

microPET/CT hardware details

Detector Architecture

Inveon's detector design includes an innovative high efficiency light guide*that delivers more photons to the photomultiplier tube, thereby improving energy and timing resolution. The detector also features a larger 20 x 20 LSO crystal array axial FOV of 12.7 cm. LSO offers the best combination of properties of any PET scintillator used today— fast scintillation decay time, high light output, and effective atomic number.

Electronics

10 bit A/D at 100 MHz sampling. Timing resolution is improved through the use of 312 ps time bins. The result is a PET system with exceedingly high singles and coincidence data rates as well as excellent random and scattered event rejection.

Reconstruction options

- 2D or 3D PET analytical and iterative reconstruction methods
- Feldkamp CT reconstruction method
- 3D-OSEM and 3D-MAP SPECT reconstruction methods
- CT attenuation correction, scatter correction, decay correction, deadtime correction, pileup rejection

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X-ray detector:

The bore diameter is 12 cm. A large area detector (165 mm diameter) is available with 4064 x 4064 pixels, providing a maximum FOV of 10 cm x 10 cm. The X-ray source and detector are positioned on precision, computer controlled mechanical slides, allowing the operator to adjust the scanner FOV and magnification from the command console. This detector also has a superior signal to noise ratio with 14 bit readout and a dynamic range of 67 dB with 1 x 1 binning, 79 dB with 2 x 2 binning, and 84 dB with 4 x 4 binning. The maximum achievable resolution with this detector and the standard X-ray source is 40 microns. With the variable-focus X-ray source, the maximum resolution is approximately 10 microns.

Data Reconstruction

Siemens uses a modified Feldkamp algorithm for fast, accurate volumetric image reconstruction. Two reconstruction configurations are supported:

- Standard – volumetric reconstruction algorithm running on the data acquisition workstation
- Real Time – reconstruction performed on a dedicated high speed platform during a scan. The real time reconstruction engine allows reconstruction to start as the projection data is being acquired. Reconstruction times depend on imaging protocol but can be complete by the end of the acquisition.

Respiratory and Cardiac Gating

A high-speed shutter acquires image frames with exposure times as short as 10 ms for gated studies. TTL gating ports allow the input of both cardiac and respiratory trigger signals.

Data Analysis

- Multiple data sets viewed in a single image window
- 2D and 3D fused data review
- View dynamic and gated processes
- List mode data format to allow for flexible rebinning and reframing
- Up to three different data sets loaded simultaneously
- Quantitative analysis including ROI statistics, time activity curves, and line profiles

Pharmacokinetic Modeling

The functionality of the core kinetic analysis workflow can be extended by the addition of pharmacokinetic analysis tools to further analyze time activity data. This option provides a range of standard pharmacokinetic models integrated within the kinetic analysis workflow allowing easy analysis of one or more regions of interest with the same model simultaneously. Any necessary input functions may also be defined from the loaded image data or alternatively loaded from an external file. The models available include:

- Two compartment reversible
- Two compartment irreversible

- Patlak
- Reference Patlak
- Logan
- Reference Logan
- Multiple Exponential
- One tissue compartment model
- Simplified reference tissue model

The results of each model are displayed in both graphical and tabular forms. The quality of the model fit can be assessed from the displayed statistical values such as the Chi-squared error and the correlation coefficient between the fitted parameters. Additionally, some of the models can be used to generate parametric images from dynamic data sets. Kinetic models available for parametric imaging are:

- Patlak
- Logan
- Reference Patlak
- Reference Logan

Once calculated, parametric images are displayed in the standard orthogonal views and can be viewed or overlaid on the original dynamic data and/or associated anatomical data.

Additional capabilities:

3D data analysis software for bone morphometric analysis

- Bone Volume/Tissue Volume
- Bone Surface/Volume
- Trabecular Thickness
- Trabecular Number
- Trabecular Spacing
- Trabecular Pattern Factor

Physiological Monitoring and Heating System

The BioVet® (m2m Imaging) is a physiological monitoring and heating system designed for use in preclinical imaging applications. The BioVet system is designed for physiological monitoring and gating of imaging sequences by physiological events (respiration and/or ECG).

Isoflurane System

This portable anesthesia system by Summit Anesthesia Solutions was designed specifically for use in laboratory research. This modular unit includes a removable compact anesthesia system mounted on a rolling stand which holds two E-tanks of oxygen. Complete with a new Tec 3 style vaporizer, induction chamber, and a Mapleson- D non-rebreathing system specifically tailored for use on the Inveon.