

Overview

Complete, versatile, high performance and vendor-neutral solution for SIRT dosimetry ⁹⁰Y-microspheres providing:

- **Pre-implantation** dosimetry based on ⁹⁹Tc^m-MAA-SPECT exam (MacroAggregate Albumin) and liver-lung shunt assessment
- **Post-implantation** dosimetry based on ⁹⁰Y-microspheres-PET (or SPECT Bremsstrahlung) exam
- **Dosimetry comparison:** treatment planning from ⁹⁹Tc^m-MAA-SPECT exam vs. *in vivo* control from ⁹⁰Y-microspheres-PET (or SPECT Bremsstrahlung) exam
- **Consolidation** of multiple treatment stages: internal dosimetry and/or external beam radiotherapy

PLANET[®] Dose is developed in partnership with Beaujon Hospital, Paris (APHP), France. PLANET Dose integrates the Voxeldose calculation algorithm (Henri Becquerel Center and CHU, Rouen [contact I Gardin], Beaujon Hospital, Paris (APHP) [contact A Dieudonné]).

Image Reviewing

Display

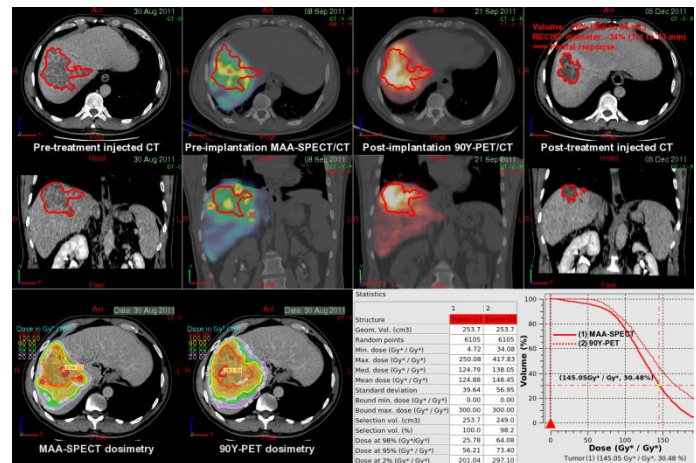
- Visualization and display of:
 - Anatomical series: CT, CTA, CBCT, 3D XA, MRI
 - Functional series: PET, SPECT
- Dedicated layouts for multimodality series review - single and dual screen configurations
- Powerful fusion of anatomical and functional series
- 2D and 3D visualization of fused series, 3D MIP display
- Adjustable fusion display parameters to highlight differences between functional series
- Set of interactive navigation and exploration tools: sensor, LUT, distance, contrast luminosity, zoom, SUV tools
- Simultaneous display of any number of exam time points
- Interactive display navigation between 2D and 3D display

Co-Registration

- Co-registration to the reference series
- Co-registration between series on same time point (e.g. SPECT vs. CT and PET/SPECT vs. MRI)
- Fully automatic rigid registration (mutual information based on optimization, block matching) and semi-automatic registration (user-defined anatomical landmarks)
- Registration focused on dedicated ROI (specific organ) to avoid positioning differences (arms, head, ...)
- Visual tool-set for registration assessment: checkerboard, adjustable magnifying glass overlapping and image fusion transparency
- Deformable registration (WIP)

Export – Archiving

- Registered series saved as DICOM format
- Export to any DICOM compliant system (e.g. PACS, archiving system, TPS)
- 3D display movie export



Transarterial radioembolization workflow (diagnosis, treatment planning, in vivo control, comparison, follow-up of therapy response)

Quantification, Segmentation

Contouring Tools

- Real-time contour drawing and edition within multiple views on series involving several modalities
- Semi-automatic advanced contouring tools
- Contour duplication and interpolation capabilities between time points and different modalities
- Unlimited number of structure definition with customizable rendering
- Boolean operator (AND, OR, XOR, NOT) for creating new structures
- User selectable contour rendering: 2D line transparency and 3D solid representation
- Intensity-based contour delineation (e.g. bones, external body contour extraction)
- 3D margin calculation
- Structures agreement quantification (Dice, Jaccard, overlap fraction, sensibility, specificity indices)

Segmentation

- One click and automatic segmentation of uptake areas on PET series: Maximum intensity, Nestle, Black, Fitting, Adaptive methods
- Partial volume effect correction for functional modalities
- Fully automatic segmentation for whole body PET/CT series
- Lesion quantification of metabolic activity: volume, SUV mean (including partial volume correction), SUV max, SUV peak and TLG
- SUV bw, SUV lbm and SUV bsa quantification available
- Automatic lung segmentation
- Semi-automatic segmentation on anatomical series: CT, MRI

Therapy Response Assessment and Treatment follow-up

PLANET[®] Dose benefits from all the advanced functionalities of PLANET[®] Onco: reviewing, segmentation and RECIST 1.1/PERCIST 1.0 format reports

Dosimetry Module - Calculations

Radionuclide

Yttrium-90 (⁹⁰Y)-microspheres

NB: more radionuclides and time integrated activity calculation based on serial SPECT/PET data sets possible with a collaboration contract.

Algorithms

- Convolution-based algorithm: dose Voxel Kernels, Voxel S-Values (VSV)
- VSV pre-calculated by Monte Carlo at a fine sampling (0.5 – 1 mm)
- Resampling of VSV at the SPECT or PET voxel size
- Dose calculation by rapid convolution (Fast Hartley Transform)
- Homogeneous tissue density assumption
- Calculation time < 20 s
- Very good agreement with direct Monte Carlo (delta < 1 %)

Dosimetry Module - Analysis

Display

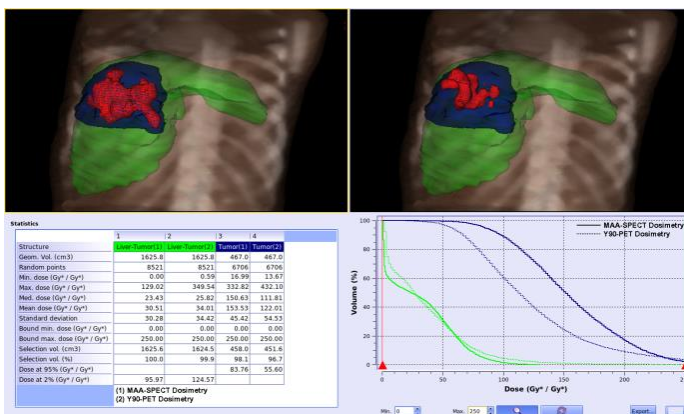
- 2D and 3D display - Color surfaces and/or isodose lines
- 2D and 3D maximum of dose
- Range of Gray values

Tools

- Dose to a point
- Dose profile on a line
- Dose in a volume including Dose Volume Histogram (DVH)
- Structure creation from user defined dose threshold

Comparison and consolidation

- Simultaneous display of 2 dose plans, including synchronized tools (juxtaposition, subtraction, superposition)
- Subtraction, addition of multiple treatment stages: internal dosimetry and/or external beam radiotherapy
- Gamma-index values



DVH comparison display: treatment planning from ⁹⁹Tc^m-MAA-SPECT exam vs. in vivo control from ⁹⁰Y-microspheres-PET exam

Report and Export

- Report preview and printing capabilities
- Creation of new DICOM objects (images, charts, screen saves) exportable to any DICOM compliant system
- DICOM encapsulated PDF reports managed in database

Connectivity

DICOM Compatibility

- DICOM CT, CTA, 3D XA, MRI, PET and SPECT image series
- DICOM Query Retrieve Import/Export (SCP/SCU)
- DICOM RT-Struct, RT-Dose Import/Export
- Network, PACS and external device (CD, DVD, USB) supported

Series management

- Long-lasting local database for series and studies management
- Unlimited number of time points including anatomical and functional series for each study
- Traceability: operation monitoring (operators and dates)

Host System

Minimum System Requirements

- Six core processor - Red Hat Linux OS 64 bits
- 3 * 1 To HDD (system/data, backup) - Memory RAM 16 Go
- 3D NVIDIA® graphic card - Flat screen 24" (1920x1080)

References

Gardin I., Bouchet L. G., Assié K., Caron J., Lisbona A., Ferrer L., Bolch W. E., Vera P. **VoxelDose: A computer program for 3D dose calculation in therapeutic nuclear medicine.** *Cancer Biother Radiopharm*, 2003.

Dieudonné A., Gardin I., Zhang P., Bolch W. E., Assié K., Buvat I. **VoxelDose: A software for 3D dosimetry in targeted radiotherapy using S-values at the voxel level.** 2008 annual meeting of the EANM. Supplement to *Eur J Nucl Med* 35(2): S135, Oct 2008.

Dieudonné A., Hobbs R. F., Bolch W. E., Sgouros G., Gardin I. **Fine-resolution voxel S values for constructing absorbed dose distributions at variable voxel size.** *J Nucl Med*, 51(10):1600-1607, Oct 2010.

Dieudonné A., Garin E., Laffont S., Rolland Y., Lebtahi R., Leguludec D., Gardin I. **Clinical feasibility of fast 3-dimensional dosimetry of the liver for treatment planning of hepatocellular carcinoma with Y90-microspheres.** *J Nucl Med*, 52(12):1930-1937, Nov 2011.