INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

MATERIALS MANAGEMENT DIVISION

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Technical specification for Small animal 3D Optical Tomography In vivo Imaging and Micro-CT System

A combination of a 3D optical tomography in vivo small animal imaging system along with a stand-alone Floor micro-CT system for small animal imaging with following specifications is required:

S. No.	Tender Specifications
3D Optical Tomography In vivo Small Animal Imaging System	
1	Should be fully automatic system to image live small animals like mice, rats, hamsters & rabbits should be suitable for biophotonic, fluorescence, bioluminescence and chemiluminescence and radio isotopic Cerenkov studies for in-vivo and in-vitro use.
2	Complete system should be provided with light tight cabinet (allowing dark room conditions to disallow any leakage of light), CCD camera, excitation and emission filters sample stage, gas anesthesia system and computer workstation.
3	Camera : Grade one back thinned, back illuminated CCD Thermoelectrically cooled to at least -90 ˚C 16-bit digitizer for broad dynamic range Minimum Imaging Pixels: 2048 x 2048 Pixel Size: 13.5 microns Min. Image Pixel Resolution: 20 microns
4	Filters which should accommodate fluorescent dyes in the Green to Far red Spectrum (430 nm - 850 nm) or better. Excitation filters: minimum 10 (equivalent to bandpass filters in the above range with an interval of 35 nm or better) Emission filters: minimum 15 (equivalent to bandpass filters in the above range with an interval of 20 nm or better)

5	The analysis software: Should perform background subtraction with the image algorithms based on compute pure spectra. Spectral unmixing of multiple reporters (at least 5) within same animal.
6	Stage movement software control for multiple Optical Field of View (FOV): 4 X 4 cm or less and 20 x 20 cm or more.
7	Stage movement should be software controlled for different levels of magnifications or equivalent approach to provide precision and flexibility for imaging. Various levels of magnifications to be provided are f/1 - f/8; 1.5x, 2.5x, 5x, 8.7x or better. The choice of magnification should be software controlled for individual imaging applications.
8	The system should be sensitive enough to detect single cell in vivo & in vitro with proven data. Publication support should be provided.
9	3D surface topography: The system should provide 3D surface topography and be able to create 3D images using optical light for accurate reconstruction of light sources in deep tissues.
10	3D tomography: The system should quantify the depth, geometry, and brightness of a fluorescent or bioluminescent source in 3-dimensional space using 3D tomography and should be able to co-register organs from the Mouse Atlas on a 3D image for exact positioning of point source.
11	Fluorescence Illumination modes: Both Epi-Illumination and Trans-illumination for localization and quantification of deep tissue sources must be provided and be compatible with all filter combinations as specified in #4.
12	Phantom Mice The system should be provided with Phantom mice both for Fluorescence and Luminescence Imaging.
13	The system should be software compatible to make 3D optical tomographic images to use with X-Ray micro-CT system.
14	The system should be supplied with high configuration computer with I5 processor, 4 GB RAM, nVidia Quadro 600, 250 GB and 1 TB HD, 24" widescreen LED Monitor work station with preinstalled complete software package for control, scanning, visualization & analysis.
Floor Micro-CT system for small animal imaging	
15	High resolution and high speed Floor CT system capable of seamlessly co-registering with 3D optical tomographic integrated markers should be provided with the following specifications: - Resolution of minimum 2.3 μm voxel

	- Voltage controllable microfocus X-ray source (90kV, 88μA, 8W) - sCMOS flat panel detector array of 2944 x 2353 pixels - Minimum scan time 4 sec or less (scanning cycle < 4 sec).
16	Micro CT in vivo and ex vivo imaging of all organs including lung, bone, kidney, heart, brain with Multispecies imaging capability for small animals such as mice, rat, hamster & rabbit and with bore size of 160 mm or more for larger animals with weight upto 5 kg for whole body imaging.
17	Must permit animal of more than 200 mm scannable range be stitched together and displayed as a single image.
18	System should have user-defined image resolution and field of view (FOV) size & should be able to adjust the animal position with respect to the X-ray source and detector for different physical magnifications. The choice of magnification should be software controlled for individual imaging applications.
19	System should be capable to do high speed imaging with less than 4 sec. scan time and be capable for high resolution (2.3 um resolution or better) imaging. System should also perform multiple scans with minimal radiation impact and adverse physiological outcomes.
20	System should be capable to do imaging of the sample in 360 degree around the sample to acquire 3D data with a choice of viewing field and magnification. Circular or helical scanning should be available.
21	System should have a continuous gantry rotation system during scanning.
22	X Ray focal spot of 5um or equivalent for better resolution with minimum 5 filters (Al 0.5 mm for low contrast samples, Al 1.0 for soft tissue/fat analysis, Al 0.5 mm + Cu 0.06 mm for standard CT scanning for bone etc., Cu 0.1 mm for dense samples at high voltages, Cu 0.2 mm for metal containing samples) allowing the user to select different filtering settings for their scans.
23	The system should be enabled with intrinsic image-based cardio-respiratory gating for multiphase reconstructions of respiratory and cardiac function without requiring cardiac and respiratory monitoring equipment like an electrocardiogram (ECG), pneumatic sensor or video camera.
24	System should be capable to use 3D Fluorescence & Bioluminescence tomographic modules with integrated, fiducial markers to seamlessly co-register with a computed tomographic platform for different disease models, such as bone metastasis longitudinal monitoring, drug kinetics, vascular disruption, cardiac & tumor therapy analysis etc. Please provide data to prove this important point, preferably published in peer-reviewed journals.
25	Animal beds such as those for Rabbits, Hamster, Mice and Rats should be provided.
26	The BMD Phantoms for Mouse with 2 different concentration of calcium hydroxyapatite and Rat with 2 different concentration of calcium hydroxyapatite (total 4 nos) need to be supplied. Phantoms (minimum 2 nos) for trabecular thickness needs to supplied along with the instrument.

27	The system should have GPU-based highspeed 3D image reconstruction. The reconstruction must be performed automatically on the same computer within 1 minute after image acquisition.
28	The temporal resolution of the detector must be 117 frames per second and less.
29	The instrument must have a high-quality glass-transparent window with protective shielding against X-ray radiation and a lighting system which allows direct observation of the animal during the scan.
30	The operational instrument noise should not be higher than 55 dB.
31	**BONE, FAT and TUMOR MORPHOMETRIC IMAGING AND ANALYSIS:** System should be able to perform morphometric analysis of bone like BMD and BMC parameters, trabecular thickness and cortical bone morphology, adipose fat analysis, structure thickness, separation and porosity, bone-implant studies and bone tumor & other tumor studies. System must have automated 3D bone segmentation and BMD and ASBMR parameter measurements. System should also be able to perform metabolic studies such as Quantitative fat segmentation: brown fat, subcutaneous fat, visceral fat.
32	**CARDIO-RESPIRATORY ANALYSIS:** Cardio-respiratory gated images must be acquired within 4 minutes or less. System should be able to do Cardiac analysis- Intrinsic, retrospective, phase gating: systole, diastole. The data acquired should allow the user to reconstruct different phases of cardiac and respiratory cycle. The allowed measurements should include Ventricular End-Diastolic Volume (LVDV & RVDV), Ventricular End-Systolic Volume (LVSV & RVSV), Ventricular Ejection Volume (LVEV & RVEV), Ventricular Ejection Fraction (LVEF & RVEF) and functional and metabolic imaging of myocardial infarction models. Should be provided with Publication support.
33	The reconstruction software should be able to perform sub-volume or slice reconstructions, allow portion of the image to be zoomed in and reconstructed at the highest resolution without the need of additional scan.
34	Must have on-screen CT dose display based on dosimetry.
35	Optical and CT mode shuttles and adapters for small animals should be available for co-registration of CT & optical 3D tomography for easily fused 3D visualization and analysis.
36	The radiation safety must be <1μSv / h at any point on the instrument surface.
37	The system should be supplied with high configuration computer of processor 3.60 GHz, 3.90 GHz turbo, 4 cores, 8,25 MB cache, Ram 32GB (4x8GB) 2666MHz with graphic card Quadro P2000 5GB, 4DP work station with preinstalled complete software package for control, scanning, visualization & analysis.
Offline computer, Software and Other requirements	

38	In line Gas anesthesia: Ports and multiple position manifolds, nose cones (5 for mice, 3 for rats and 2 for hamster/rabbit) with gas flow controller should be supplied. Complete working configuration inclusive of hardware/software, tubing, valves, should be supplied.
39	Must provide additional Laptop/PC with specifications - i5 processor, 8 GB RAM, 1TB hard drive, 24 inches HD monitor, graphics card with 24/32 bit capability with Windows 10 (or latest model) for analysis with image acquisition and analysis software(s) installed.
40	The software for image acquisition and analysis should be provided with minimum 3 copies.
GENERAL TERMS AND CONDITIONS	
41	The company should provide a comprehensive plan for on-site training, conducting workshops and software upgrade every six months during warranty period.
42	Company should provide free of cost training in first 3 months after installation to multiple users PLUS one onsite training session to multiple users every six months for the entire period of Warranty.
43	Trained engineer & application support within India should be available for onsite training & support.
44	The company should provide performance proof of similar scope of work (3D optical tomography co-registered with stand-alone micro-CT) in India. Provide list of current installation.
45	The equipment and all accessories must be provided with a comprehensive on-site warranty for 5 years (60 months) including spare parts and labor.
46	Warranty will start from date of successful installation.
47	During the Warranty period, the supplier is required to visit at consignee's site at 2 times in the year commencing from the date of the installation for preventive maintenance of the Equipment/Stores.
48	The Supplier along with its Indian Agent and the CMC provider shall ensure continued supply of the spare parts for the machines and Equipment supplied by them to the purchaser for 10 years from the date of installation and handing over. Company should ensure that spare parts will be available till 10 years from the installation
49	Performance security 3% of the cost of the supply value shall be deposited till the Warranty period of the Instrument.
50	Should attend all breakdown calls within 24 hours of the receipt of information from the institute through fax/e-mail/mobile/sms.
51	The equipment will be diagnosed with a problem within 72 hours of receiving the complaint and repaired within 4 weeks, failing which the warranty period will be extended by the number of days the instrument is non-functional post 4 weeks.
52	Technically qualified operator should be provided for 3 years. The technical operator should be present on all working days of the institute as per the norms. She/he should be able to train students on a periodic basis. This should be quoted with a monthly salary of the operator to be comparable to that of a JRF i.e. 50000 INR/month or better. The overall cost should also include a general 10% hike of salary every year.

53	1. Animal isolation box