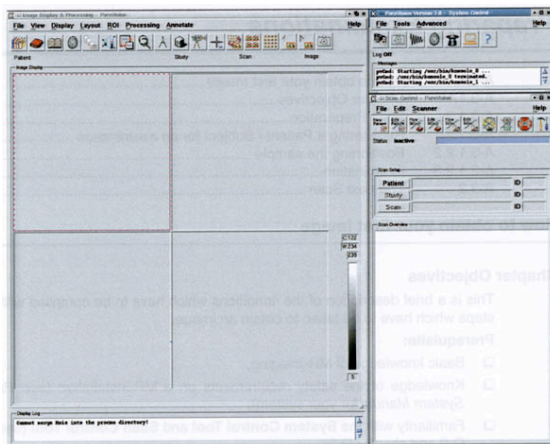## 1. HOW TO OBTAIN YOUR FIRST MR IMAGES

Initial situation:
- ✓ The system must be up running, an RF-coil must be connected, and a sample or an animal must be placed in the centre of the scanner.
- ✓ You should be logged in as a valid user.
- ✓ The screen should display the following set of windows:

Registering a patient:
- ✓ Click on the new patient button.
- ✓ The Patient Editor window appears.

- ✓ Fill out as a minimum Name and Registration.
- ✓ Click Accept.
- ✓ The Study Editor window appears.

- ✓ Leave Entry and Position as it is.
- ✓ Click Accept.
- ✓ Choose a Location.
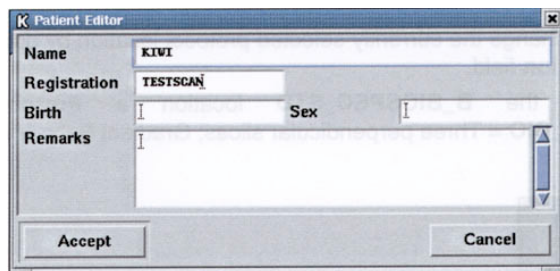
The Location window appears.
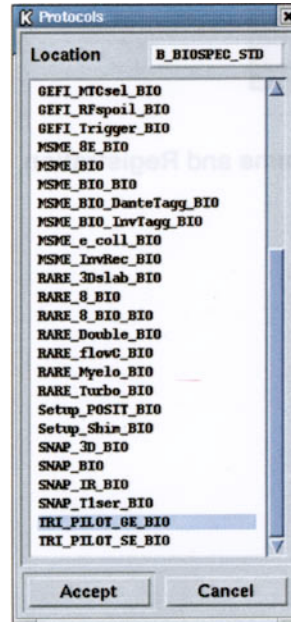
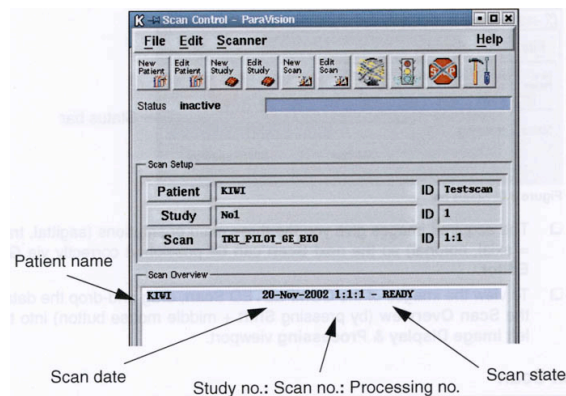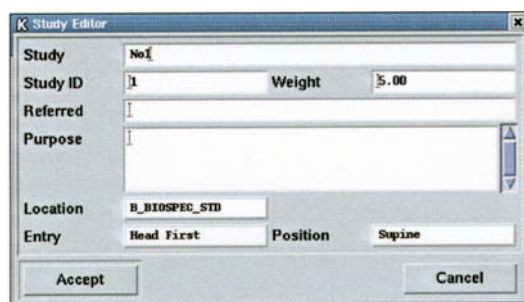- ✓ Choose within the B_BIOSPEC_STD location the protocol TRI_PILOT_GE_BIO.
- ✓ Click Accept

The Scan Control window appears.

Acquiring the overview scan:

- ✓ Click the Traffic Light to start the scanning process.
- ✓ The system will perform an automatic adjustment procedure (Auto Shim, Auto Frequency Adjustment, Auto Flip Angle and

Auto Receiver Gain) and acquires the image.
- ✓ Every time prior to starting the scanning of a New Patient, New Study or after starting ParaVision an automatic adjustment procedure is started.
- ✓ You can always force ParaVision to perform all automatic adjustment procedures by clicking Shift + Traffic Light simultaneously.
- ✓ The scanning is done when the countdown in the Status bar is finished, the Status shows inactive and the Scan state in the Overview list is COMPLETED.
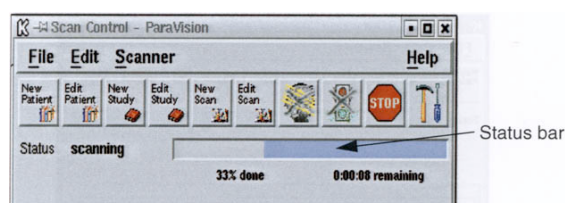

- ✓ The acquired images gives you three main orientations (sagital, transversal and coronal), so the next Scan can be positioned correctly via Geometry Editor.
- ✓ To view the images, drag and drop the dataset from the Scan Overview (by pressing Shift+middle mouse button) into the upper left Image Display & Processing viewport.

The next scan:

- ✓ Use the TRI_PILOT_GE_BIO images as reference images to position the next Scan.
- ✓ Click on New Scan, select a Location, and a Protocol (RARE_8_BIO).
- ✓ Click the geometry Editor icon to position the Scan correctly.
- ✓ The TRI_PILOT appears automatically in the viewport.
- ✓ Change viewport segmentation from 1X1 window to 4X4 window with the 2nd mouse button.
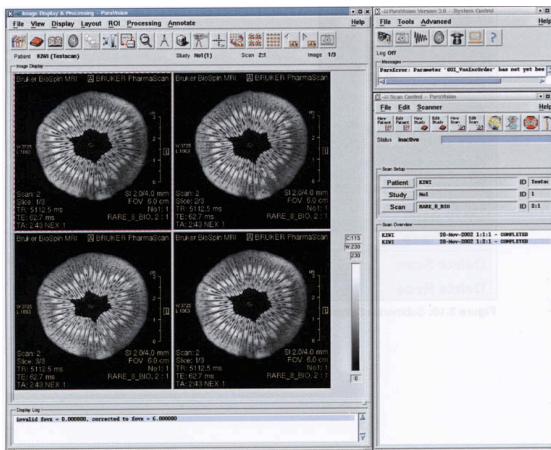
- ✓ The dashed borderline shows the current active viewport.
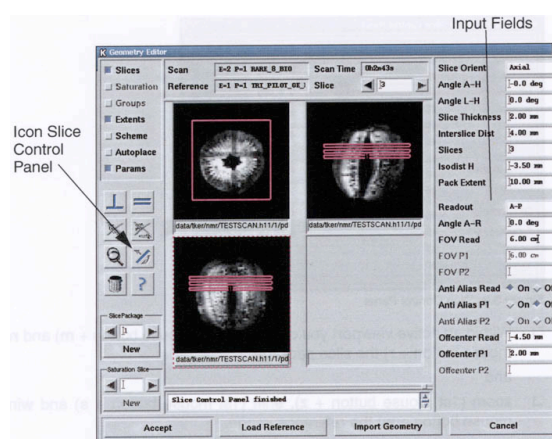
- ✓ Parameters can be modified either manually in the Input Fields or interactively by clicking on icon for Slice Control Panel.
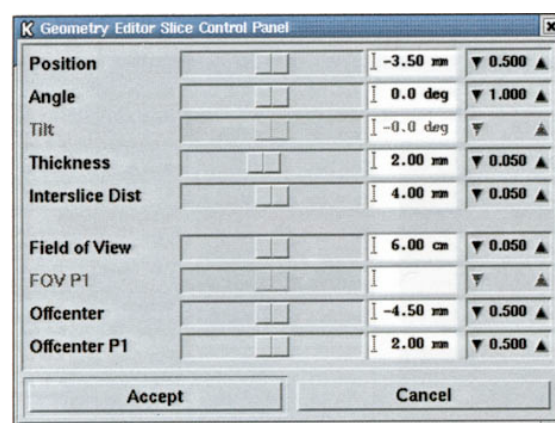
- ✓ Confirm the modifications with Accept.
- ✓ Start the scan with the Traffic Light..
- ✓ After a scan is completed, the Image Display & Processing window might look like this:

- ✓ Further scans can be obtained in the same way as just described.
- ✓ Or, if you wish, clone the Scan by highlighting the COMPLETED Scan and press the 2nd mouse button to select Clone Scan. Parameters, positioning etc are duplicated and the Scan is ready to run.
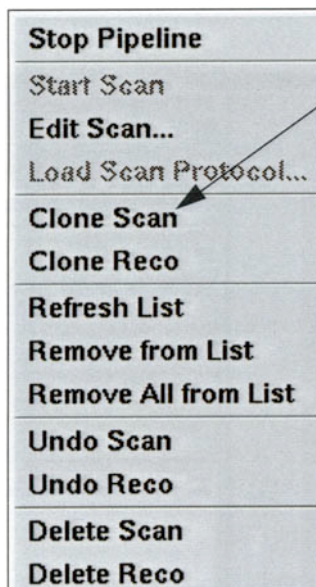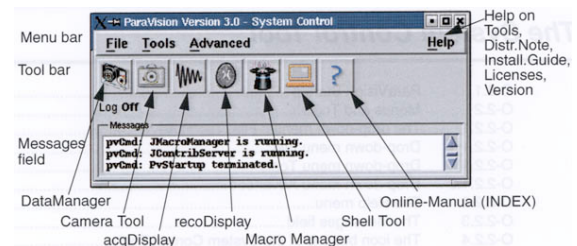

(For more details; see ParaVision 3.0.2 Application Manual, pages A-4-1 to A-4-32).

2. THE SYSTEM CONTROL TOOL
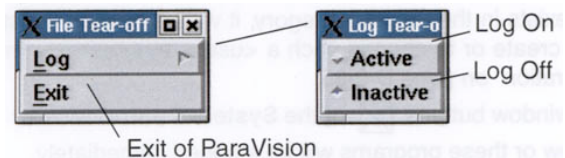
Paravision startup:

When ParaVision is started, the XWIN-NMR window appears and the ParaVision System Control Tool is opened in the right upper corner of the screen.

In addition, some other windows appear (Scan Control, Reqonstruction status, Acquisition status).

Menus and Tools:

The drop-down menu Files provides the buttons Log and Exit.

Log opens a submenu Log with two radio buttons: Active, Inactive.
- ✓ Active: The history file ParaVisionHistory will be written into the directory <PvInstDir>/prog/curdir/ <user>/ParaVisionHistory/.
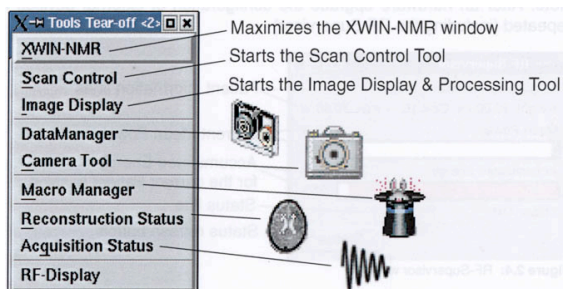
Drop-down menu Tools:

The menu Tools provides start options for several tools:

- ✓ Scan control: Starts the Scan Control Tool.
- ✓ Image Display: Starts the Image Display & Processing Tool.
- ✓ DataManager: Starts the DataManager.

- ✓ Camera Tool: Starts the Camera Tool (not working on our MR).
- ✓ Macro Manager: Starts the Macro Manager.
- ✓ Reconstruction Status: Opens the recoDisplay window.
- ✓ Acquisition Status: Opens the acqDisplay window.
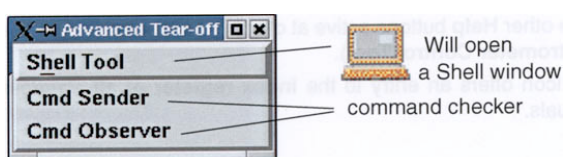- ✓ RF-Display: The RF-Supervisor window is opened.

The RF Supervisor gives information about maximum allowed mean power value, the current mean power value, and the accumulated energy:
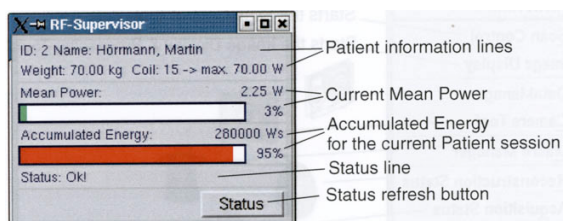
If the transmitter power exceeds the max allowed power, the user must lower the transmitter gain (i.e. by adjusting imaging parameters, e.g. pulse lengths and TR).

Drop-down menu Advanced:

The drop-down menu Advanced provides a command button to open a shell window:

- ✓ Cmd Sender: Gives you information about commands and arguments in ParaVision applications.
- ✓ Cmd Observer: May help to find and fix problems by observing the program responsible for sending and executing commands.

The icon buttons:

(For more details; se ParaVision 3.0.2 Operation Manual, pages O-2-1 to O-2-8).

3. THE SCAN CONTROL TOOL

The Scan Control Tool is started automatically when ParaVision is started.
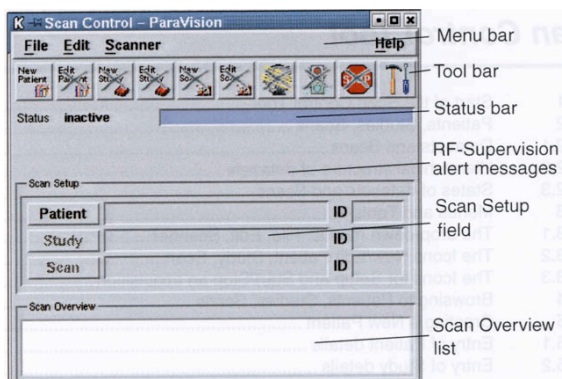
- ✓ Status bar: Indicates if the acquisition is active or inactive.
- ✓ RF-Supervision alert messages: Important messages from the RF-Supervisor are shown here.
- ✓ Scan Setup field: This field contains three lines (Patient, Study, Scan) representing the hierarchical structure of data sets.
- ✓ Scan overview list: Contains a list over the scans you have performed.

Patients, Studies, Scans:

The hierarchical structure is shown below:
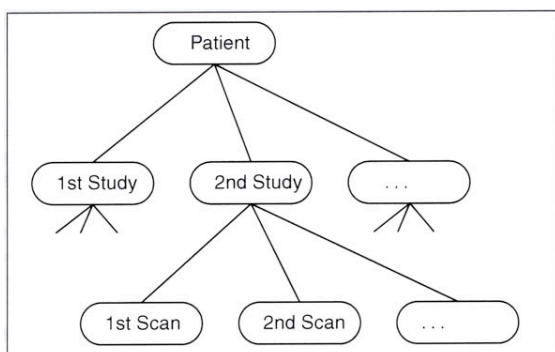
The highest level is the Patient level. This could for instance be the project you are working with. Example: Frits is working with Diffusion experiments on glioblastoma xenografts in nude rats.

The "Patient" in this case could for instance be "Diffusion_experiment".

The Study in the above example would then be the individual animals. For instance: cage1_animal1, or similar.

The Scan would be the individual scans for each animal.

There are of course several ways to do this notation, but you should think through it in beforehand, and decide which notation fits your experiments.

Menus and Tools:

The drop-down menu File is shown below:
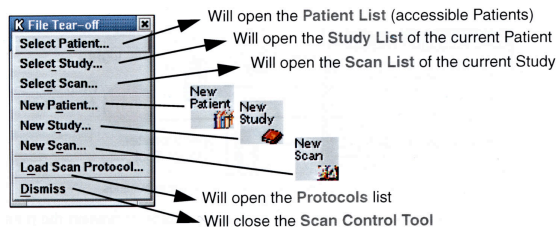
Note that you can "tear off" the File menu from the Scan control window.

Scan Control Tool icons:

The icons for Setup, Start/Stop:

The Icons for Setup and Start/Stop an acquisition

	Geometry Editor: Opens the Geometry Editor for the current READY Scan. Equivalent to Scan Control Tool > Scanner > Position...
	Traffic Light: For a READY Scan all automatic adjustments will be made as required (shim, resonance, pulse gain, receiver gain) and acquisition will be started. For a NOT RECONSTRUCTED Scan the reconstruction begins. Equivalent to Scan Control Tool > Scanner > Start.
STOP	Stop Scan: Interrupts the currently running acquisition (GSP, GOP, GS Auto). Equivalent to Scan Control Tool > Scanner > Stop... .

Table 3.4: Icon buttons for start/stop an acquisition

	Spectrometer Control: Opens the Spectrometer Control Tool. Equivalent to Scan Control Tool > Scanner > Spectrometer Setup ... .

Browsing to Patients, Studies, Scans:

By clicking File>Select Patient, you will see the Patient List displayed:
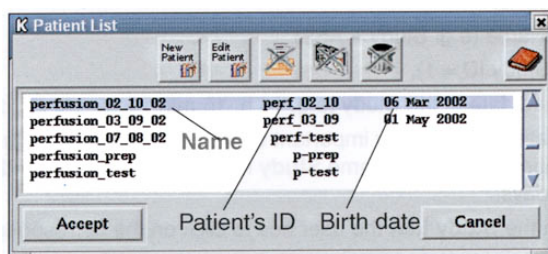
The Patient List contains Name, Registration and Birth.

By double clicking on a Patient (or clicking Accept), the Study List will open:

In this example, only one study exists for this patient. Double clicking on the study (or clicking Accept) will open the Scan List:

In the present example 5 scans exist. If you highlight one of the scans, and thereafter drag it into the Scan Control window by using the middle mouse button, you will be able to look at the scan in the Image Display & Processing window afterwards:
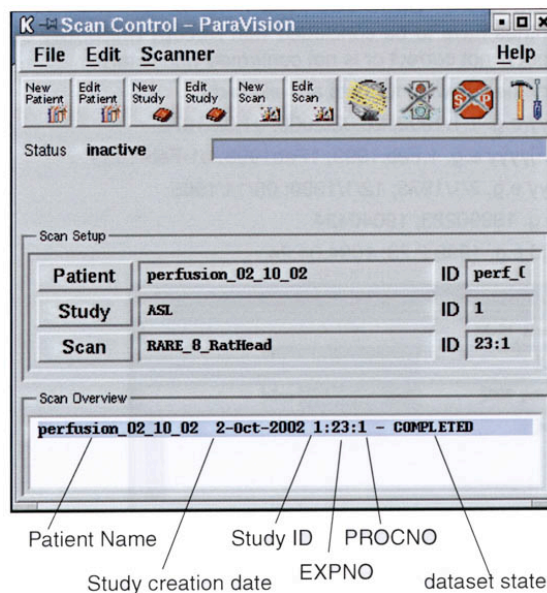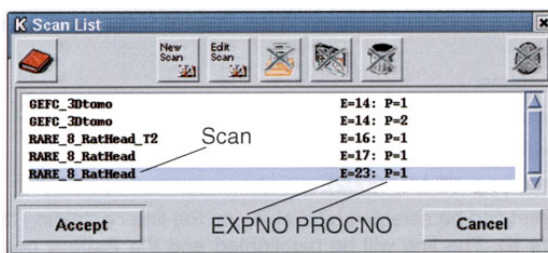
(For more details; see ParaVision 3.0.2 Operation Manual, pages O-3-1 to O-3-22).

4. THE SPECTROMETER CONTROL TOOL.

The Spectrometer Control Tool allows the direct control of the spectrometer in a "low level manner". It is started by pressing the following button:

It is possible to start and stop an acquisition or an Auto Adjustment, to invoke a parameter editor or to adjust some important acquisition parameters (frequency offset, transmitter attenuators, receiver gain, etc):
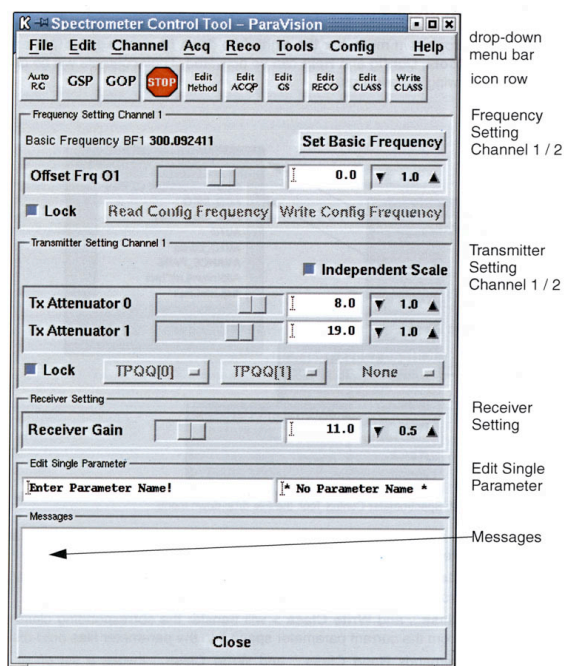
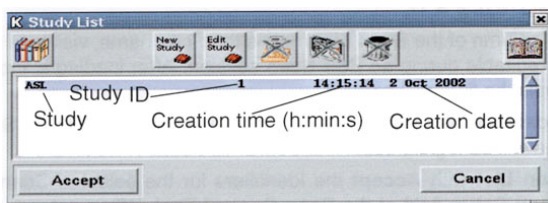The Spectrometer Control Tool should **not** be used by routine users.

(For more details; see ParaVision 3.0.2 Operation Manual, pages O-4-1 to O-4-24).

5. THE SCAN EDITOR

The Scan Editor may be started by pressing the following buttons:

icon button New Scan   or icon button Edit Scan
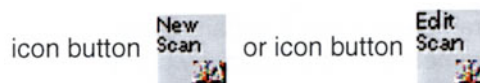
The Scan Editor is the most important editor for checking and changing measurement parameters in routine work:
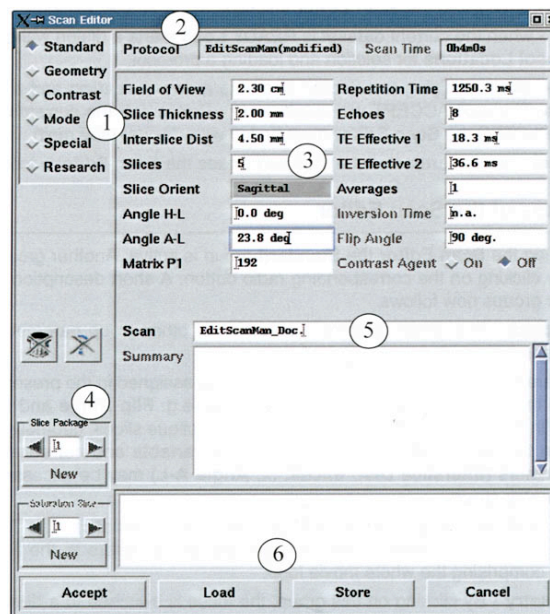
1) The six parameter groups Standard, Geometry, Contrast, Mode, Special and Research are shown. Only one group can be active at any one time.
2) Protocol is the name of the last loaded protocol. An added "modified" means that the originally loaded protocol has been changed.
3) In the centre of the window we find the currently active parameter group.
4) The Slice Package counter indicates the current active slice package. In case of more than one slice package another package can be activated here. Below is the Saturation Slice counter.
5) Scan in the middle of the window is the currently selected scan.
6) Control buttons for the Scan Editor.

Standard parameter group:

This group contains a selection of parameters which are varied most often (see above figure).

Parameters of Geometry group:

Geometrical specifications can be set in this window:

The Field of View (FOV) is the size of the scanned area. The specified FOV can be small than the object diameter. To avoid folding the Anti Alias option should be used. To reduce artifacts saturation slices can be applied.

The matrix size can be specified (range between 32 and 2048).

The Resolution in Read and P1 direction is shown in cm/pixel.

The Offcenter parameters allow the user to shift the imaged object out of the image centre.

The Patient Coordinate System:

The parameters of the coordinate system has been defined in a medical environment:

Slice Thickness and Interslice Distance:

Profile of two neighbouring slices with the definition of slice thickness and interslice distance. The slice thickness is defined as the thickness of the region where the signal intensity is half of the maximum possible value.

Parameters of Contrast group:
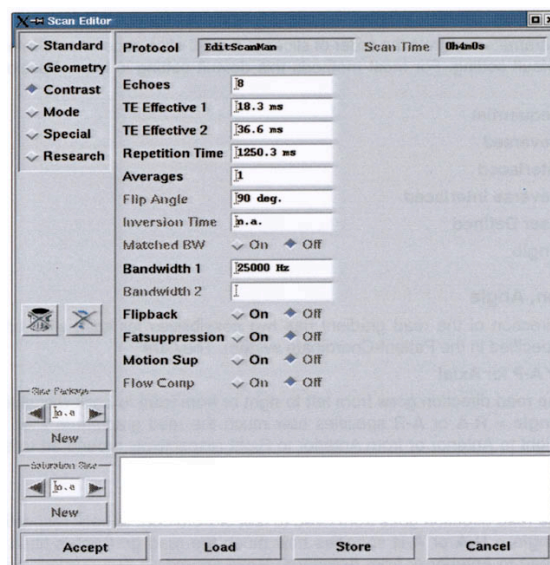
The parameter Echoes specifies the number of echo groups. Each echo group produces one image. TE Effective1 specifies the mean echo time for all echoes of the first group. TE Effective2 specifies

the mean echo time for all echoes of the second group.

Repetition time (TR): For instance in a Spin Echo sequence, the TR is the time between two 90^0 pulses.

The parameter Averages is used to increase the signal to noise (S/N) ratio, and thereby decrease noise and increase contrast. To increase the S/N ratio by a factor of 2 the number of acquired scans must be multiplied by 2^2 and so on. A very common value is Averages 4.

Flip Angle refers to the pulse angle for excitation (90^0 for SE sequences, less than 90^0 for GE sequences).

The Inversion time is the delay between the inversion pulse and the onset of data acquisition in an inversion experiment.

Bandwidth is the effective bandwidth used for excitation.

Flipback, Fatsuppression, Motion suppression and Flow Compensation might also be chosen for the different scans.

Parameters of the Mode group:
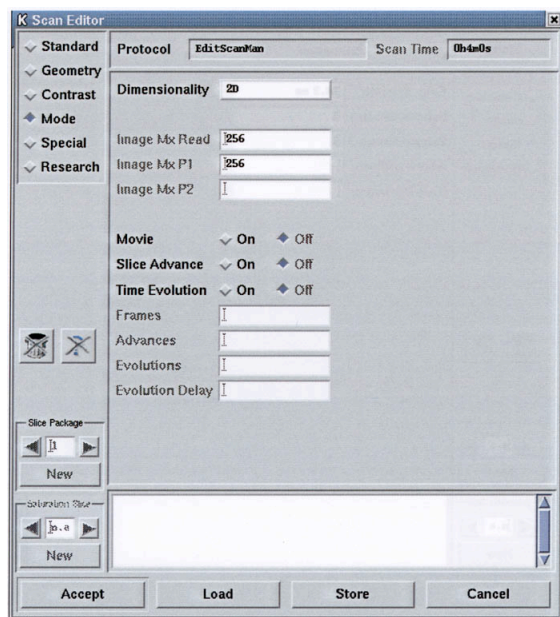
Very often only the parameter Dimensionality is editable.

Parameters of the Special group:
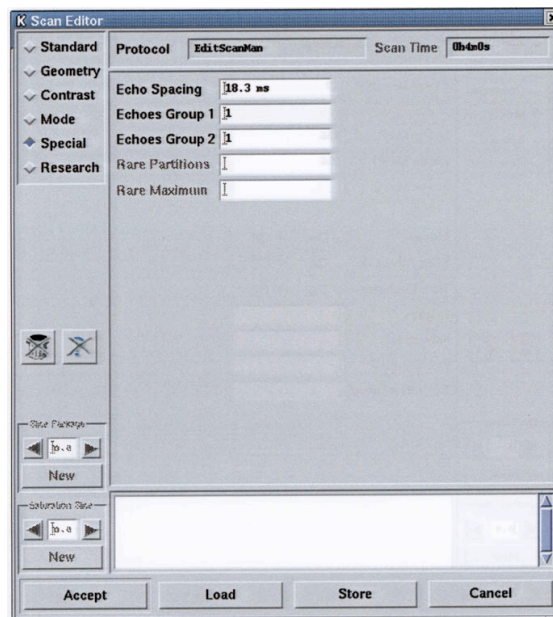
The parameter Echo Spacing refers to the time difference between two subsequent echoes in a symmetric echo train.

Echoes Group 1 and Echoes Group 2 are editable in case Number of Echo Images are >=2.

(For more details; see ParaVision 3.0.2 Operation Manual, pages O-5-1 to O-5-22).

6.   THE GEOMETRY EDITOR

The Geometry is started by pressing the following icon in the Scan Control Tool:

The Geometry Editor is used to set up the geometric arrangement of slice packages and saturation slices for imaging experiments, to define and position voxels for volume selective experiments, and to inspect the geometry of COMPLETED scans.

1) Scan and Reference Info section.
2) Image Data Display Area.
3) Options Region.
4) Icon Buttons.
5) Slize [Voxel] Package Selector.
6) Saturation Slice Selector.
7) Message Area.
8) Slice Parameter Field.
9) Saturation Parameter Field.
10) Dialog Control.

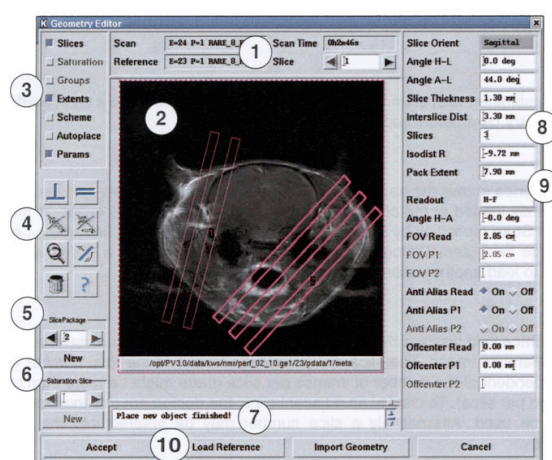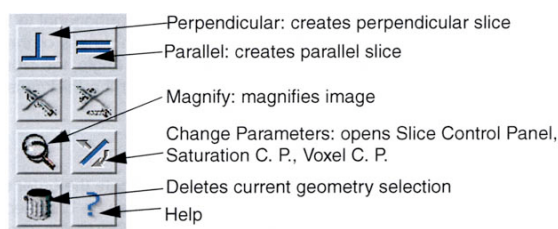A little more detail is shown on the Icon Buttons:

You will often push the Slice Control Panel icon, and then this window appears:
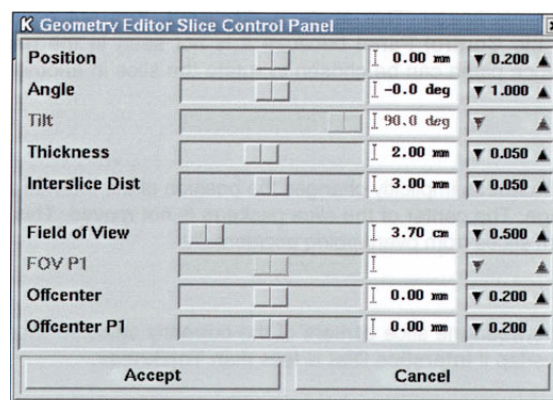
The scan package is moved in X, Y and Z planes by changing the sliders Position, Offcenter and Offcenter P1. The Angle of the slices can be changed, as well as Slice Thickness, Interslice Distance and FOV.

A little more detail on the Dialog Control:

- ✓ Accept: Implements all parameter modifications entered in the Geometry Editor, and closes the window.
- ✓ Load Referance: You can use previous reference images for setting up you sequence.
- ✓ Import Geometry: All geometry parameters may be loaded from a previous Scan within the current Study.
- ✓ Cancel: Closes the Geometry Editor and discards all changes.

(For more details; see ParaVision 3.0.2 Operation Manual, pages O-6-1 to O-6-30).

7. ACQUISITION AND RECONSTRUCTION DISPLAY TOOLS

In a standard configuration both tools (acqDisplay and recoDisplay) will be automatically started when ParaVision is started:
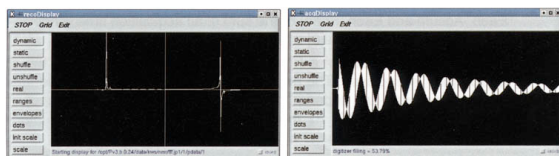
This example shows a one-pulse experiment.

As long as the scan is being performed, both windows are in a so-called dynamic state. The displays will be updated periodically depending on the corresponding parameter settings. When the scan is finished, both windows are in a static state.

What is displayed:

acqDisplay: The horizontal scale represent the time for one acquisition time window.
recoDisplay: The result of a Fourier Transform of the data shown in acqDisplay.
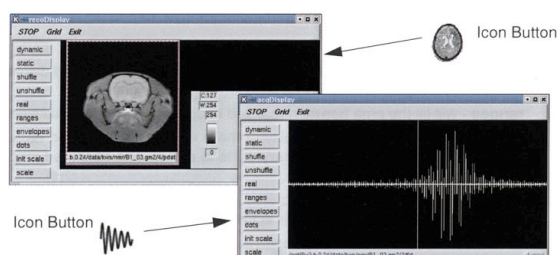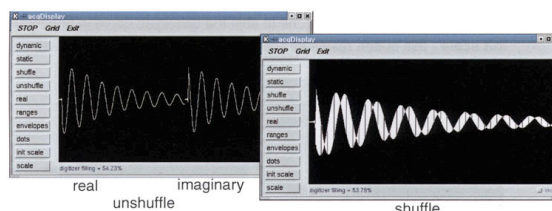
The results of completed scans can be displayed in both windows by a drag and drop operation:

There are several command buttons on the left side of these windows, we will not go into details here, just show two examples below:

real   imaginary
unshuffle   shuffle

In shuffle mode the data will be displayed as a real and an imaginary part of the complex signal in an interleaved manner. In unshuffle mode the real part of the data is diaplayed on the left side, and the imaginary part is displayed on the right side.

(For more details; see ParaVision 3.0.2 Operation Manual, pages O-7-1 to O-7-8).

8. IMAGE DISPLAY AND PROCESSING

When ParaVision is started in the default layout the left part of the monitor screen is covered by the window of the ParaVision Display & Processing Tool, called XTIP:
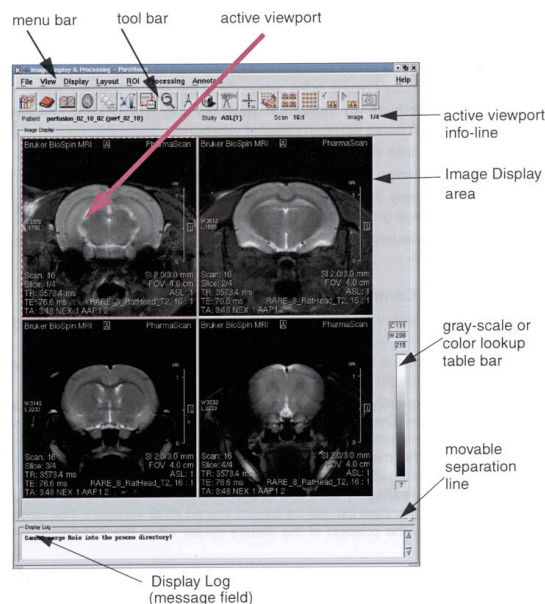
The window is composed of the following subareas:

- ✓ A menu bar
- ✓ A tool bar just below the menu bar, with frequently used XTIP commands

- ✓ An info-line for the currently active viewport
- ✓ An Image Display area where images and related information are displayed in a user selectable layout
- ✓ A scrollable and resizeable Display Log

You display the images from a completed scan in a drag and drop fashion:

Highlight the scan you want to display. Then click and hold down then middle mouse button. Last, click with the middle mouse button on the highlighted scan, and drag it into the Image Display area. All images of the series will now be shown. If you do not click and hold down the shift key, only the middle image of the completed scan will be displayed.

Details on how to use the mouse buttons are shown in ParaVision 3.0.2 Operation Manual, pages O-8-7 to O-8-9.

Icon Tool bar commands:

Patient selection: It opens a window which display the list of all patients for whom images are available on the disk:
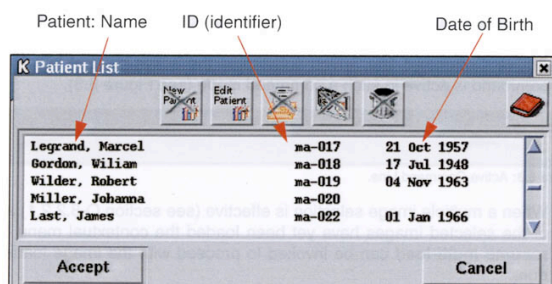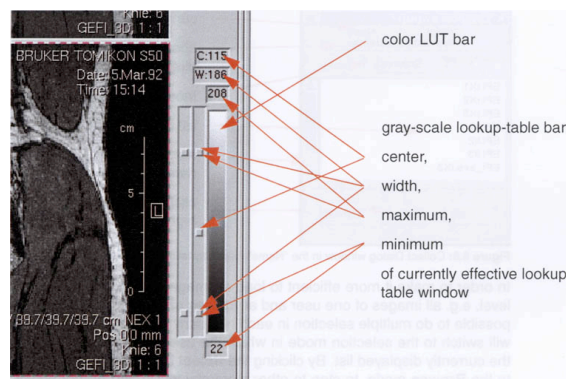

Patient name, ID and date of birth is shown.

Clicking the Window Lookup Table icon allows the user to adjust brightness and contrast of the images:

A maximum of 256 image intensity values of colors or gray levels can be displayed simultaneously.

After clicking the Color Window Lookup Table icon the color LUT is activated and several drag boxes are drawn. By dragging these boxes with the 1st mouse button the window level and width is changed.

Toggle between resized and original size imae presentation.

Magnifying glass. Allows for interactive zooming and scrolling of images.


Interactive distance measurements.

3D image visualisation: Cube view. The user can inspect the 3D image data matrix by simultaneously viewing three orthogonal planes presening the sides of a cube.

Skimming through an image sequence in the cine mode.

Clicking the Pixel Scan icon invokes the interactive display of the intensity values of single image points (pixels) and of intensity profiles of horizontal rows and vertical columns of the currently active image.
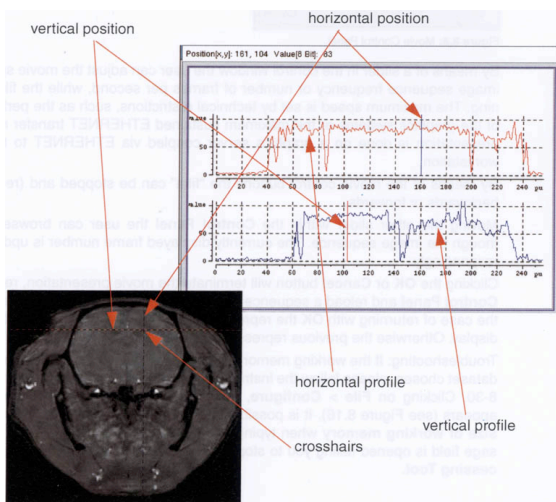
Starting this command will display a dialog window used to display the profiles and the image intensities, and will also cause crosshairs to be superimposed on the image in the currently active viewport.

Toggling between One- and Multiple-Viewport Layout.

Using the 2x2 Viewport Standard Layout.

Using the 4x4 Viewport Standard Layout.

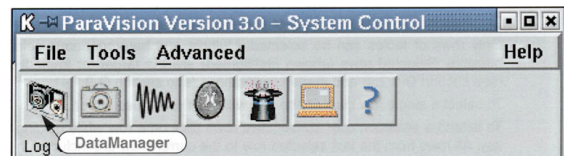Loading the Next Frame into the Next Viewport.

Loading the Previous Frame into the Next Viewport.

(For more details; see ParaVision 3.0.2 Operation Manual, pages O-8-1 to O-8-104).
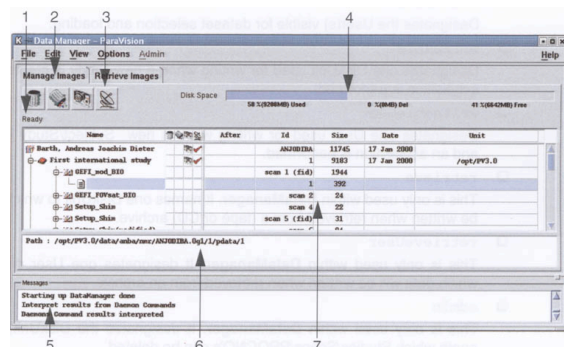
9.   THE DATA MANAGER

To Start up choose for instance the icon as shown below:

The Data Manager consists of two views: The *Manage Images* view allows the user to delete, archive or transfer data sets stored on the local disks. The *Retrieve Images* view gives an overview about archived data sets and allows the user to restore them.

Manage Image view:

1. Status line. Display status operations.
2. Folder tabs. Switches between *Manage Images* and *Retrieve Images* view.
3. Mark icon row. Selected Subjects and Studies are marked or unmarked for different operations by clicking on the mark icons. Four mark icons exist: Mark for Delayed Deletion, Immediate Deletion, Archiving and Transfer.
4. Disk usage bar. It shows the current state of the writable disk unit.
5. Message window (info, warning, error messages).
6. Information window. Displays information about the selected study, experiment and processed images on disk.
7. Study table. Displays Subjects, Studies, Experiments and Processed Images.

Sorting and searching:

Subjects can be sorted in the Manage Images and Retrieve Images view. The following sort criteria is possible:

View by name, Id, date or Size.

Searching can also be performed by filtering:
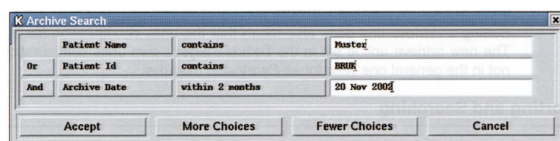
Deletion:

Subjects, Studies, Experiments/Scans and Processed Images can be deleted from the harddisk using DataManager.

Using the delete operation has to be done carefully because it can not be undone!

It is not possible to delete raw data files which are protected with read-only permissions for the current user.

Archiving and retrieving studies:

Studies and all accompanying data can be archived to an archive medium. To archive a study the following steps are necessary:

✓ Configuration of archive media
✓ Labeling a medium
✓ Mounting a volume
✓ Marking subjects for archiving
✓ Archiving the studies
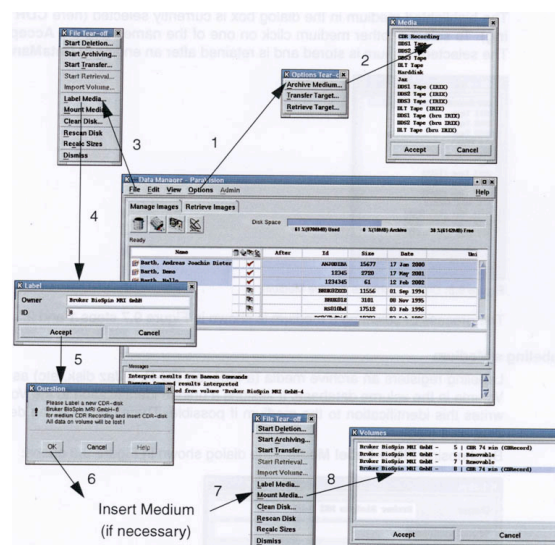
You can also archive your data using a memstick. Put it into one of the USB ports in the front of the Linux pc, and mount it by double clicking on the USB stick icon on the desk top. You can now drag and drop your data into the memstick.

Your data are found in the catalogue:

/opt/PV3.0.2/
data/<username>/nmr/<filename>

(For more details; see ParaVision 3.0.2 Operation Manual, pages O-9-1 to O-9-64).