



ParaVision® 360

- The Most Advanced Software for Preclinical Imaging Research

Consistent Quantification

With a focus on consistent quantification, ParaVision 360 guarantees highest accuracy in all research stages, from set-up to quantification, leading to accurate, reliable data.

Used in the most distinguished laboratories, ParaVision plays an integral role when ground breaking discoveries ranging from basic research to drug development are performed on Bruker MRI, PET/MR, and PET/CT instruments with one software.

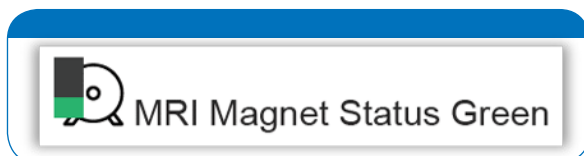
This fully integrated software provides optimal consistency across MRI, PET, and μ CT modalities and throughout studies. From preparation to analysis, the intuitive use, leads to fastest turn-around of results.

Precision in Preparation

Highest research accuracy starts with perfect animal set-up. Exact precision is guaranteed by the Animal Transport System¹ which can be controlled quickly and easily using the touchscreen at the front of the instrument. This contains such features as push-button automatic centering of slices to the isocenter of the magnet for maximum B0 homogeneity. The information from the touchscreen is directly fed to the ParaVision 360 console, allowing multi-station acquisition and subsequent automated image stitching, for largest Field of Views.

Accuracy in Imaging

For the most accurate interpretation of morphological and functional results, imaging protocols are the next step in data veracity. Pre-optimized protocols and scan programs provide consistency throughout studies.



Magnet status display

Consistency of Results

Taking consistency to the next level, the Continuous Arterial Spin Labeling (CASL) workflow package minimizes user interaction with its automatic operator independent output of quantitative Cerebral Blood Flow (CBF) maps. It decreases user bias and in turn increases the quality and reproducibility of longitudinal studies.

Reliability of Performance

Magnet status is displayed directly within ParaVision and can be monitored remotely² alerting users should the need arise, thus ensuring that critical studies can be carried out without interruption.

- Animal Transport System¹ control via touchscreen or from the console
- Pre-optimized protocols categorized via anatomy and application
- Scan program capability
- CASL workflow package for optimal scanning, reproducibility, and consistency
- Magnet status display and remote monitoring

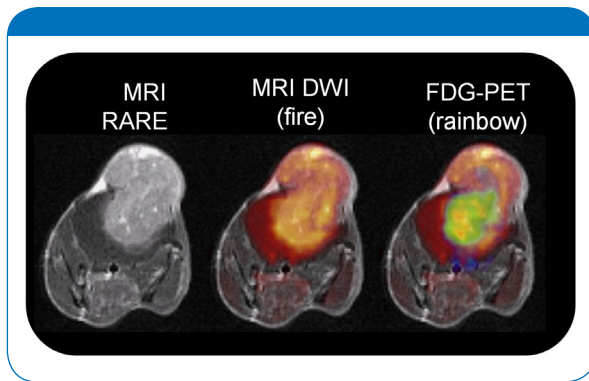
¹ Available for BioSpec 3T, Inline PET/MR, and PET/CT Si78

² BMU-5 required

● New Imaging Power

Precise Characterization of Cancer

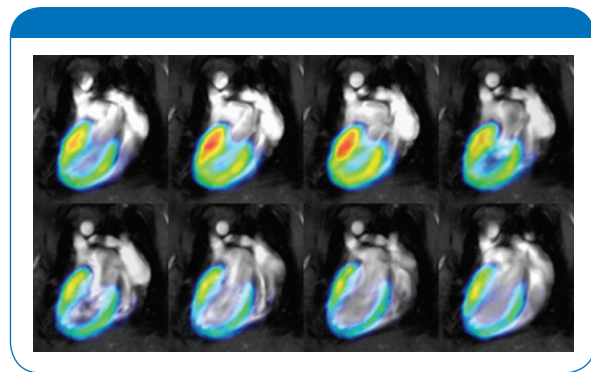
Accurate image reproducibility and quantification are imperative for oncologists measuring tumor progression, metastatic burden, and tumor treatment. PET images can be automatically fused to MRI or CT images. With the MR or CT images combined with the display of time activity curves from dynamic PET, oncologists have the full picture of the course of the disease and to identify and evaluate candidate tracers.



Mouse glioma study performed with simultaneous PET/MR at 7 Tesla. Fusion of one underlay and two overlay datasets.
Courtesy: U. Himmelreich, W. Gsell, C. Casteels, C. Deroose, KU Leuven, Leuven, Belgium.

Functional and Structural Cardiovascular Imaging

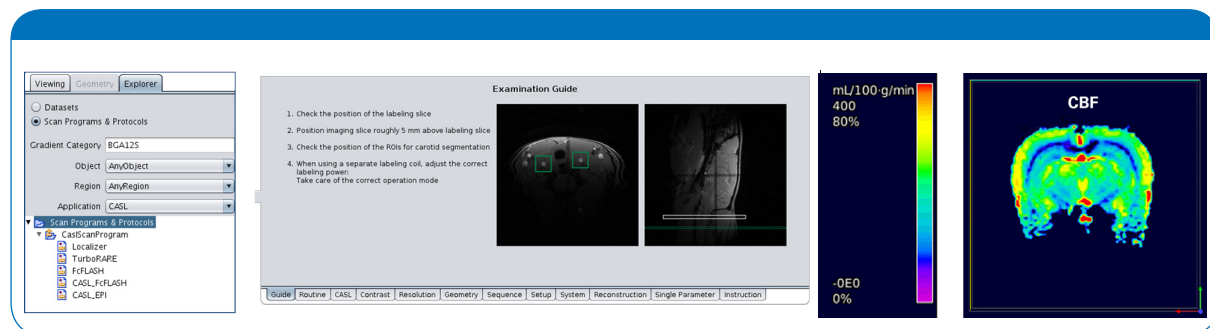
A common characteristic of cardiac models is their instability. Speed of investigation is therefore crucial for animal welfare as well as elimination of subject drop-out. Valuable setup time is saved by using IntraGate based scans, since they do not require any electrodes. These unique methods reconstruct all heart frames retrospectively without the need for time-intensive triggering. They are available for MR and simultaneous PET/MR.



Simultaneous PET and MR cardiac imaging without the need for ECG electrodes and using the PET insert and IntraGatePET.
Courtesy: W. Gsell, C. Deroose, U. Himmelreich, KU Leuven, Leuven, Belgium

New Levels of Accuracy in Neuroscience

Whether it be for investigating the extent of stroke or for following the progression of dementia, MRI arterial spin labeling researchers will appreciate the exceptional level of reproducibility that the CASL workflow package provides. This package escorts the user throughout the scanning process with a complete pre-prepared scan program, an examination guide and an integrated reconstruction with automatic measurement of inversion efficiency and output of quantitative Cerebral Blood Flow (CBF) maps.



CASL workflow package with automatic Cerebral Blood Flow (CBF) map output.
Courtesy: E. Barbier, L. Hirschler, J. Warnking, Grenoble Institute of Neuroscience, Grenoble, France

● Unified Imaging Interface

ParaVision 360's consistency across modalities lets users perform all of their imaging work within one familiar software. Common terminology between the modalities and integrated single and multimodal workflows provides optimal clarity during scanning. The cross-modality commonality between image processing and analysis, and data structure and management makes imaging even more intuitive, all while maintaining the full flexibility that Bruker users praise. The sophisticated viewing, reconstruction, and analysis tools let them gain the most information from their imaging subjects.

Throughput Optimized Scanning

In laboratories such as core facilities, that scan large numbers of subjects, every minute counts. Touchscreen control of the Animal Transport System¹, and quick and easy image positioning via interactive slice definition in the 3D viewport, lead to fastest set-ups and increased throughput. Pre-optimized ready-to-use protocols and scan programs with the integrated examination guide make scanning most time efficient.

- Animal Transport System control via touchscreen with direct interface to ParaVision 360 for fastest set-ups
- Common terminology between instruments and common integrated multimodal workflows for optimal clarity
- Over 100 validated and ready-to-use *in vivo* protocols and scan programs for mice and rats with integrated examination guide
- Slice geometry definition in interactive 3D viewport
- Scan to scan importation of parameters capability for maximum consistency

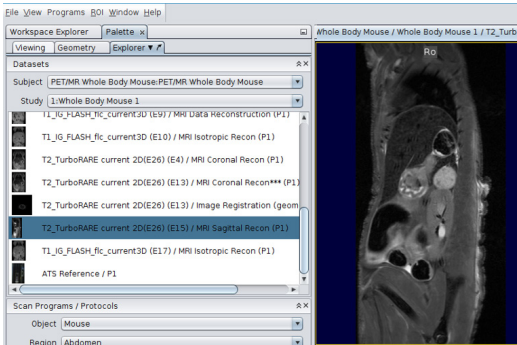
Flexible Viewing and Reconstructions

Institutes that host multiple instruments or multimodal instruments especially profit from straightforward and simple common image viewing and reconstruction tools, such as automatic multimodal fusion with up to two image overlays. Users who want to push the envelope can design their own methods and reconstructions within the open method development framework.

- Simple selection of prone or supine viewing
- Automatic 3D image fusion
- MIP, MinIP, surface rendering
- Zooming, panning, brightness, contrast, colormap, smoothing
- CT beam hardening and ring artefact correction
- PET partial volume correction
- PET dynamic frame slicing
- Method development framework
- MRI pulse program display

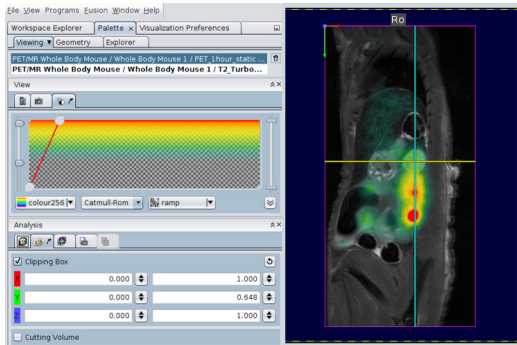
¹Available for BioSpec 3T, Inline PET/MR, and PET/CT Si78.

Scan



Protocols are pre-optimized according to species, anatomical region, application, field strength, and gradient type.

View



Flexible image viewing in automatically fused multimodal data facilitates interpretation.

Advanced Analysis

Whether performing basic research or preclinical trials, one thing that is common to all studies is the need for more than morphological images. Quantitative data is necessary for study evaluation and interpretation. Extensive analysis functions, such as interactive ROI navigation with immediate update, allow quantitative evaluation directly within ParaVision for fastest turnaround between measurements and study results.

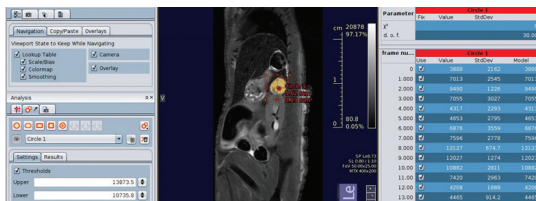
- Drag and drop image processing
- MRI T1, T2, T2* fitting
- MRI diffusion tensor evaluation
- Profiling, distance, angles
- Advanced intensity based image registration
- Dual overlay, alpha blending, image clipping, cut volumes
- Stacked ROIs with thresholding, seeded region growing, and freehand definition for precise volume quantification
- PET kinetic data display
- On-the-fly quantitative image mapping
- Image Algebra

Universal Documentation

Rigorous documentation is a must for highly meticulous laboratories such as those of pharmaceutical companies. Study reports ensure that all scan parameters are documented for future reference. These study reports, which come as a standard template for measurements and Q&A checks, can also be customized to meet individual needs. Data can be quickly accessed within the database which has a hierarchical sorting function as well as a free text search.

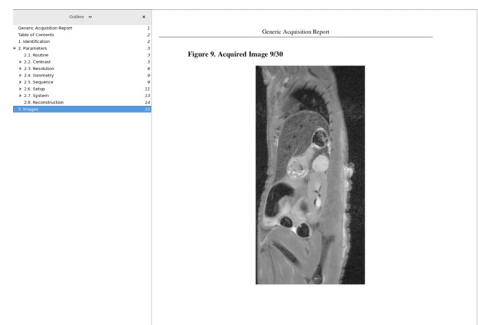
- Common dataset structure and management
- Data browser with simple searching functions for accessing stored protocols and recorded data
- Standardized and customizable report creation capabilities
- Standardized and customizable Q&A protocols
- CSV export of Image Sequence Analysis fit result tables and graph display for all ROIs
- Database and archiving
- DICOM and NIfTI formats allow seamless transfer to third party data analysis software

Analyze



Thresholded ROI analysis can be performed across all image slices and yields quantitative results.

Document



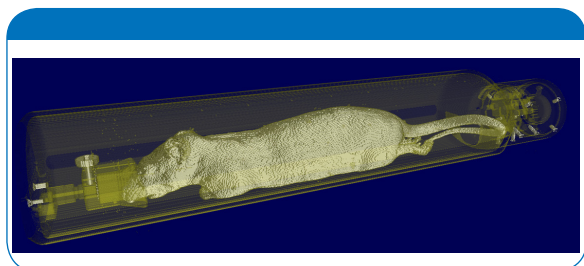
Customizable automatic report generation ensures scan parameter and image documentation.

● Seamless Multi-modality

The PET Comprehensive Acquisition Workplace allows the setup and control of preclinical PET imaging studies from a single workplace. The workplace is the software interface for multimodal imaging studies and enables multimodal research workflows involving different modalities from a single and common user interface.

Data Focused Pet

Animal registration and study setup are simple and intuitive, so that no precious tracer decay time is wasted.



MR-based isosurface reconstruction of Attenuation Correction Map.

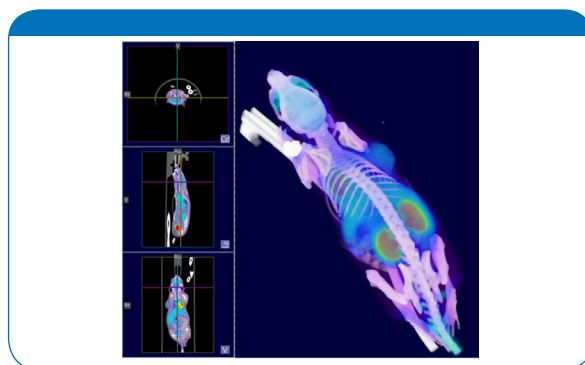
PET raw data stored in the List Mode format gives flexibility to the user to perform different post processing on the data such as dynamic or static reconstructions. Different image reconstruction algorithms are available ranging from the analytic FBP to time-saving OSEM and MAP that provides a higher signal to noise ratio (SNR).

- Ready to use PET application protocols for mice and rats
- Cardiac and respiratory gating (wireless for PET inserts)
- 2D/3D interactive viewing and co-registration (PET/MR or PET/CT)
- Image analysis: ROI, profiles, histograms, numeric
- Image time course analysis and multi-parametric fitting for kinetic modeling
- DICOM and NIfTI data export
- Automated and fast reconstruction: MLEM, OSEM, 3D-FBP and MAP.
- PET Data and Image Corrections: Scatter, Random, Decay, PSF and PVC
- Attenuation corrections, including corrections for animal cradles, and animal/sample attenuation.

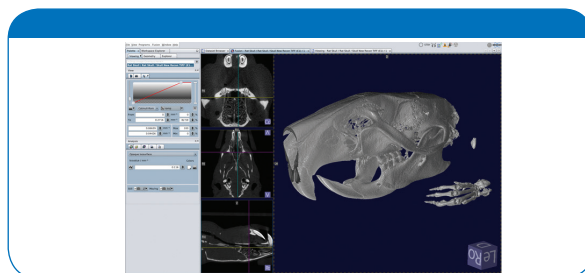
Routine and Fully Customizable microCT

The predefined microCT protocol library provides simple drag and drop scanning for routine studies. CT scanning includes a range of default options optimized for resolution, speed, dose, anatomy, and cardiac and motion corrections. Methods are defined to support body mass analysis, cardiac and pulmonary imaging, and anatomical reference and attenuation map functions. Full access to microCT parameters for customized applications extends the flexibility and range of applications, while features such as display of voltage, current, and ambient dose rate display when X-ray source is switched on, provide optimal overview.

- Static, multi-stage, dynamic imaging
- 3D/2D
- Step & shoot or continuous
- Ultrafast low dose protocols
- Cardiac & respiratory gating
- Real-time adjustments preview
- Smoothing, beam hardening & ring corrections
- Hounsfield scaling



PET/CT images are easily co-registered and tracer uptake can be inspected in detail using the advanced 3D viewing tool.



Orthogonal views and 3D display of rat microCT data.

● Powerful MRI

Bruker's exclusively large MRI sequence portfolio, contains all common spectroscopy, and gradient and echo-based imaging methods, as well as Ultra-short Echo Time (UTE) and Zero Echo Time (ZTE). All methods come as protocols that are pre-optimized for field strength, gradient version, species, anatomy, and application.

Protocols can additionally be stored for a specific nucleus, e.g. ^{13}C , re-establishing the coil operation mode when the protocol is reloaded. X-nuclei spectroscopy and imaging is further simplified by an auto-adjustment method for calibration of reference power and the possibility to optimize for reference pulse length or pulse power.

The range of methods also contains a Saturation Transfer module including Chemical Exchange Saturation Transfer (CEST) and Magnetization Transfer Contrast (MTC) and a dual echo-time option in UTE3D. A fat-water separation option is provided in RARE, enabling fat, water, and/or fat-chemical-shift-corrected images.

Fastest gradient timings guarantee imperative image fidelity and a gradient linearity correction allows most accurate volume calculation. Additionally, B1 can be mapped and shimmed with the ultrafast, robust, B1Map method.

For those whose focus is on understanding brain activity, dynamic shimming¹ in EPI improves fMRI signal location, leading to more precise results. Dynamic shimming is also available in multislice Chemical Shift Imaging (CSI), leading to decreased line widths, greater peak-to-noise ratio, and therefore a greater number of detectable metabolites and in turn a better understanding of brain metabolism.

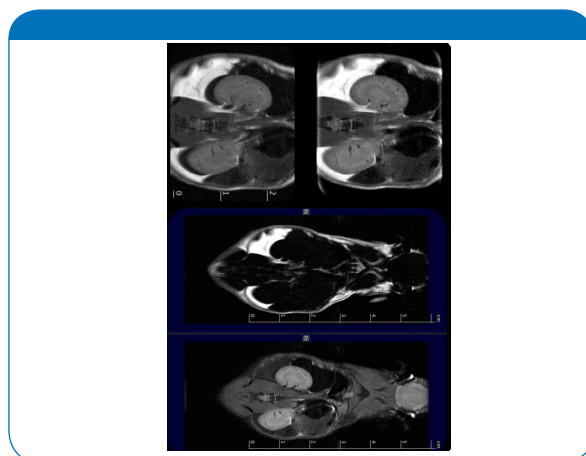
ECG-free cardiac imaging can be performed via IntraGate FLASH or IntraGateUTE, which couples wireless IntraGate imaging with radial UTE to provide virtually flow-artifact-free full heart cine coverage for up to x8-fold accelerated cardiac functional assessments.

Fastest results can be achieved using compressed sensing² based on random undersampling and iterative reconstruction, 3D GRAPPA with CAIPIRINHA reconstruction, or simultaneous multislice imaging (SMS) and partial-FT which allows homodyne reconstruction.

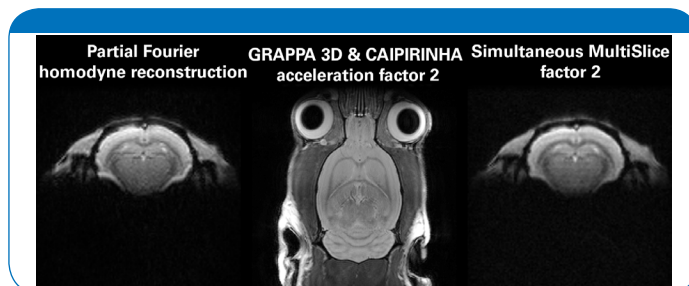
- Saturation Transfer module with CEST and MTC
- IntraGateUTE for virtually flow-artifact free cardiac scanning
- Compressed Sensing and 3D GRAPPA with CAIPIRINHA
- Simultaneous Multislice imaging
- Partial Fourier with homodyne reconstruction
- Fat and water images and chemical shift corrected images in RARE
- Dynamic shimming in EPI and CSI

¹ Research feature. Outcomes depend on the available shim hardware.

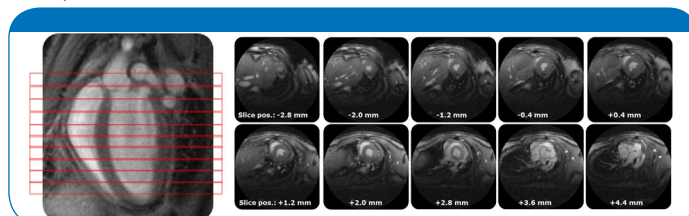
² Compressed Sensing is work in progress, not commercially available, and its future availability cannot be ensured. Not for distribution or use in the U.S.



Chemical Shift Corrected RARE (top right) Standard RARE (top left) Fat imaging (middle) and water imaging in mouse (bottom).



Rat brain EPI (left and right) and RARE images acquired with various acceleration techniques



IntraGateUTE enables full cardiac assessment with $(130 \times 130) \mu\text{m}^2$ in plane resolution and 14 cine frames per heart beat in less than 15 minutes.

ParaVision 360



ParaVision's fully integrated imaging platform common to MRI, PET/MR, and PET/CT, enables easy and high throughput imaging. All images, protocols, and subjects are in one location with inherent co-registration, image fusion, data processing, and analysis. This simplicity and uniformity across the range of instrumentation allows users to put their focus on their research.