Mackie	trmackie@facstaff.wisc.edu

**Problem Statement:**

The overall aim of this project is to develop an open source small animal imaging and therapy platform that integrates imaging (e.g., Computed Tomography (CT), Positron Emission Tomography (PET)) and therapy (e.g., radiotherapy (RT)) together. This system will be designed on a flexible platform, enabling researchers to build their own system according to the available resources and needs. The specific aim for the design project is to provide initial design of such an open source imaging/therapy platform and potentially start prototyping the system at the fast prototyping system at the Morgridge Institute for Research (MIR).

**Client Requirements:**

- Complete list of specifications necessary for the design of a small animal imaging system
- System should be able to perform PET, CT, and radiation therapy
- Each type of imaging or therapy modality should be independent (e.g., an example device could only incorporate CT or only CT/RT)
- The development should be open source (i.e., all intellectual property is publicly available)
- The final product should have software and hardware completely ready to go in a "plug and play" format

**Physical and Operational Characteristics:**

- The device is to be used on small animals (e.g., rats and mice)
- The system should be able to incorporate any combination of PET, CT, and RT.
- Couch positioning, data acquisition, and data storage should be independent of any imaging/therapy modality.
- Each imaging/therapy modality will have its own level of specification

**Miscellaneous:**

Initial specifications for the imaging/therapy modalities and the overall device systems can be found in the tables below.

*Radiation Therapy:*

<b>Systems</b>	<b>Specifications</b>	<b>Vendors</b>
<b>Radiation Therapy System</b>		
Orthovoltage tube	2 Focal spots, 250 kVp max	Seifert ISO VOLT 225 M2, Seifert X-ray, Lewistown , PA  Nucletron Selectron HDR system (Ir core)
Large focal spot	2.0 mm	
Dose Monitoring system	detectors-ion chamber, Radiochromic films	Ion Chambers - IBA Dosimetry, Bartlett, TN
Primary collimation system	Material-W, Cu, Brass	Millenium MLC - 120 leaves - Field size = 40 cm x 40 cm - Varian Medical Systems
MLC leaves: W or Pb	thickness - 2 mm, 120 leaves	
Beam control system		
Target cooling system	Water cooling	
Motor	Same used for CT	
Animal Positioning System - Table	0.125 mm, 0.05° rotational	Servo Systems Co. Montville, NJ
Physical Platfrom	Made with plastics	

*CT :*

<b>CT system</b>	<b>Specifications</b>	<b>Vendor</b>
Bore diameter	12 cm	
X-ray source	Tungsten anode, 50-100 kVp	
Focal Spot	< 10 micron,	0.3mm Seifert X-ray
Filters	0.5 mm Cu, 1 mm Al	
Flat panel Si (amorphous) detector	resolution: 20 - 40 micron, 0.25 mm <sup>3</sup> voxel resolution  Fan beam, FOV= 10 cm X 10 cm	Perkin Elmer, Fremont, CA
Image reconstruction system	Feldkamp projection for CT	
Motor	same as for RT system	
Three dimentional Digitizer	MlcroScribe3DX, Immersion Corp, SanJose, CA	
Animal Positioning System - Table	0.125 mm, 0.05° rotational	Servo Systems Co. Montville, NJ

*PET:*

<b>PET system</b>	
LSO detector crystals	10 mm thick, 64 blocks 20 by 20 array
Timing resolution	312 ps
Transmission source	Co-57
Image reconstruction system	Filterback projection for PET

*Other Systems:*

Couch positioning system	
Data acquisition system	
Treatment planning system	Wisc plan
Data management System	
Beam shielding system	Pb shielding
Power control system	
Power backup system	
Fail Safety System	
Report verifying system	
QA system	
PACS system	
Data base management system	
Scheduling system	
Electronic recording system	