The „Video" program: spectroscopic data display and analysis for video imaging on TEXTOR–94

Alexander Huber, Albrecht Pospieszczyk, Bernd Schweer, Genady Sergienko, Philippe Mertens, Volker Philipps

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Abstract

A new system for routine digitization of video images has been implemented on TEXTOR-94. This video images system is used to analyse the impurity production, recycling and power deposition on limiters and to study the structure and location of visible emissions from the main plasma. The video system is based on a PC and is characterised by a high space and temporal resolution of video capture, storage and retrieval. On TEXTOR-94 cameras with CCIR norm take video pictures at 50 half frame per second with a resolution of 728x480 pixels. The videio signals are captured from the cameras with a commercial framegrabber board and transferred with about 100Mbytes/sec directly into the main memory, which then processes every conceivable video signal in real time. The captured images are stored automatically on the hard disc of the PC. A special data display and analysis program has been developed to analyse the 2D images from spectroscopic, thermographic and other observations allowing an easy and comfortable handling of stored images. In this paper, we give a short description of the video system concentrating mostly on guidelines for the use of the VIDEO program.

Contents

1 Introduction

VIDEO is a data display and analysis program especially developed for supporting spectroscopy, thermography and 2D observation on TEXTOR-94. This program is written in IDL and can:

- load images from the hard disc, DAT device or over a network
- replay videos in slow motion with different speed
- view single frames for selected time

Also possible are:

- working with image memory, which allows to compare directly frames from different shots or cameras
- presentation of videos in false colours with the possibility of colour table selection
- interactive creation of colour table
- definition of interactive graphics boxes for calculation of total intensities. Saving of sets of boxes
- calculation of total intensities in defined boxes as a function of time (needed for evaluation of impurity fluxes)
- calculation of profiles in X or Y directions for selected time
- creation and working with an averaged images
- create contour or surface plots from video images
- manipulating of images: substract or add another images
- hardcopy
- calibration: pixel to nm (spectral axis) or pixel to cm (spatially)
- annotation of graphics with text, legend, lines or rectangles

In chapter 2 we report shotly on video images system for routine digitization of video images and about the AIX operating system with VIDEO software. In the other chapters, we concentrate only on guidelines for the use of the VIDEO program.

2 Data acquisition

A new system for routine digitization of video images is presently implemented on TEXTOR-94. The PC-based system features high resolution video capture, storage and retrieval. The system consist of four basic components

- video cameras
- framegrabber board for capturing
- PC's that stores the video frames
- Digital Audio Tape (DAT) drive device for permanent data storage.

A schematic view of this system is shown in Fig. 1. On TEXTOR-94 cameras on CCIR norm with analogue output are commonly used. The dynamical range of these cameras is not better than 8 bits due to pure linearity. These cameras take video pictures at 50 half frame per second with 728×480 pixels resolution. The video signal is captured from one of cameras with a commercial framegrabber board, INSPECTA2 MVFG. Its image transfers with more than 100 MBytes/sec directly into main memory, which can process every conceivable video source in real time. Eight kilobyte of on-board FIFO memory ensures no losses of video data even if the PCI-bus is heavily loaded. The camera-interface is universal for

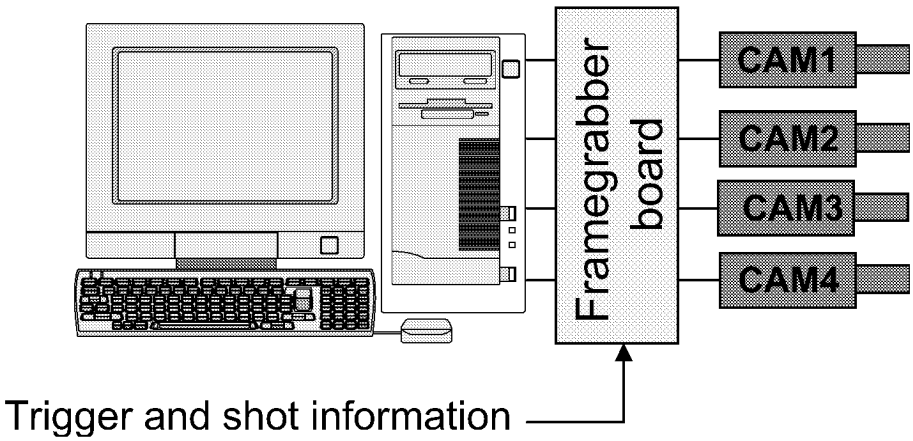

Fig. 1. The PC-based system for routine digitization of video images

all imaginable video sources- independent of whether analogue or digital, RS-170 or CCIR, non-standard, matrix or line–scan camera. INSPECTA2 has a two-dimensional bus-master DMA: every image can be grabbed to an individually sized window anywhere in the 4 GB address space of the

addressable memory. After the image is captured, the following video data is stored automatically in a new section of the memory. This storage scheme allows the application program to work with a completely undisturbed image, while the next one is grabbed with a speed of more than 100 MBytes/sec.
Each video frame is stored automatically in BMP or JPG formats on hard disc. In uncompressed format, one frame requires about 200kB, so that video from 4 cameras of a 10s plasma discharge requires about 400MB. The PC is equipped with 768MB RAM and a hard disc capacity of 20GB. Thus, the PC is capable of storing about 50 shots of 10s duration, which is usually the result of one experimental day. It means that at the end of the experimental day, the video must be stored on DAT band. Currently, the most economical media are DAT band with a capacity of 12-24GB per band (DDS3, 125meter).

On TEXTOR-94, there are 4 PC systems as shown in Fig. 2. A commercial software from the Mikrotron company is implemented on each PC. This software replays the video on the monitor in real time or in slow motion after a plasma discharge. These PCs are not used for data evaluation. For this purpose a powerful AIX processor with following properties is used:

- 104GB capacity of hard disc
- 3GB capacity of SDRAM
- four 332MHz processors
- 4mm DAT/DDS3 tape drive
- two 10/100Mbps Ethernet PCI adapter

Each PC is locally connected via Multi Switch Fast Ethernet Hub with the AIX processor. This connection allows the fast transfer of data from PC to evaluation software. The AIX processor is equipped with the DAT device, which allows to load old video shots conveniently in "tar" format.

3 Structure of the file system

The structure of the file system on the AIX processor is shown in Fig. 3. All video data must be stored in the "*/home/pph105/textor*" directory, which has a capacity of about 60GB at most.

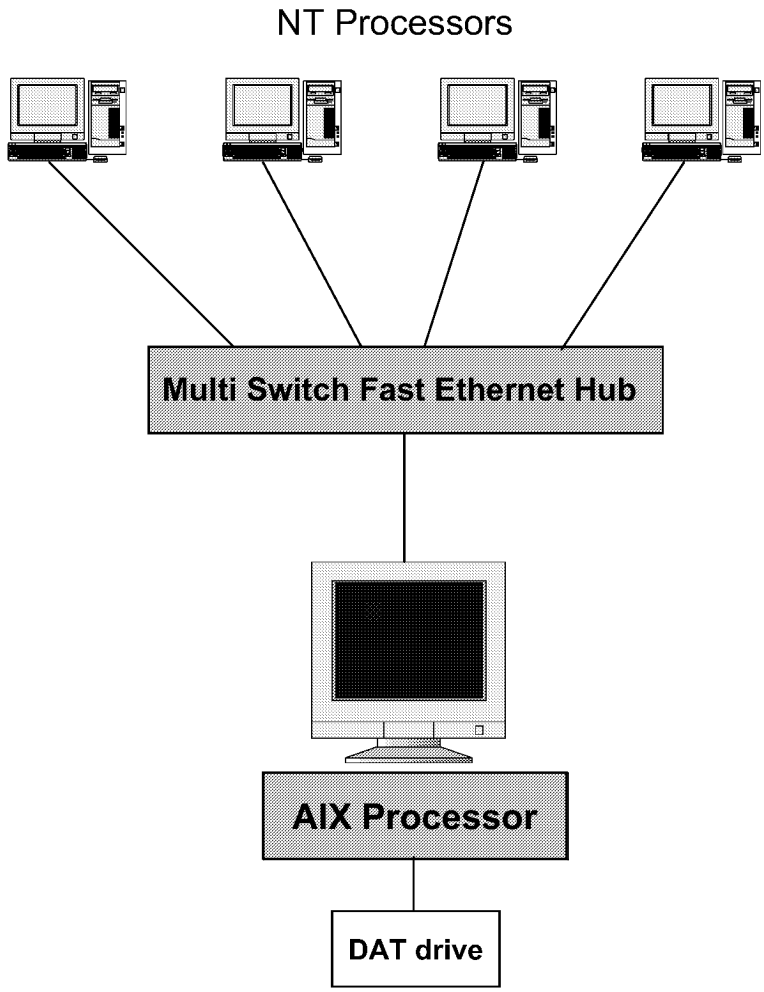

Fig. 2. Data acquisition system of video images on TEXTOR-94

The subdirectories ls1,ls3,blh,alt,... contain the video data of different locations at TEXTOR-94. For example, subdirectory ls1 contains videos measured in the limiter lock 1. The videos must be stored in the subdirectory "Versuche". The "Versuche" directory invokes subdirectory, which name reflects the number of plasma discharge. For example the subdirectory 082275 enfolds the discharge number 82275. Every shot subdirectory contains at maximum 4 subdirectories (CAM1,CAM2,CAM3,CAM4) and a shot information file. The video in CAM1 is captured from camera 1. Additional information, such as the presence of an interference filter or coupling with a spectrometer, is given in the information file (for example in 082275.dat).

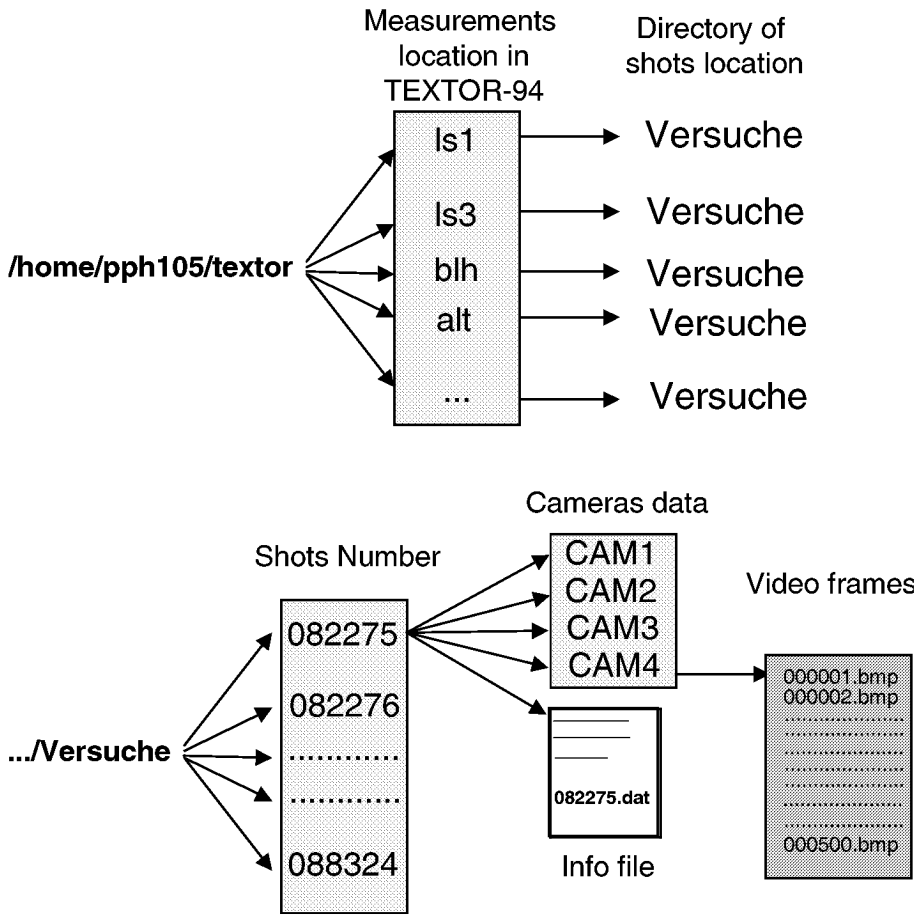

Fig. 3. Structure of the file system on the AIX

4 Reading the Data from Tape

A DDS3/DAT drive is available on the IBM platform for reading the experimental data from tape.
Note: This drive will read DDS3 125 meters, DDS2 120 meters, DDS1 90 meters tapes. To use this drive, load a tape and run the following command:
/home/pph105/dat
The magnetic tape program should appear as shown in Fig. 4. The Magnetic Tape Program menu is described in the following:

- **Working Directory** Select "Working Directory" button from Magnetic Tape Program menu to define the working directory (the video data from the tape will be saved in this directory). The selected working directory should appear in the box on the right side from the "Working Directory" button;

- **Go to Archive**: Typically, the content of tape is subdivided in many

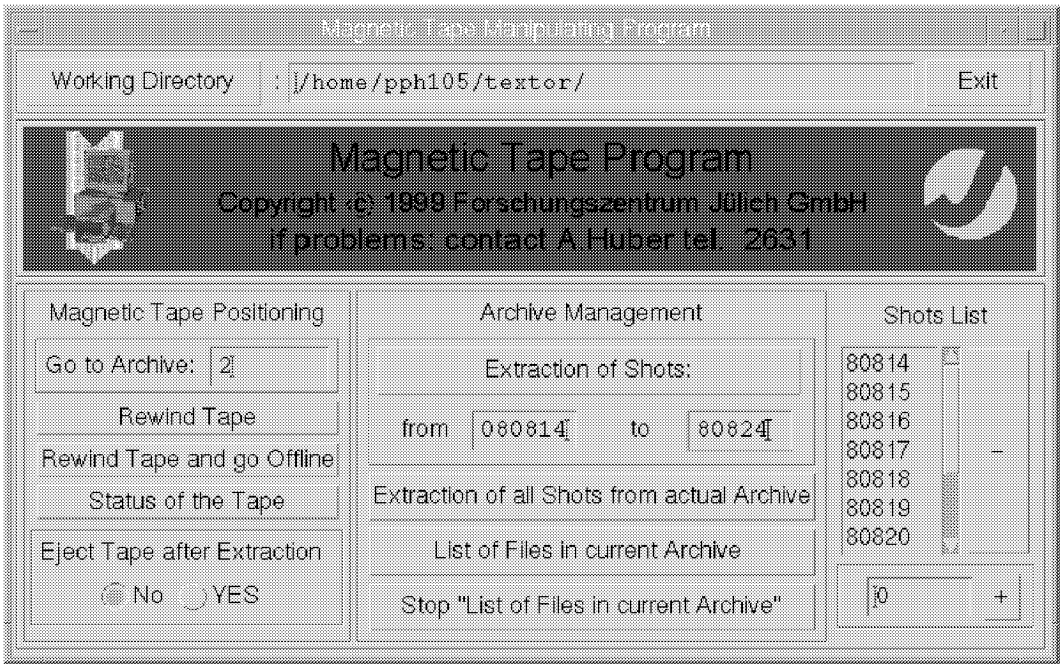

Fig. 4. Magnetic tape program for data reading from DAT tapes

archives. The multi-archive structure of the band is recommended for fast loading of video data in the AIX processor. Enter the wanted archive number in the "Go to Archive" field and press "Return" button. The DAT drive sets the tape at the beginning of the chosen archive;

- **Rewind Tape**: Press "Rewind Tape" button to reset the tape at the beginning;
- **Rewind Tape and go Offline**: Press "Rewind Tap and go Offline" button to rewind the tape and eject it;
- **Status of the Tape**: Press "Status of the Tape" button to get the status of the tape;
- **Eject Tape after Extraction options**: Select "YES" option to rewind the tape and eject it after extraction of shots;
- **List of Files in current Archive**: Press "List of Files in current Archive" button to check which data are contained in the current archive by listing tarfile contents to screen;
- **Stop List of Files in current Archive** Press the "Stop List of Files in current Archive" button to interrupt the listing tarfile contents. It

is reasonable to stop the listing process for time saving in the case of large archives.

- **Extraction of all Shots from actual Archive** Press "Extraction of all Shots ..." button to extract all shot data from the current archive;
- **Extraction of Shots** If you want to extract only certain shot data from the current archive select the shot numbers in the "from" and "to" fields;

- **Shots List Field** By selection of certain shots range in the "from" and "to" fields, the selected shots are listed in the "Shots List Field" on the right side of program menu;
- **Plus Button** If one or more shots are selected, you can add a new shot to the already selected shot list. Insert the wanted shot number in the field on the left side from "Plus Button" and Press "Plus Button". The shot number should appear in the shot list;
- **Minus Button** To delete one or more shots from the selected shot list, mark the shot number to be deleted and press "Minus" button. **Note** Press "Return" button after selection.
  Press "Extraction of Shots" to start the extraction in the chosen working directory;
- **Exit** Press "Exit" button to leave the Magnetic Tape Program.

5 Starting the Video Program

The program "Video" can be started by the following command:
/home/pph105/video
The Video menu should appear as shown in Fig. 5.

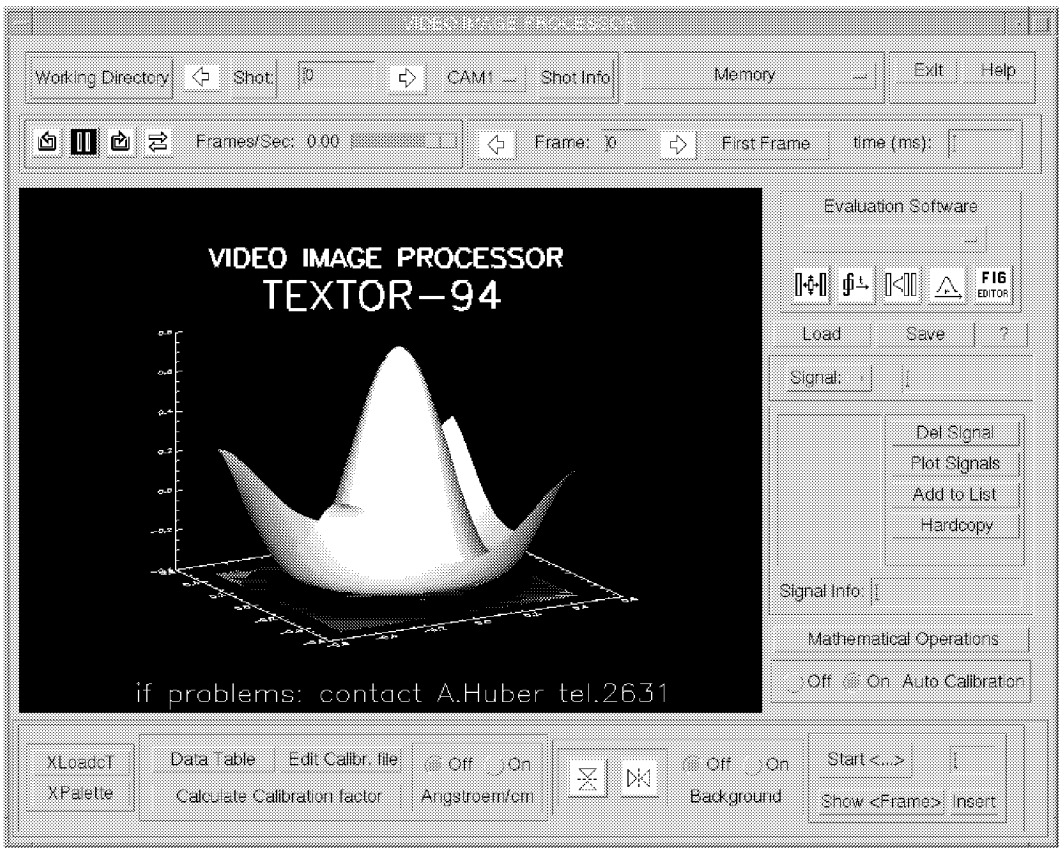

Fig. 5. Menu of Video program

The Video menu is organized in the following way:

- **on the top of the menu** the buttons and fields are assigned to the definition of working directory, of shot and of camera number, for replay of video sequences, for working with image memories,

- **on the right of the menu** the buttons and fields are intended for evaluation software and mathematical operations with evaluated data,

- **on the bottom of the menu** the buttons and fields serve for colour table definition, calibration procedure and averaging of images,

- The Video windows is situated **in the middle of the menu**.

6 Video data loading

To load video data in program use the "data loading" toolbar shown in Fig. 6 This toolbar has the following controls

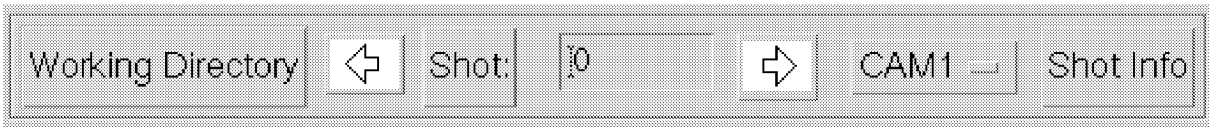

Fig. 6. Video data loading toolbar

- selection of a working directory,
- selection of a wanted shot number,
- show information on a specific shot.

Note: the Video program can work with data of **BMP** and **JPG** formats. The format of video data is identified automatically.

6.1 Selection of a working directory

Select "Working Directory" from Video menu to define the working directory. A new dialogue window with the list of directory on the right-hand side of the dialogue should appear as shown in Fig. 7.

Mark the desired working directory on the right side of dialogue window (Files column) and click "OK". The working directory is thus defined. Each working directory contains the data measured at different locations on TEXTOR:

- alt : spectroscopic measurements at the ALT-II limiter
- blh : spectroscopic measurements with spectrometer and 2D-CCD cameras situated in blue house
- ivd: 2D-CCD cameras (with or without interference filters) for measuring the impurity radiation.

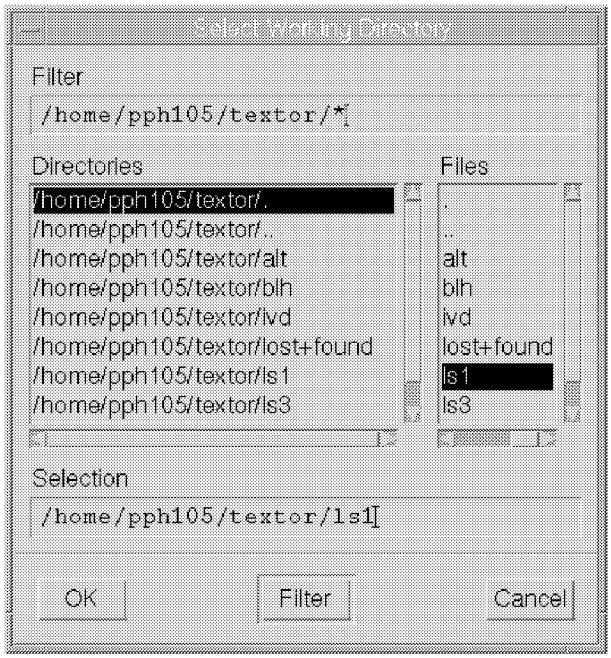

Fig. 7. "Working directory" dialogue window

- s1: spectroscopic measurements with spectrometer and 2D-CCD cameras at test limiter in limiter lock1.

- s3: spectroscopic measurements with spectrometer and 2D-CCD cameras at test limiter in limiter lock3.

- vxi: spectroscopic measurements with 2D-CCD cameras with VXI data acquisition system.

6.2 Selection of a shot number

After defining a working directory:

- Select "Shot:" from Video menu to define the shot number. A new dialogue window with the list of shots on the right-hand side of the dialogue should appear as shown in Fig. 8. Select the shot number on the right side (**Note: Files column and not Directories column**) and click "OK". The shot number will appear in the shot number field of Video menu.

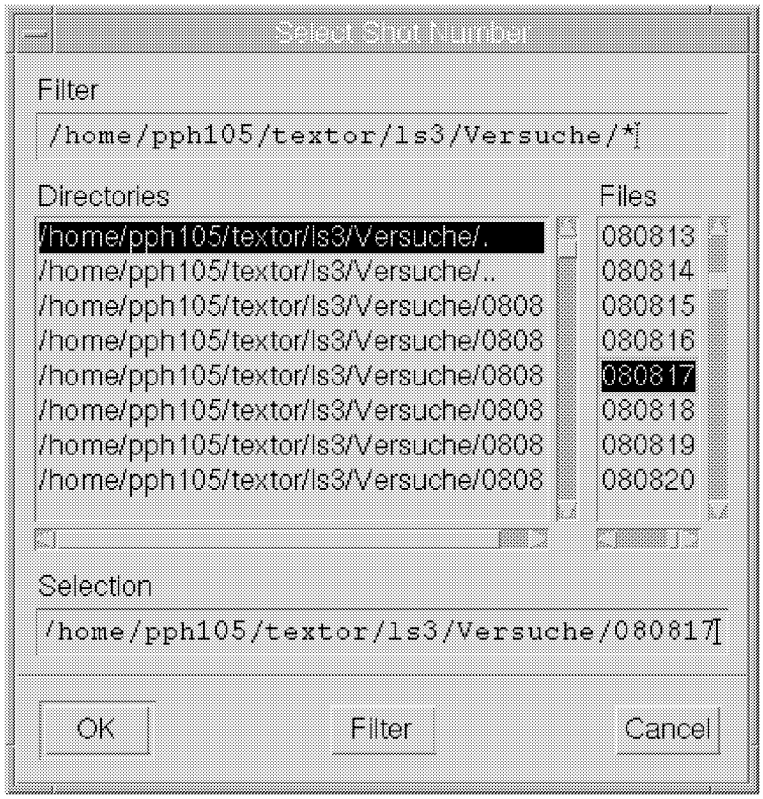

Fig. 8. "Shot" dialogue window

or

- Click in the shot number field and enter the shot number.

Note: At this point, the data of the selected shot are not yet loaded.

To load the data, click in the shot number field and press the **Return button**.

Once the shot number has been defined, you can jump to any shot in the selected working directory. Use the Left Arrow button (in the video data loading toolbar) to jump to the previous shot and the Right Arrow button to the next shot in actual working directory.

The video is captured from maximal four black and white cameras (or one colour and one black and white cameras) with a framegrabber board and is stored in real time into PC's memory. The video data from each camera are stored into separate directories. For example, the data, measured in the shot number 58475 with camera number 2, are stored in the directory

.../058475/CAM2. From the "CAM" drop list, select the camera you wish.

Note: The drop list "CAM" shows only cameras, which were active during the selected plasma discharge.

6.3 Show shot info

Select "Shot info" in the Video menu to get the information about the defined shot. The Shot Info dialogue will open.

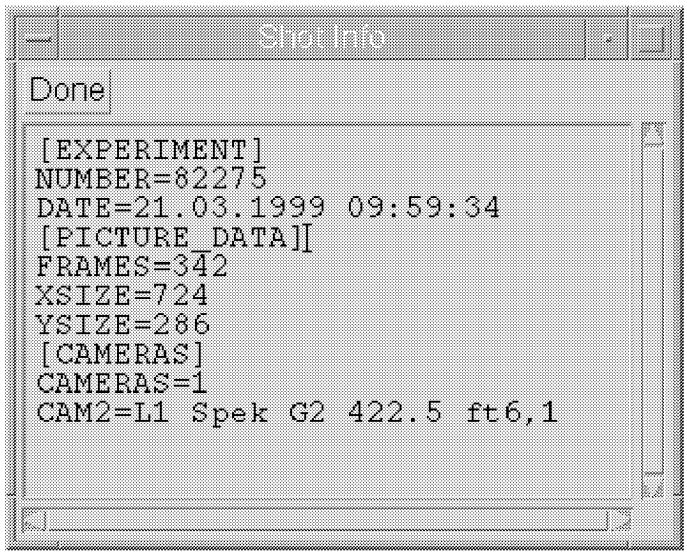

Fig. 9. Shot information dialogue window

This window contains the following information:

- **about experiment**: Shot number and date of the experiment,
- **about picture data**: Number of frames, x-size and y-size of image in pixels,
- **about cameras**: Number of active cameras and the notice of experimental conditions to each camera.

7 Animation

To make a qualitative analysis of the measured data, the video program contain the animation toolbar shown in Fig.10.

Fig. 10. The animation toolbar for displaying a series of images

This toolbar is used for displaying a series of images. The user can select the speed, direction or specific frames in the animation. The toolbar consists the following options:

- **Play backwards**
  Select "Play backward" button to display the animation frames in decreasing order. The animation repeats by continuing backwards.

- **Pause**
  Select "Play pause" button to suspend animation until "Play backward", "Play forward", or "Play in cycle" button is pressed.

- **Play forward**
  Select "Play forward" button to display the animation frames in increasing order. The animation repeats by continuing from the actual frame on.

- **Play in cycle**
  Select "Play in cycle" button to display the animation frames repeatedly from the actual frame to the last and then from the last frame back to the first.

- **Animation speed**
  The"Animation speed" is used to control the speed (in frames/second) of the animation. Moving it to the far right corresponds to one hundred percent, i.e. as fast as the animation can go. If there are other IDL widget applications using background tasks they can result in a slowing down of the animation. Closing the other applications can speed up the animation.

- **Frame number**
  The "Frame number" field shows the frame number that is currently

displayed. This field can be used to view single frames from the animation. The animation must be paused to use the "Frame number" field. A specific frame of the animation can be viewed, in one of follow ways:

  - Click in the "frame number" field and enter the frame number you wish. Press the "RETURN" button to accept this frame. The selected frame will appear in the graphics window.
  - Use the Left Arrow button in the animation toolbar to jump to the previous frame and the Right Arrow button to the next frame. The selected frame will automatically appear in the graphics window.

- **Time of the frame**
  The "time" field shows the time of the frame which is currently displayed. To select the frame at a wanted time, click in the "time" field and enter the time. Press the "RETURN" button to confirm. The frame at the selected time will appear in the graphics window.

8 Working with Image Memory

It is often necessary to compare several images in a single graphical windows. The Video program allows you to do this by means of three image memories. To import the specific images into the memory pull down the "Memory" drop list and choose the "Store Frames in Memo" option. The "Save Frame in Memory" window should appear as shown in Fig. 11.

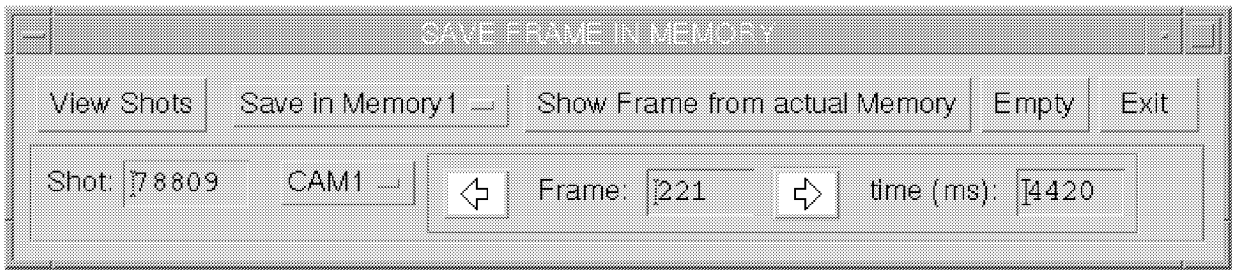

Fig. 11. "Save Frame in Memory" dialogue window

Now do the following:

- Select the shot number by means of "View Shots" selection dialogue or by entering in the "Shot:" field.
- Select camera from "CAM1" drop list.
- Click in the "Shot:" field and press "RETURN" button.
- Select frame number in "Frame" field or the time in "time (ms):" filed. After selection, click in the selected field and press "RETURN" button.
- Press "Show Frame from actual Memory" to view the selected image. The new window with selected and original images should appear as shown in Fig. 12

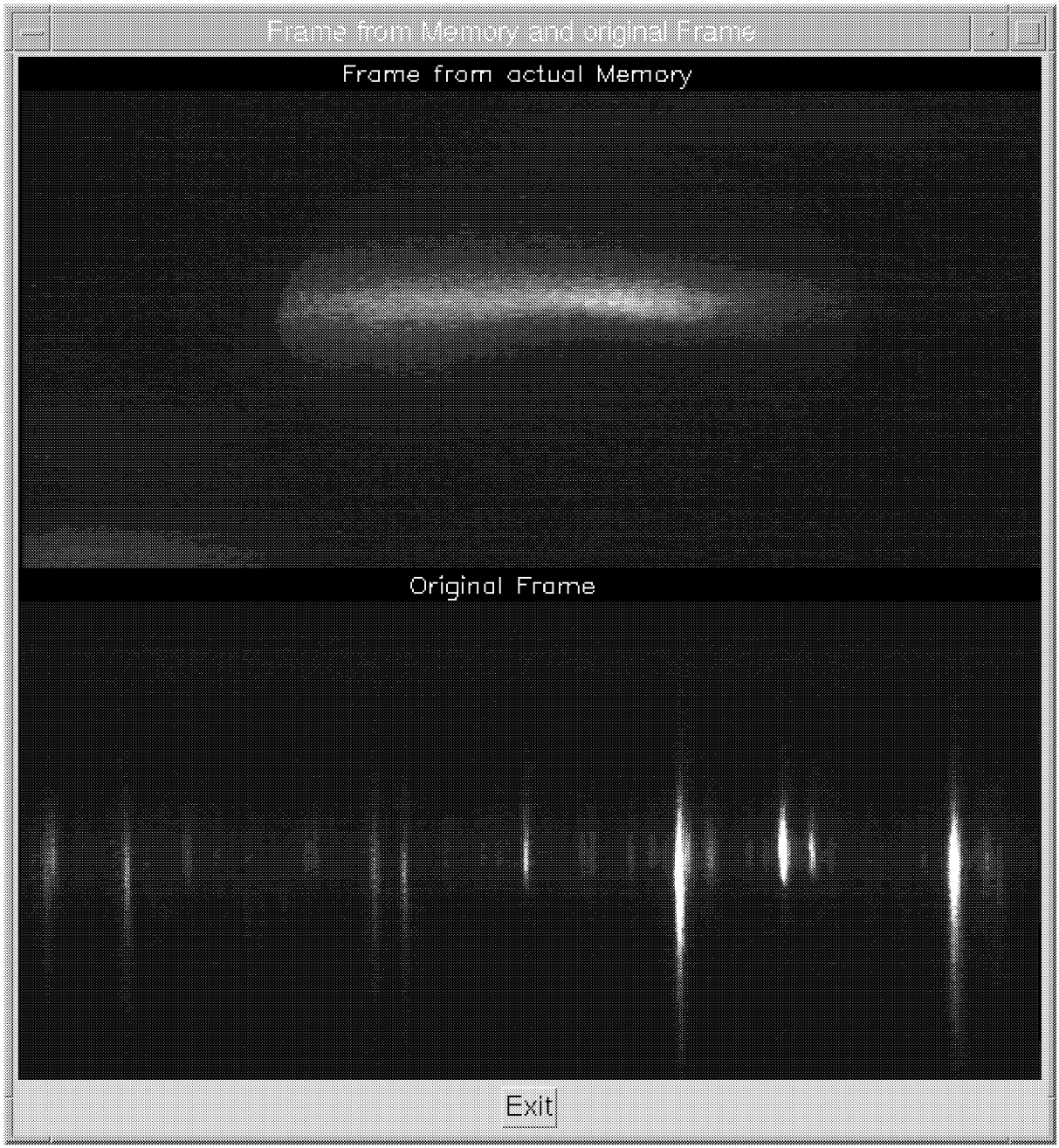

Fig. 12. Selected and original images

- Pull down "Save in Memory" drop list and choose "Save in Memory1" or "Save in Memory2" or "Save in Memory3" option. To reset all memories select "Empty" button. You can save other images in the same way into the other memories.
  Note: The memory (or several memories) can be kept empty.

- Select "Exit" button to leave "Save Frame in Memory" dialogue window.

You can view the images from memories by pulling down the "Memory" drop list and choosing the "Show Frames from Memo" option. The new window with orginal and memory images should appear as shown in Fig. 13.

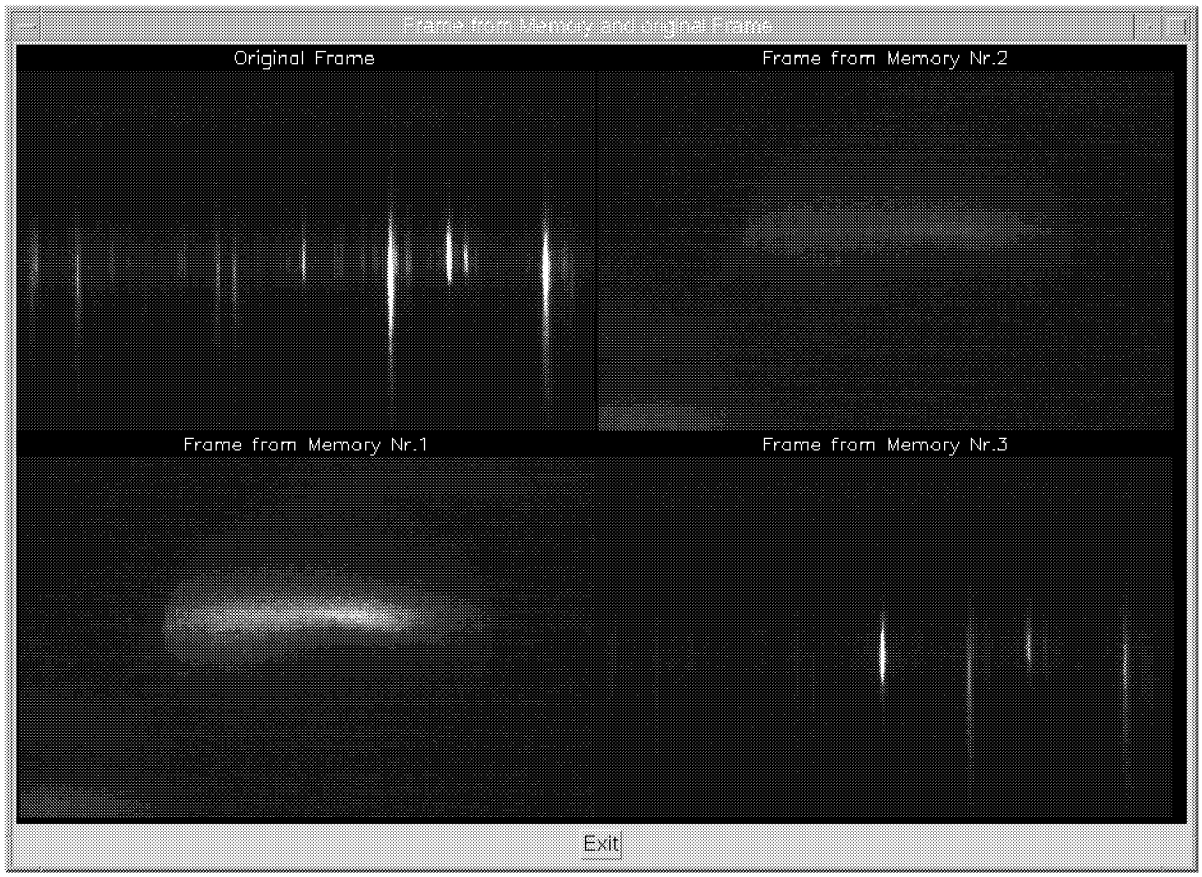

Fig. 13. View of three selected and original images

Press "Exit" button to close this window.

9 Image evaluation Software

Fig. 14 shows the image evaluation software menu. The software in this menu allows to provide five operations:

- definition of interactive graphic boxes,
- calculation of integral intensities within boxes,
- calculation of profiles in X or Y directions,
- extraction of line profiles,

- working with single frames,
- calculation of integral intensities within boxes for set of shots.

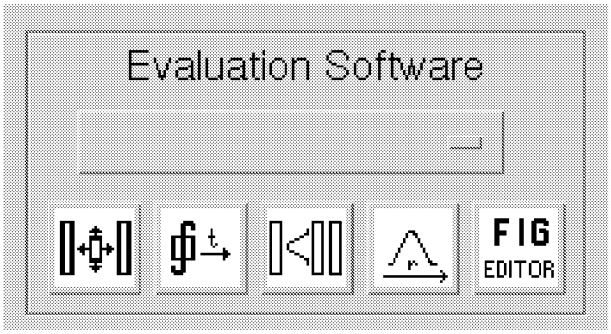

Fig. 14. Image evaluation software menu

To perform these operations press the button in the software menu or select the corresponding functions in the drop list.

9.1 Definition of Interactive graphic Boxes

Here an explanation is given how to create a set of interactive graphic boxes. This allows to draw and erase the box without disturbing the contents of the graphic window.
Select "Define Boxes" in the "Evaluation Software" drop list or the "boxes icon" to define the boxes set. The BOX MANAGER dialogue window will open. For box definition, designate:

- **Left-down corner of the box**
  Use the "x1" and "y1" sliders to designate the x and y– coordinates of the left-down corner of the box. Adjust the slider value by clicking in its bar or dragging its knob to the desired location. Moving the "x1" slider to the left or right moves the box left or right in the graphic window. Moving the "y1" slider up and down moves the box up or down in the graphic window.
- **Width of the box**
  Use "dx" slider to determine the width of the box
- **Height of the box**
  Use "dy" slider to assign the height of the box
- **Schift of all boxes in the x-direction**
  Use "Boxes Shift" slider to shift all boxes in the x-direction

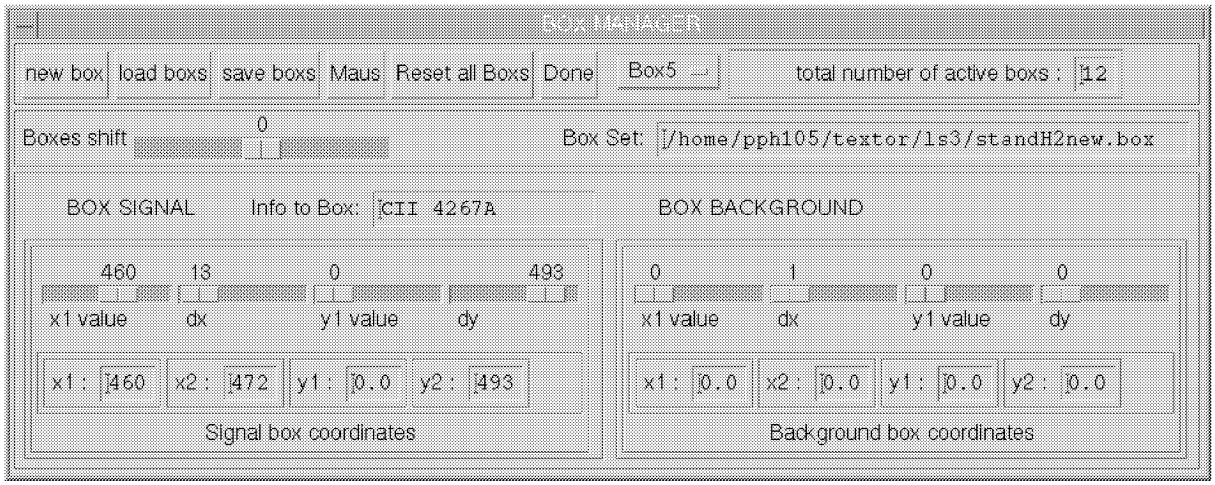

Fig. 15. Box Manager dialogue window

On the right side of the BOX MANAGER, you can define in the same way the background box. The definition of the background box is recommended if the bachground of video varies with time.
Note: The size of the background box can differ from the signal box size.

To make comments about the defined box, write the text in the "Info to Box" field.

If one or more boxes are already selected, you can add a new box to the already selected box–set. Select "New box" in the BOX MANAGER. The new box appears in the graphic window. Use then the "x1","y1","dx" and "dy" sliders for correction of size and location of the new box.

The box can be created and controlled using the mouse.
Select "Mouse" in the BOX MANAGER Menu to start the mouse operation mode. This mode allows operation as follows:

- **Move the box** Move the cursor to one of the desired box, press and hold down the left mouse button while moving the mouse to the desired location within the graphic window. Release the button to lock the box at the selected location.

- **Resize the box** Move the cursor to one of the corners of the desired box, pres and hold down the left mouse button. Then holding the left button down, move the mouse to one of the other corners of the desired box. Release the button to lock the box.

- **Exit and accept the box** Press the right button to exit and accept the box.

If the box–set is completely defined, you can save it into the the working directory by selecting "save boxes" in the BOX MANAGER. The comments to the boxes will also be saved.The name of saved Boxes-Set will be appear in the field "Box Set".
Note: If the defined set of boxes was not saved and you leave the BOX MANAGER dialogue with "Done", the box–set is current as long as the video program is open. To reset this box–set, open the boxmanager dialogue window and press the "Reset all boxes" button.
Select "load boxes" in the BOX MANAGER to load the earlier defined box–set in the video program. For corrections of loaded box–set, select in the "Box" drop list the desired box and change this box with "x1","y1","dx" and "dy" sliders.
The total number of active boxes will appear automatically on the right side of the toolbar in the top of the BOX MANAGER.

9.2 Calculation of integral intensities within boxes

Press the second button in the software menu to calculate the integral intensities within boxes. The time–resolved integral will be saved in the SDRAM.

9.3 Calculation of profiles in X or Y directions

Select the time or the frame number of the desired frame in the animation toolbar. Press the third button in the software menu to calculate the profiles. The calculated profiles should be saved in the SDRAM. If the width of the box in X direction is larger than in Y direction, the x-resolved profile should be calculated. Else, the y-resolved profile should be calculated.

9.4 Extraction of Line Profiles

Select "Line Profile" in the "Evaluation Software" drop list or the "Profile" icon to extract a line profile from the image. The PROFILES window should appear. Move the cursor over the original image to see the profile at the cursor position. The program returns a floating-point vector containing

the values of the image along the profile line marked by the user. Fig. 16 shows the row profile in the "Profiles" window.

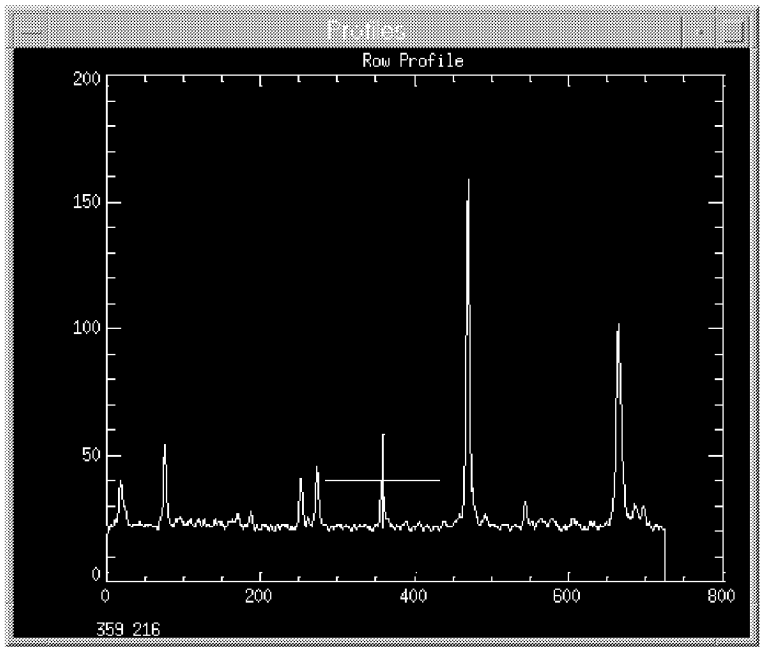

Fig. 16. Row profile in the "Profiles" window

The starting location X=0 and Y=0 is specified in the lower-left corner of the image. The mouse position is showed by the cursor in the "Profile" window. The coordinates (x,y) appear automatically in the lower-left corner of the "Profile" window.

Press the left mouse button to toggle between row and column profiles. Fig. 17 shows the evaluated from the image column profile.

To exit the routine, press the right mouse button (with the cursor over the original image). The "Profile" window should disappear.

9.5 Working with single frames

The video image sequences need large hard disc capacity. Sometimes, one needs only a few frames out of the complete sequence. In this case, it is reasonable to work with the "Working with single frames" function. With this function the program loads only a single frames in a SDRAM memory. Press the button on the right side of the software menu to start the single frame function. A file selection dialogue should appear. Select required file. The shot dialogue should appear. Insert the shot number in the shot number field and press the "OK" button. The selected frame should load

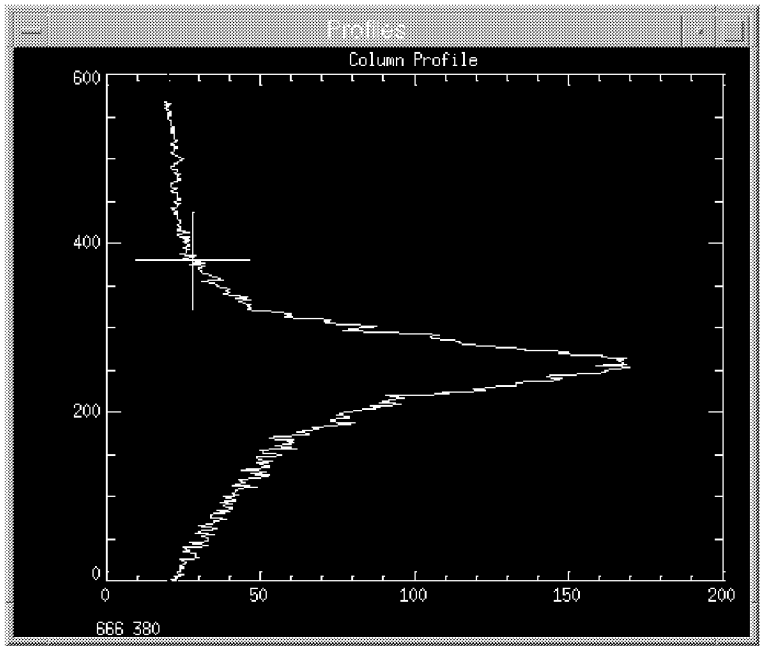

Fig. 17. Column profile in the "Profiles" window

in the Video window. Information about the shot number is necessary for working with calibration files.

9.6 Calculation of integral intensities within boxes for a set of shots

There are two ways to for calculation of integral intensities for a set of shots:

- From the drop list in the evaluation software menu select the **"Integral for Shots Set"** option. The evaluation software program for sets of shots should appear as shown in Fig. 18. It is reasonable to use this option for calculation of intensities in the case of some shots. During the calculation of intensities, the "Video" program is not available.

- This program can be started separately from "Video" program by the following command
  /home/pph105/shots
  The evaluation software program for set of shots should appear as shown in Fig. 18. It is reasonable to work with this program separately in the case of a large amount of shots.

This sections describes the evaluation program for sets of shots.

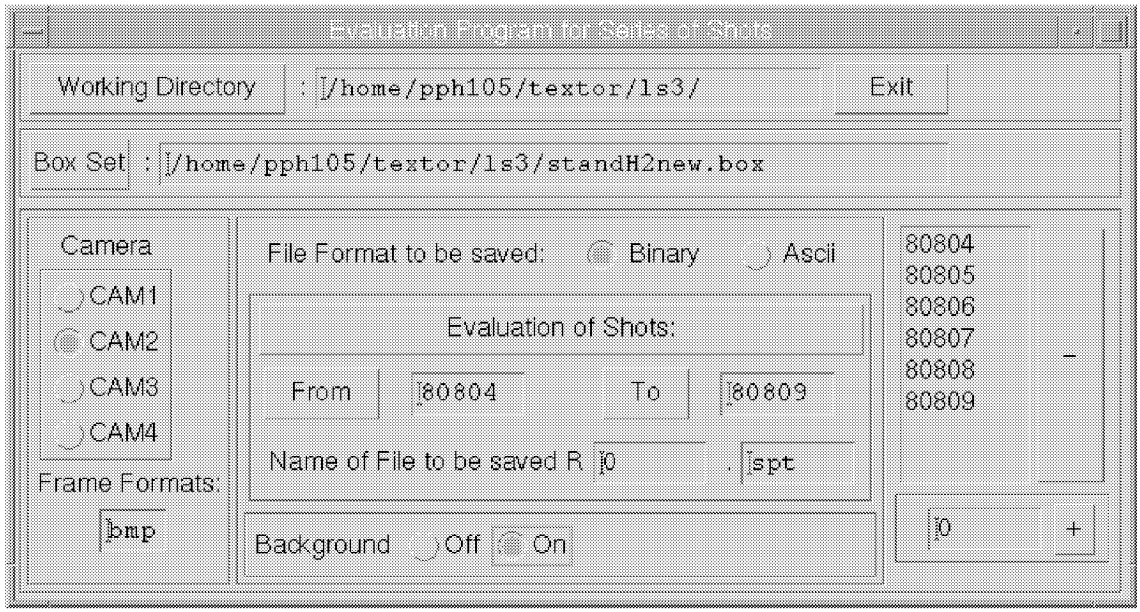

Fig. 18. Dialogue menu for calculation of integral intensities within boxes for set of shots

- **Working Directory** Select "Working Directory" button from Program menu to define the working directory (the evaluated data will be saved in this directory)

- **Select "Box Set"** in the dialogue menu to load the earlier defined box–set in the "Video" program.

- **Camera options** Select the camera you wish.

- **Frame Format Field** The format of video frames is identified automatically and appears in the "Frame Format Field". This program can work with data of **BMP** and **JPG** formats.

- **File Format to be saved options** Select the format of files to be saved.

- **From Field** Enter shot number into the "From" box to designate the start shot for evaluation. You can also select the start shot number from the dialog menu by pressing the "From" button.

- **To Field** Enter shot number into the "To" box to designate the last shot for evaluation. You can also select the last shot number from the dialog menu by pressing the "To" button.

- **Shot List Field on the right side of menu** By selection of shots range with "From" and "To" options the selected shots are appeared in the "Shot List Field" on the right side of program menu.
- **Plus Button** If one or more shots are selected, you can add a new shot to the already selected shot list. Insert the wanted shot number in the field on the left side from "Plus Button" and Press "Plus Button". The shot number should appear in the shot list.
- **Minus Button** To delete one or more shots from the selected shot list, mark the shot number to be deleted and press "Minus" button.
- **Background Off** option for evaluation of data with background
- **Background On** option for evaluationof data without background
- **Evaluation of Shots Button** If working directory, box–set, camera and shots range are defined, press "Evaluation of Shots" button to start the calculation of intensities.
- **Name of File to be saved R Field** show the status of the calculation. The program working with shot, that is showed in the "Name of File to be saved R" field.
- **File Extension Field** (in Fig. 18 we used extension "spt") Insert file extension in the "File Extension" field. If the chosen extension is "spt", the calculation result from shot number for example 84659 will be saved in the file name "R84659.spt".

9.7 Saving and Loading of evaluated data

If the data evaluation is completed, you can save this data into the workind directory by selecting "Save" Button under the "Image evaluation software menu". The dialog menu with "Format options" will be appear. Select the save file type from this options. File formats supported are: **Binary** and **Ascii**.
The saved files include information about Shot number, Box coordinates, Box information,Box Name, total value and average value of each estimated signals, signal values. The figure 19 shows the example of saved file in ascii format.
To load the evaluated data select the "Load" Button under the "Image evaluation software menu".

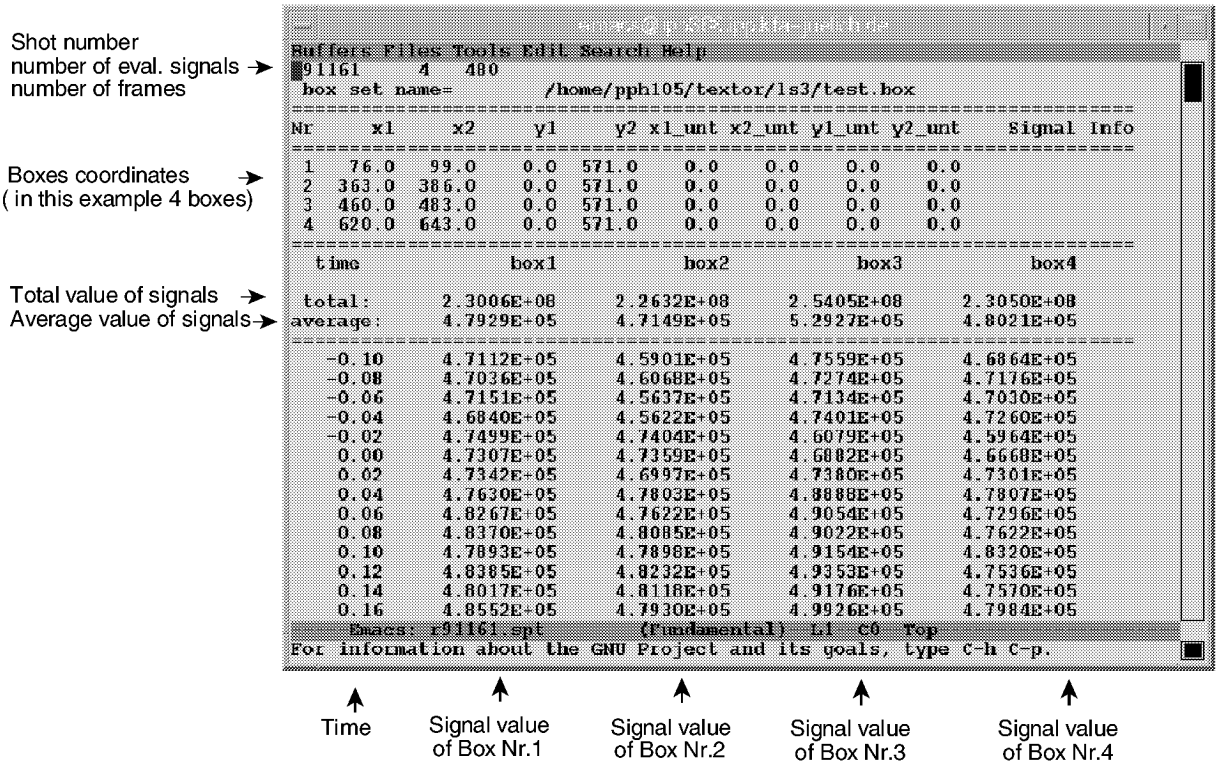

Fig. 19. Example of saved ascii file

10 Creation of an average image

There are two ways to create an average Image:

- **Average of image series from frame number N1 to frame number N2 (N2>N1)**
  Enter the frame number N1 into the "frame number" field of the Video menu (not in the "Average" toolbar) and press the "RETURN" button to accept this frame. The frame N1 will appear in the graphic window (see Fig.5). Select the "Start < ... >" button in the "average" toolbar

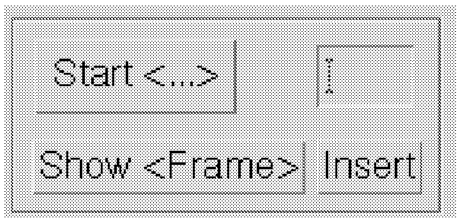

Fig. 20. "Average" toolbar

to start the averaging process. The name of this button will change to "Stop < ... >". Click in the text field on the right side of average

toolbar and enter the number N2-N1+1. Press "RETURN" button. The averaged image is created.
Select "Show < *Frame* >" to view the averaged image. It will show up in the graphic window.

- **Average of specific frames**
  As example, you can create an averaged picture using the frames 20,24,40 and 45. Select the "Start < ... >" button in the "average" toolbar to start the averaging process. The name of this button will change to "Stop < ... >". Load the frame number 20 in the graphic window of the Video menu. Select "Insert" button in the "average" toolbar. Frame 20 will be saved in the memory of the video program. In the text field the number of averaged frames will appear automatically. Continue this procedure up to frame number 45.
  To view an averaged image select "Show < *Frame* >" button. The averaged picture will appear in the graphic window.

  To leave the averaging mode press "Stop < ... >" in the average toolbar.

  You can work with the average picture in the same way as with the original image (for example, evaluate spectral or spatial profiles). If you plot the evaluated data, the message dialogue will appear with the information that the average process is active. Press the "OK" button to accept this. To leave the average mode, press "Stop the < ... >" button in the average toolbar.

11 Visualisation of evaluated data

For visualisation of evaluated data proceed as follows:

- Pull down the "Signal" drop list and choose the signal name. The chosen signal name should appear in the field on the right side.

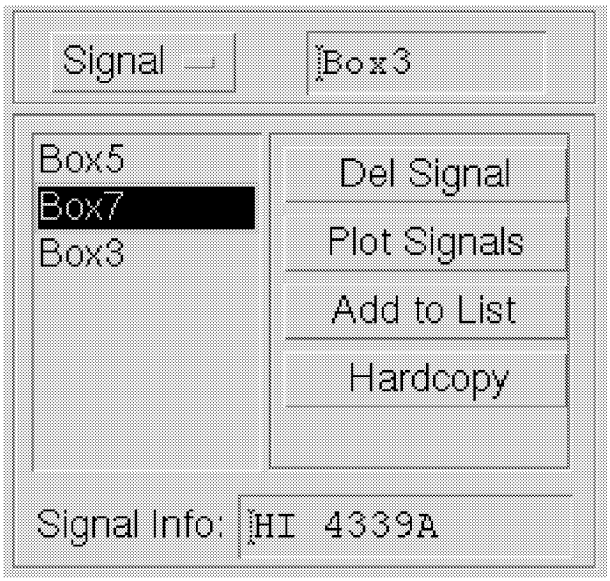

Fig. 21. Visualisation menu bar

- To insert the chosen signal name in the signals list field, click the button "Add to List". The signal name should appear in the field of signals list. If one or more signals are already selected, your can add a new signal to the already selected signal list. To delete one or more signals from the selected list, mark the signal to be deleted and press the "Del Signal" button.

- If one or more signals are already selected, your can get the comments about the selected signals. Mark the signal in the selected list, the comments about this signal should appear in the "Signal Info" field.

- If the signal list for visualisation is completely ready, press the "Plot Signals" button. The new window with plotted signals should appear as shown in Fig.22.

As default the signals will be plotted as line plots in the Visualisation window as shown in Fig. 22.

The visualisation window has the following controls:

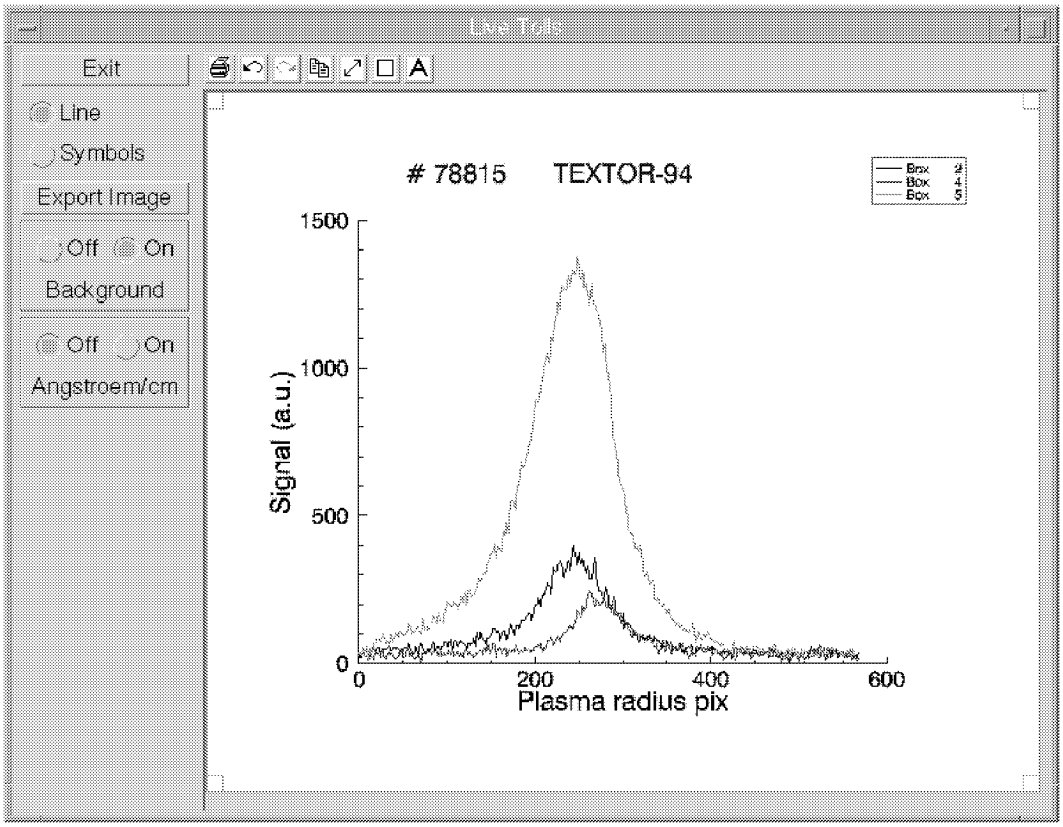

Fig. 22. Plot signal dialogue window

- **Line** option for data visualisation as line plots
- **Symbols** option for data visualisation as symbol plot
- **export** of visualisation window as one of the listed formats (JPEG,TIFF,GIF, etc.)
- **Background Off** option for visualisation of data with background
- **Background On** option for visualisation of data without background
- **Angstroem/cm Off** option for visualisation of data in Pixel
- **Angstroem/cm On** option for visualisation of data in Å or cm

A set of buttons in the upper left corner of the Visualisation window (see Fig. 23) allows you to print, undo the last operation, redo the last "undone" operation, copy, draw a line, draw a rectangle or add text.

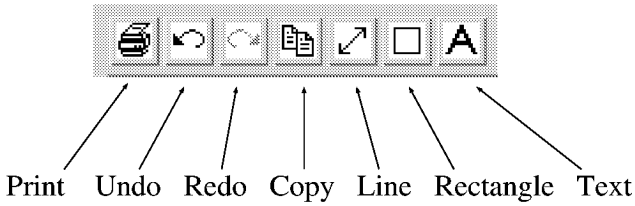

Fig. 23. Set of buttons in the visualisation window

11.1 Visualisation properties dialogue

To modify properties of all Visualisation types (Line, Scatter, Histogram, Polar plot, Contour, Image and Surface) click with the left mouse button in the Visualisation window. A Visualisation Properties dialogue should appear.

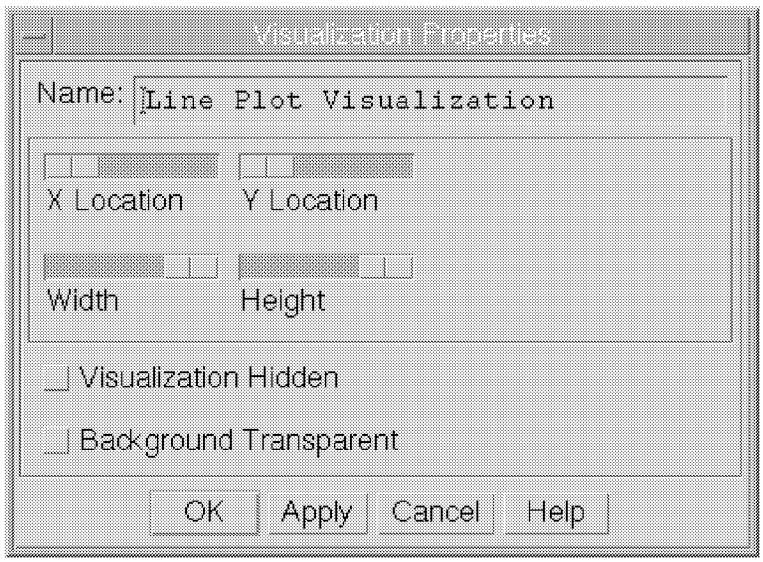

Fig. 24. Visualisation properties dialogue window

This subsection describes these dialogue controls and how to use them.

- **Name Text Field** A Visualisation is identified by its name. Video refers to the name whenever a Visualisation needs to be referenced textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **X Location Slider** Use the "X Location" slider to modify the X location of the Visualisation in the window.

- **Y Location Slider** Use the "Y Location" slider to modify the Y location of the Visualisation in the window.

- **Width Slider** Use the "Width" slider to modify the width of the entire Visualisation relative to the dimensions of the Visualisation window. Adjust the slider value by clicking in its bar or dragging its knob to the desired width. Moving the knob to the left decreases the width.

- **Height Slider** Use the "Height" slider to modify the height of the entire Visualisation relative to the dimensions of the Visualisation window. Adjust the slider value by clicking in its bar or dragging its knob to the desired height. Moving the knob to the left decreases the height.

  Note: You also can manipulate Visualisations directly using the mouse.

- **Visualisation Hidden Checkbox** Select the "Visualisation Hidden" checkbox to hide the selected Visualisation from view. This option is helpful when you are working with several Visualisations in the window and you do not want to re-draw all of the Visualisations each time a modification is made. Hidden Visualisations are not removed from the Visualisation window.

- **Background Transparent Checkbox** Select the "Background Transparent" checkbox to change the selected Visualisation's background from white to clear. Use this option to overlay one Visualisation on top of another and view both at the same time. For example, if a contour is placed over an image Visualisation, the image will be obscured unless the contour's background is transparent.

After you have finished viewing and modifying properties in the dialogue, you can click "Apply" to apply modifications as a trial. This option is helpful if you want to see how the changes modify the Visualisation in the window before accepting them. You can click "Apply" as many times as you wish. The Properties dialogue remains open.

If you want to accept the changes, click "OK". The Properties dialogue closes.

11.2 Properties Dialogue for Plot Lines

If you select a plot line by double-clicking in the Visualisation window, a control dialogue as shown in Fig. 25 appears in the Properties dialogue allowing you to modify properties of the line plot.

The following subsection describes the control dialogue and how to use it.

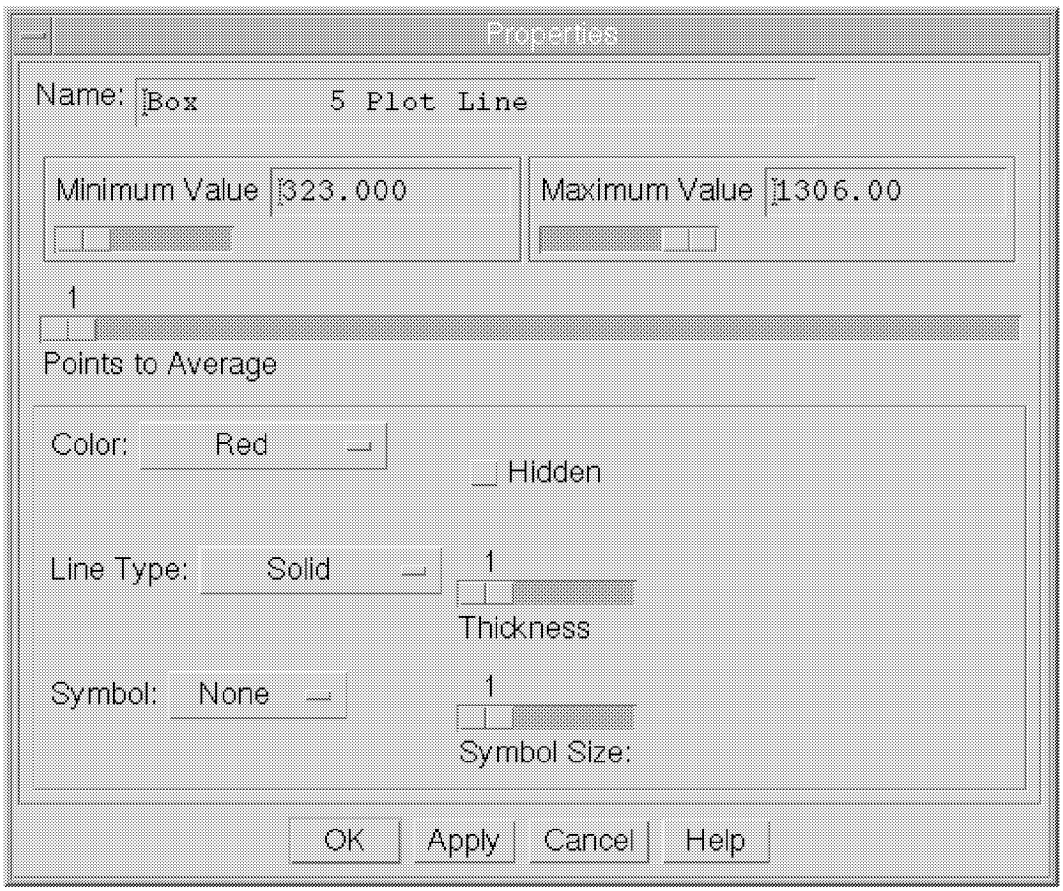

Fig. 25. Properties dialogue for plot lines

- **Name Text Field** A plot element is identified by its name. Video refers to the name whenever a plot element needs to be referenced textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name click in the "Name" text field and edit the name.

- **Minimum Value Slider and Text Field** Use the "Minimum Value" slider or the corresponding text field to limit the value of the plotted data. Data values less than this value will not be plotted. The default value is the minimum value of the data.

- **Maximum Value Slider and Text Field** Use the "Maximum Value" slider or the corresponding text field to limit the value of the plotted data. Data values larger than this value will not be plotted. The default value is the maximum value of the data.

- **Points To Average Slider** Use the "Points to Average" slider to define the number of data points over which Video should average when plotting. Adjust the slider value by clicking in its bar or dragging its knob to the desired number. The number is displayed above the slider. Possible numbers range from one to the number of data points.

- **Colour Drop list** select a colour for the line from the "Colour" drop list. This option is particularly useful when working with several plots in the Visualisation window.

- **Hidden Checkbox** Select this option to hide the selected element from view.

  Note: To make a hidden graphic element visible: Select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all elements of all Visualisations. Select the hidden element and click the "Edit" button. In the Properties dialogue, deselect the Hidden option.

- **Line Type Drop list** From the "Line Type" drop list, select a type for the line. Options are: solid, dotted, dashed, dash dot, dash double dot, and long dashes. This option is particularly useful when working with several plots in the Visualisation window

- **Thickness Slider** Use this slider to define the thickness of the line. Adjust the slider value by clicking in its bar or dragging its knob to the desired thickness. The range is from 1 to 10 pixels. The thickness is displayed above the slider. This option is particularly useful to guide the eye when working with several lines in the Visualisation window.

- **Symbol Drop list** From the "Symbol" drop list, select a plotting symbol. Options are: plus, asterisk, period, diamond, triangle, square, and X. If you do not want to use a symbol, select "None".

  Plotting symbols mark each data point in a plot. This option is particularly useful when working with several plots in the Visualisation window.

Note: The "Symbol" drop list is not available for histogram plots.

- **Symbol Size Slider** Use this slider to define symbol size. Adjust the slider value by clicking in its bar or dragging its knob to the desired size. The range is from 1 to 10 (percent of Visualisation size). The size is displayed above the slider.

11.3 Properties Dialogue for Axes

If you select an axis by double–clicking in the Visualisation window, the control dialogue (Fig. 26) appears in the Properties dialogue allowing you to modify the properties of the axis.

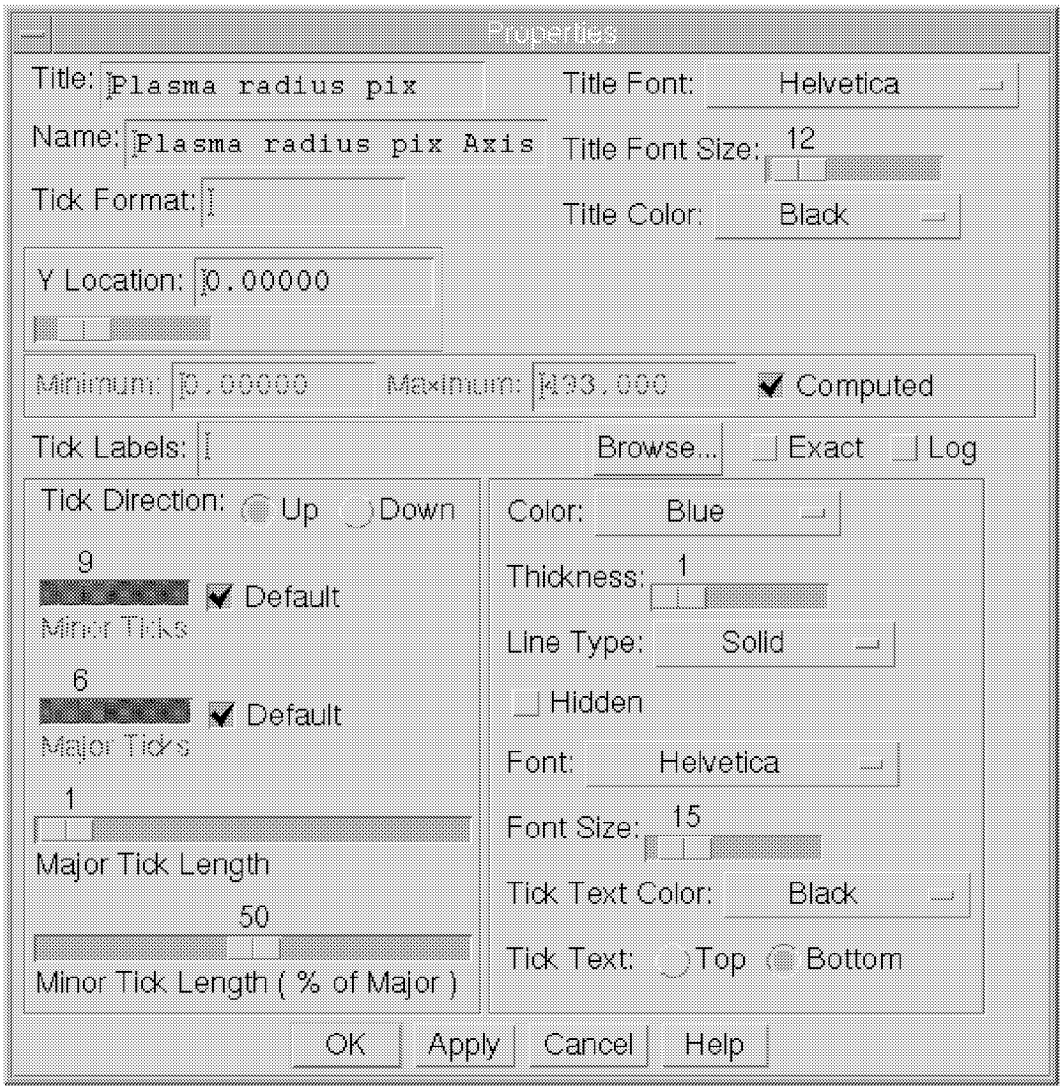

Fig. 26. Properties dialogue window for axes

This section describes the dialogue controls for each type of axis: X, Y, Z, radius and Theta.

- **Title Text Field** Enter the text of the axis title in the "Title" text field. Note that the title of an axis is different from its Name.

- **Name Text Field** An axis is identified by its name. Video refers to the name whenever an axis needs to be referenced textually (for example in lists or for processing error messages). A name is necessary and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **Tick Format** Allows you to specify a format string to determine the format of the tick text. Blank is the default. For more information, see IDL Reference Guide.

- **Title Font Drop List** Select a font for the axis title from the "Title Font" drop list.

- **Title Font Size Slider** Select a size for the axis title using the "Title Font Size" slider.

- **Title Colour Drop List** From the "Title Colour" drop list, select the title text colour.

- **Axis Location Slider** Use the "Axis location" slider to definee the location of the selected axis. Adjust the slider value by clicking in its bar or dragging its knob to the desired location.

- **Minimum/Maximum** Enter values into the Minimum/Maximum boxes to definee the minimum/maximum range of the selected axis. The Minimum/Maximum range has the effect of zooming in/out.

- **Computed Checkbox** Select the Computed option to compute the axis minimum/maximum ranges automatically based on the min/max of the data sets associated with the axes.

- **Tick Labels Browse Menu** Use this menu to browse the data that can be used as tick labels.

- **Exact Checkbox** Select the "Exact" option to define the data range of the axis corresponding to the minimum and maximum data values of

the data being visualized. If this box is not checked, Video may adjust the range of the axis in order to fit the tickmark increment. Changing the axis range does not change the way the data are displayed but how the axis is displayed.

- **Log Checkbox** Select Log to display the data as a logarithmic plot.
- **Tick Direction Options** Select the desired direction of the tick marks at the selected axis (X axis: "Up" or "Down"; Y axis: "Left" or "Right").
- **Minor Ticks Slider** Use this slider to fix the number of minor tick marks between the major tick marks. Adjust the slider value by clicking in its bar or dragging its knob to the desired value.
- **Major Ticks Slider** Use this slider to fix the number of major tick marks along the axis. Adjust the slider value by clicking in its bar or dragging its knob to the desired value.
- **Default Checkboxes** Resets the Minor/Major Ticks to default values.
- **Tick Length Slider** Use the "Tick Length" slider to define the length of the tick marks along the axis. Adjust the slider value by clicking in its bar or dragging its knob to the desired length (0-100
- **Colour Drop List** From the "Colour" drop list select a colour for the axis.
- **Thickness Slider** Use this slider to fix the thickness of the axis. Adjust the slider value by clicking in its bar or dragging its knob to the desired thickness. The number is displayed above the slider. Numbers range from 1 to 10 pixels.
- **Line Type Drop List** From the "Line Type" drop list, select a line type for the tick marks. Options are: solid, dotted, dashed, dash dot, dash dot dot, and long dashes.
- **Hidden Checkbox** Select this option to hide the selected element from view.

  Note: To make a hidden graphic element visible: select the Visualisation Manager option from the Edit menu. The Visualisation Manager

Window appears listing all elements of all Visualisations. Select the hidden element and click the "Edit" button. One can deselect the Hidden option in the Properties dialogue.

- **Font Drop List** Select a font to use for the axis tick marks from the drop list.
- **Font Size Slider** Select a size for the axis tick marks using the "Font Size" slider.
- **Tick Text Colour Drop List** Select a colour for the Tick Text.
- **Tick Text Location** Adjust the Tick Text by selecting Right or Left (x axis) or Top or Bottom (y axis).

11.4 Properties Dialogue for Text Annotations

To edit an annotation line, either double-click on it or use the "Text" symbol (Fig.23) in the Visualisation window (Fig.22). A properties dialogue window for text annotation as shown in Fig.27 should appear

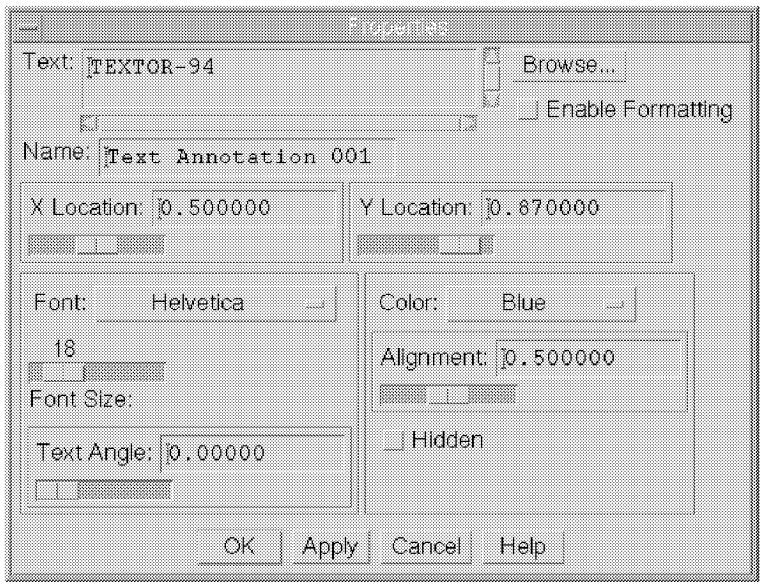

Fig. 27. Properties Dialogue for Text Annotations

- **Text Field** Enter the annotation text in the "Text" field. Multiple line entries are possible.
- **Browse** Use browse to select a data item for the "Text" field. The name must be enclosed by bars ("|"). For example, there are two

plotted signals (Y1 and Y2 variables) in visualisation window. Select "Y2" value to insert the data value as a string into the text annotation. Press the "Ok" button. The value of Y1 variable will be plotted in the visualisation window.

- **Enable Formatting** For this information, see chapter "Fonts" in IDL Reference Guide.

- **Name Text Field** An annotation is identified by its name. Video refers to the name whenever an annotation needs to be referenced textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **X and Y Location Sliders** Use the "X Location" and "Y Location" sliders to fix the X and Y location of the annotation. Adjust the slider value by clicking in its bar or dragging its knob to the desired location. Moving the Y slider to the left and right moves the annotation up and down in the Visualisation window.

  X Slider: left=left, right=right

  Y Slider: left=down, right=up

- **Font Drop List** From the "Font Type" drop list, select a font for a text annotation.

- **Font Size Slider** Adjust the "Font Size" slider to the desired character size (9-72) for a text annotation.

- **Text Angle Text Field and Slider** Enter the angle of rotation for a text annotation in the "Text Angle" text field or adjust the slider to the desired angle of rotation.

- **Colour Drop List** From the "Colour" drop list, select a colour for the text annotation.

- **Alignment Slider** Adjust the slider to the desired alignment (0 to 1). A setting of zero aligns the text on the right, an alignment of one aligns it on the left. The default alignment (0.5) centers the text.

- **Hidden Checkbox** Select this option to hide the text annotation from view.

Note: To make a hidden annotation visible select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all Visualisations, annotations and elements. Select the hidden element and click the "Edit" button. In the Properties dialogue, deselect the Hidden option.

11.5 Properties Dialogue for Legend Annotations

Legends will be generated when a plot, contour or surface graph is created. To edit a legend click double times on it. A window dialogue for legend annotations as shown in Fig. 28 should appear. This section describes dialogue controls.

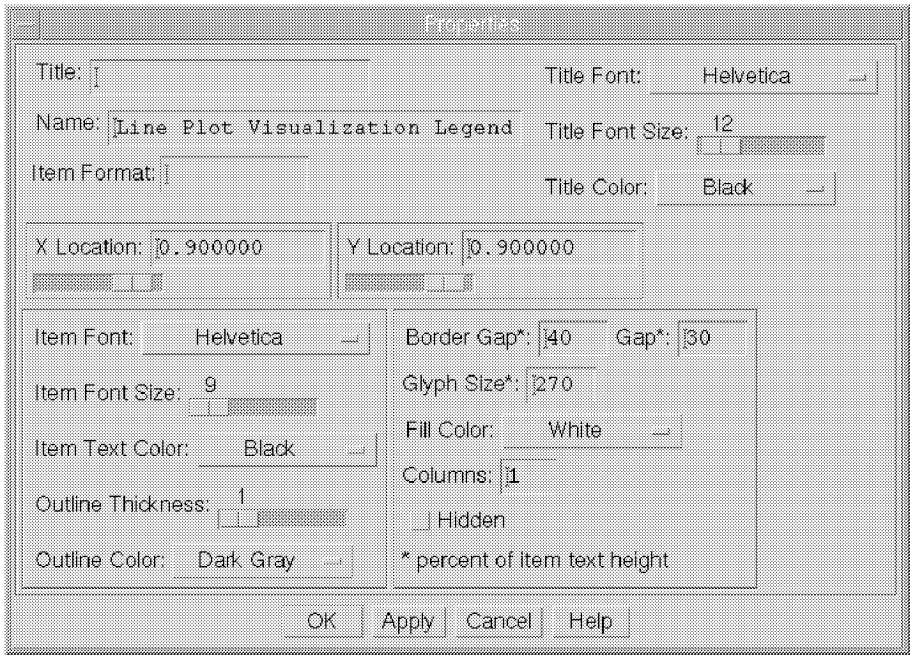

Fig. 28. Properties Dialogue for Legend Annotations

- **Title Text Field** Enter the title in the "Title" text field. Note that a legend title is different from its name.
- **Title Font Drop List** From the "Title Font" drop list, select a font for the title text.
- **Title Font Size Slider** Adjust the "Title Font Size" slider to the desired character size (9-72) for the title text.
- **Title Colour Drop List** From the "Title Colour" drop list, select the title text colour.

- **Name Text Field** An annotation is identified by its name. Video refers to the name whenever an annotation needs to be referenced textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **Item Format** Allows you to specify a format string to determine the format of contour legends. Blank is the default. For more information, see IDL Reference Guide.

  Note: Item Format is used only for contour legends.

- **X and Y Location Sliders** Use the "X Location" and "Y Location" sliders to define the X and Y location of the legend. Adjust the slider value by clicking in its bar or dragging its knob to the desired location. Moving the slider to the left and right moves the legend up or down in the Visualisation window.

  X Slider: left=left, right=right

  Y Slider: left=down, right=up

- **Item Font Drop List** From the "Item Font" drop list, select the desired item font for the legend. The item corresponds to the text next to they glyph in the legend.

- **Item Font Size Slider** Use this slider to adjust the size of the font. The range is from 9 to 72.

- **Item Text Colour Drop List** From the "Item Text Colour" drop list, select the desired colour for the text.

- **Outline Thickness Slider** Use this slider to adjust the thickness of the legend outline.

- **Outline Colour Drop List** From the "Outline Colour" drop list, select the desired colour for the outline of the legend.

- **Border Gap** Set the distance between the text and the legend border by entering a number here (units are percent of item text height).

- **Gap** Set the distance between each item text with this number (units are percent of item text height).

- **Glyph Size** Set this number to the desired size of the reference symbol.
- **Fill Colour Drop List** From the "Fill Colour" drop list, select a background colour for the legend.
- **Columns** Set the number of columns for the item.
- **Hidden Checkbox** Select this option to hide the legend from view.

  Note: To make a hidden annotation visible, first select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all Visualisations, annotations and elements. Select the hidden element and click the "Edit" button. In the Properties dialogue, deselect the Hidden option.

11.6 Properties Dialogue for Line Annotations

To edit a line annotation, either double-click on it or use the "Line" symbol (Fig.23) in the Visualisation window (Fig.22). A Dialogue window as shown in Fig. 29 should appear.

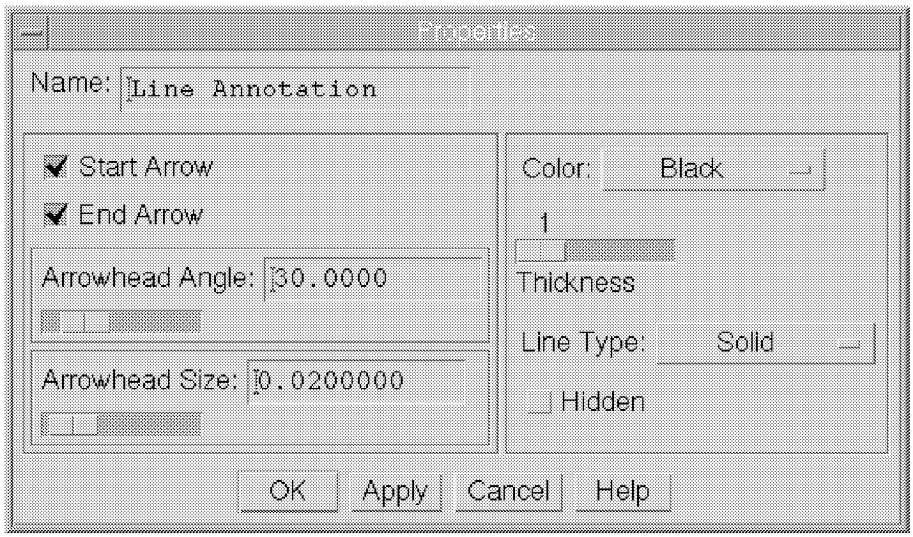

Fig. 29. Properties Dialogue for Line Annotations

- **Name Text Field** An annotation is identified by its name. Video refers to the name whenever an annotation needs to be referenced textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **Start Arrow Checkbox** Select this option to display an arrow at the starting point of a line annotation.
- **End Arrow Checkbox** Select this option to add an arrow to the ending point of a line annotation.
- **Arrowhead Angle Slider** Use this slider to designate the angle of the line annotation's arrowhead(s). Adjust the slider value by clicking in its bar or dragging its knob to the desired angle.
- **Arrowhead Size Slider** Use this slider to define the size of the line annotation's arrowhead(s). Adjust the slider value by clicking in its bar or dragging its knob to the desired size (units = size x 100
- **Colour Drop List** From the "Colour" drop list, select a colour for the line.
- **Thickness Slider** Use this slider to fix the thickness of the annotation. Adjust the slider value by clicking in its bar or dragging its knob to the desired thickness. The number is displayed above the slider. Numbers range from 1 to 10 pixels.
- **Line Type Drop List** From the "Line Type" drop list, select a line type for the line. Options are: solid, dotted, dashed, dash dot, dash dot dot, and long dashes.
- **Hidden Checkbox** Select this option to hide the line from view.

  Note To make a hidden annotation visible: select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all Visualisations, annotations and elements. Select the hidden element and click the "Edit" button. In the Properties dialogue, deselect the Hidden option.

11.7 Properties Dialogue for Rectangle Annotations

To edit a rectangle annotation, either double-click on it or use "Rectangle" symbol (Fig.23) in the visualisation window (Fig.22). The dialogue window for rectangle annotations should appear as shown in Fig. 30.

- **Name Text Field** An annotation is identified by its name. Video refers to the name whenever an annotation needs to be referenced

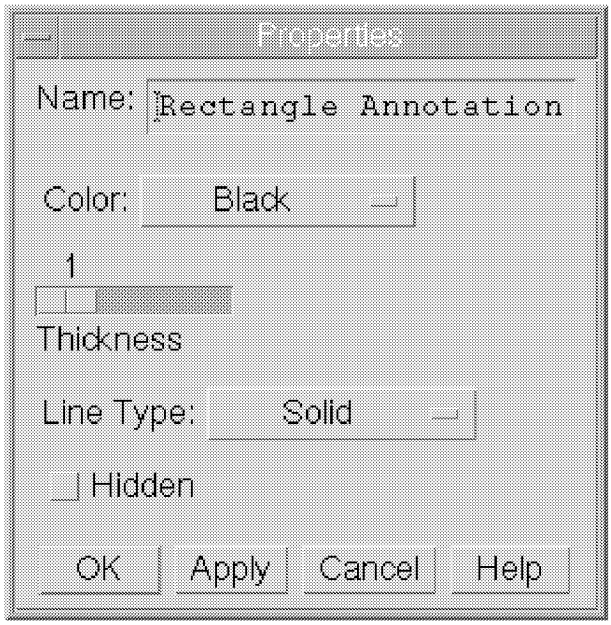

Fig. 30. Properties Dialogue for Rectangle Annotations

textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

To enter a new name, click in the "Name" text field and edit the name.

- **Colour Drop List** Select a colour from the "Colour" drop list for the rectangle.

- **Thickness Slider** Use this slider to designate the thickness of the rectangle. Adjust the slider value by clicking in its bar or dragging its knob to the desired thickness. The number is displayed above the slider. Numbers range from 1 to 10 pixels.

- **Line Type Drop List** From the "Line Type" drop list, select a line type for the rectangle. Options are: solid, dotted, dashed, dash dot, dash dot dot, and long dashes.

- **Hidden Checkbox** Select this option to hide the rectangle from view.

  Note: To make a hidden annotation visible: select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all Visualisations, annotations and elements. Select the hidden element and click the "Edit" button. Deselect the Hidden option in the Properties dialogue.

12 Exporting Data

Select "Export Image" in Plot Signal window (see Fig. 22) to export the image in one of the listed formats (JPEG, TIFF, GIF, etc.). An Export dialogue window will open as shown in Fig. 31.

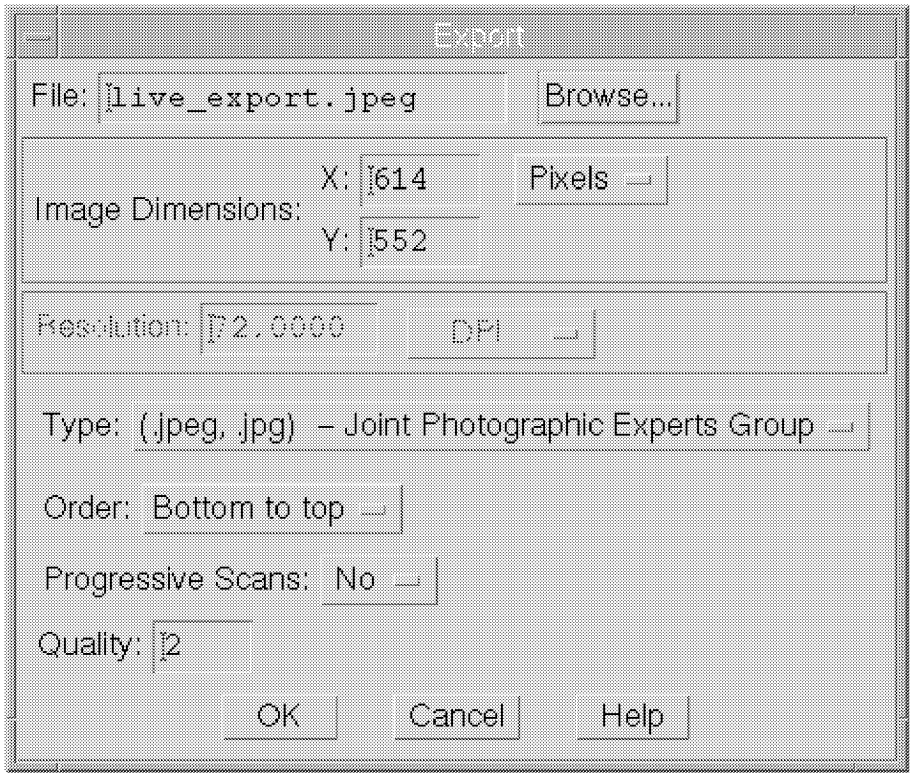

Fig. 31. Window for exporting files

- **File** Enter the file name or use the Browse button to select the file name for export.

  Note: Be sure to add an extension for the file name. The extensions (.tif, .jpg, .gif, etc.) are not automatically included in the file name.

- **Image Dimensions** Enter the X and Y dimensions of the export image. Use the drop list to select either pixels, inches, or centimeters.

- **Resolution** Enter the resolution of the image.

  Note: This option is not available if the image dimensions are in pixels.

- **Type Drop List** Select the export file type from this drop list. File types supported are:

BMP - Windows Bitmap

DAT - Structured Binary

GIF - Graphics Interchange Format

HDF - Hierarchical Data Format

JPEG, JPG - Joint Photographics Experts Group format

PICT - Macintosh Picture Format

PPM, PGM - PPM or PGM Format

SRF, SUN, RAST - Sun Raster File

TIFF, TIF - Tagged Image File Format

XWD - X Windows Dump

VRML - Virtual Reality Modelling Language (**Note:** This format is not available when exporting with the Data Manager. It is only available if the exporting is done by means of the Video's main "Export Menu Option".)

Note: The following options apply only to the JPEG (or JPG) format.

- **Order Drop List** Select the order in which the export file will be written: "Top to Bottom" or "Bottom to Top".

- **Progressive Scans Drop List** Select "Yes" to write the image as a series of scans with increasing quality or "No" to write the image all at once.

- **Quality** Enter the quality of the file to be exported. The quality scale ranges from 0 (bad) to 100 (excellent). The default is 75 which corresponds to a high quality.

  For more information about exporting files, see WRITE JPEG and other WRITE (TYPE) functions in the IDL Reference Guide.

13 Printing

To print a plot from a visualisation window (Fig. 22), select the "Printer" symbol (Fig.23). The hardcopy dialogue window appears as shown in in Fig.32.

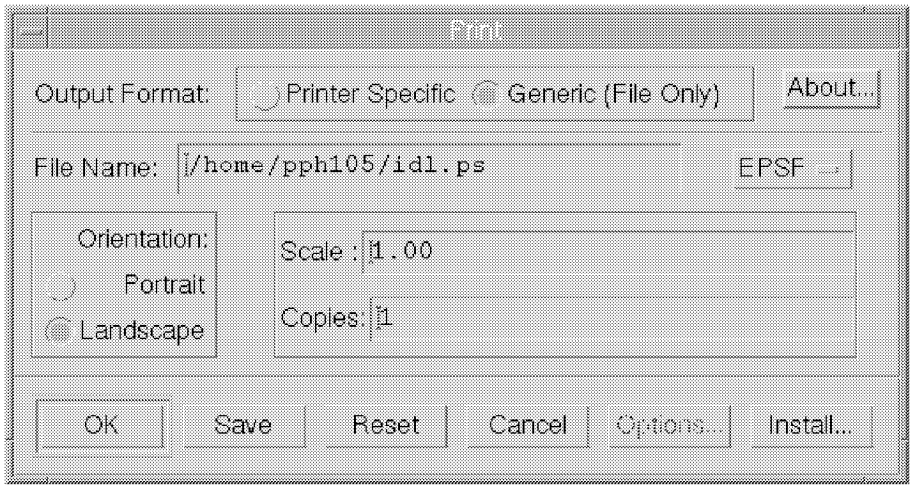

Fig. 32. Hardcopy dialogue window

Choose "Generic (File Only)" on the top line if you want to print to file. This option is recommended if you have problems sending data to a particular printer - instead, send the output to the file, then check the file and try to send it to the printer from the command prompt.

To select a physical printer for sending the output directly, click on "Options..." to invoke the following dialogue as shown in Fig. 33:

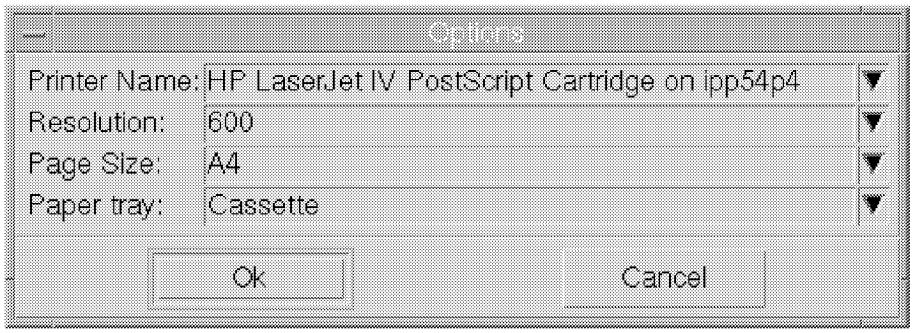

Fig. 33. Options dialogue window for hardcopy

Click on the arrow to the right of the "Printer Name" field to get a list of available printer names. Choose the desired printer. Check that the associated characteristics are correct, in particular that the Page Size is A4 and not "letter". Click OK.

Click "Save" on the previous dialogue to retain this printer choice between Video (and IDL) sessions. Click OK to start the printing process.

14 Images, Surfaces and Contours

To work with images, surfaces and contours, the signal field in the visualisation menu (Fig. 5) must be empty. If not, mark the signals and press the "Del Signal" button. Press the "Plot Signals" button and the visualisation window with an image (as default) as shown in Fig. 34 should appear. The

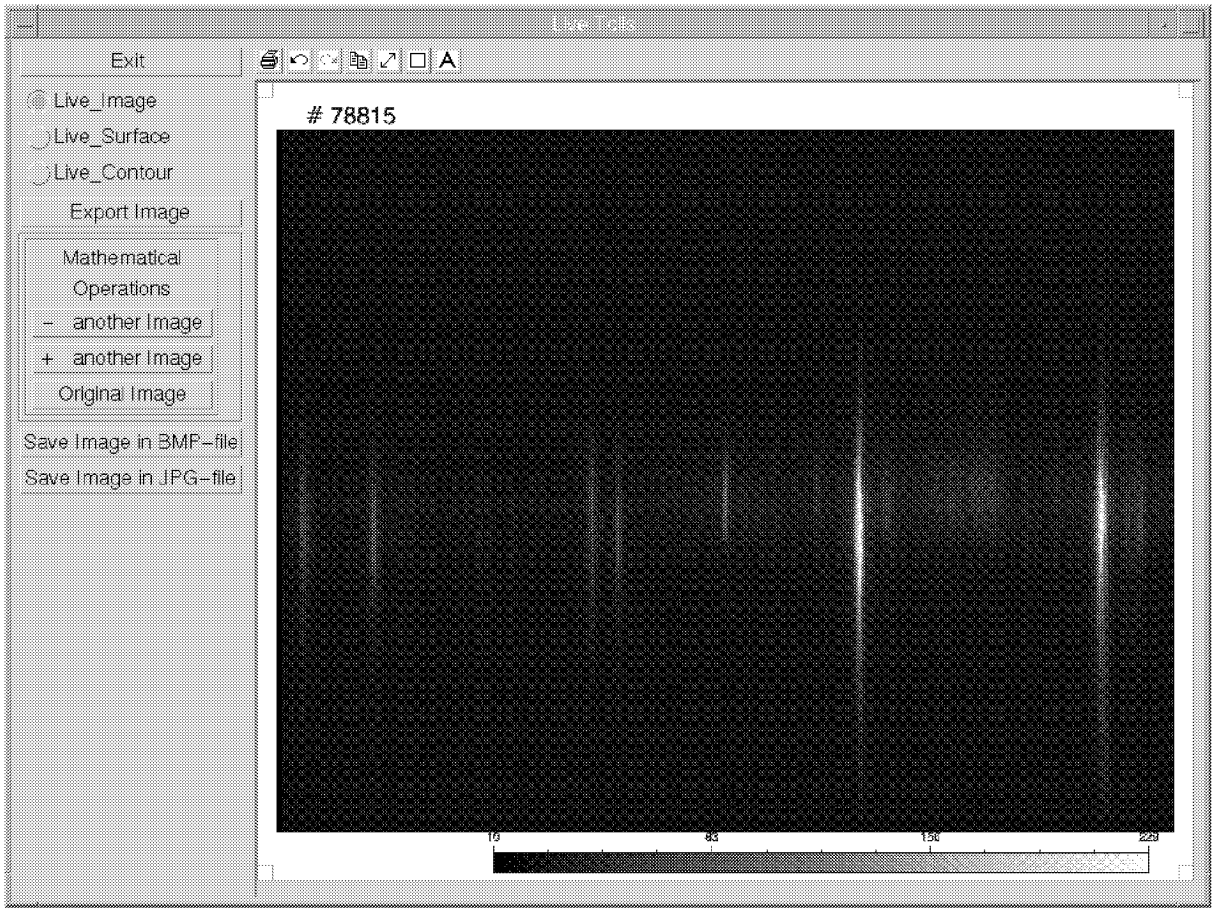

Fig. 34. Visualisation window with image

dialogue window has the following controls:

- video data presentation as image
- video data presentation as surface
- video data presentation as contours
- export image in another format
- mathematical operations with image:
  - subtraction of another image from the original one

  - addition of another image to the original image
  - back to the original image
- save image in BMP-file. Recommended for later work on this image.
- save image in JPG-file. Recommended for later work on this image.

14.1 Properties dialogue for image manupulation

If you select an image by double-clicking in the Visualisation window (Fig.34), the dialogue controls appears as shown in Fig. 35 in the Properties dialogue allowing you to modify the properties of the image. This section describes the dialogue controls and how to use them.

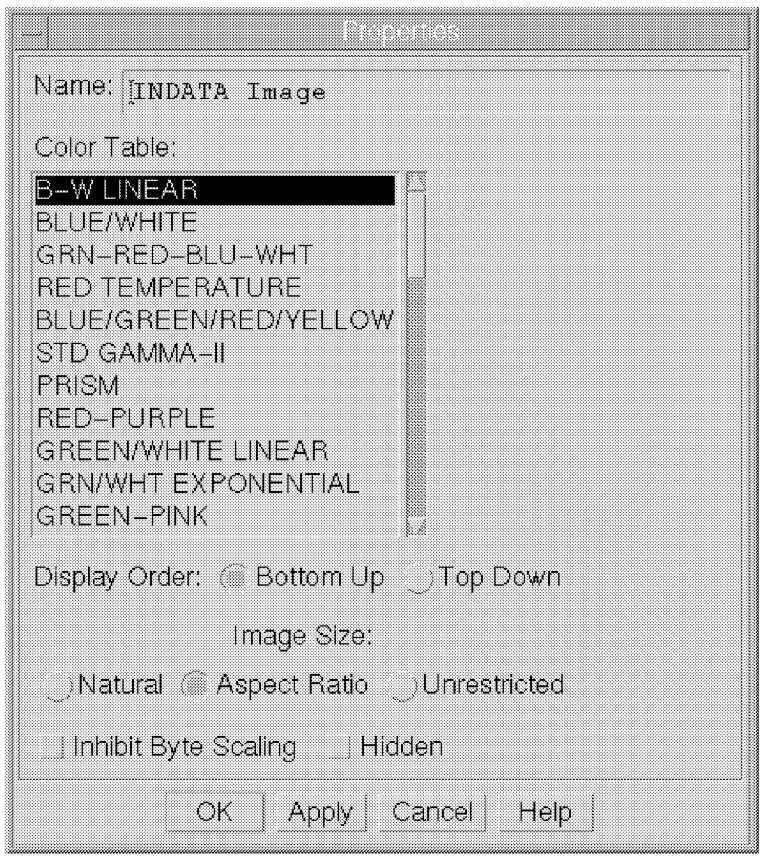

Fig. 35. Dialogue window to modify the properties of an image

- **Name Text Field** An image is identified by its name. Video refers to the name whenever an image needs to be referenced textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **Colour Table List** Select the desired colour table from the "Colour Table" list. This option is available for indexed colour images but not for true colour images.

- **Display Order Options** Select "Bottom Up" or "Top Down". to specify the order in which the image should be displayed.

- **Image Size Options** Select "Natural", "Aspect Ratio", or "Unrestricted" to specify the image size in the Visualisation window.

  Select "Natural" to restrict the image size in the Visualisation window to the width and height of the image data. The displayed image will not be changed in size and will be an accurate reproduction of the image data. **Note:** The natural imaged data size could become too small or too large to work with.

  Select "Aspect Ratio" so that the image maintains the same aspect ratio as the image data whenever the image is sized. Note that with "Aspect Ratio", Video has to scale the image and interpolate the image data which diminishes the image accuracy.

  Select "Unrestricted" so that the image has the width and height of the Visualisation that contains it. Note that selecting an unrestricted image size could result in distortion of the image appearance.

- **Inhibit Byte Scaling Checkbox** Select "Inhibit Byte Scaling" to prevent Video from automatically scaling the array to enhance its contrast. Video automatically turns this option "on" for images that were imported into Video with colour tables. Video automatically turns this option "off" for indexed colour images without colour tables, true-colour images, and for arrays of non-image data.

- **Hidden Checkbox** Select this option to hide the selected element from view.

  Note: To make a hidden graphic element visible select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all elements of all Visualisations. Select the hidden element and click the "Edit" button. Deselect the Hidden option in the Properties dialogue.

14.2 Colour bars

Colour bars will be generated automatically for grayscale or colour images if an image Visualisation is created. The colour bar will correspond to the palette of the image. To modify the properties of the colour bar click on it and the following properties dialogue as shown in Fig. ?? appears.

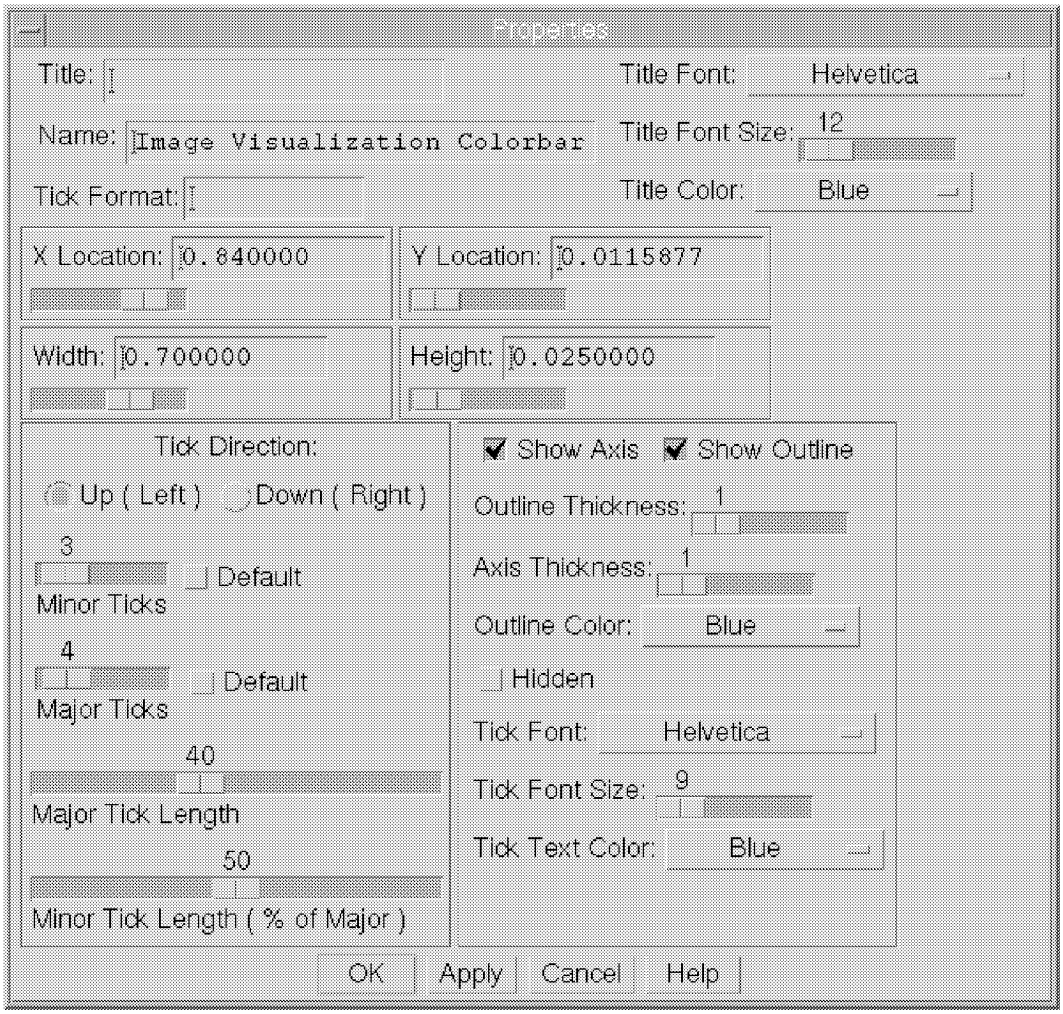

Fig. 36. Colour bar properties dialogue window

- **Title Text Field** Enter the colour bar title in the "Title" text field. Note that a colour bar title is different from its name.
- **Title Font Drop List** Select a font for the title text from the "Title Font" drop list.
- **Title Font Size Slider** Adjust the "Title Font Size" slider to the desired character size (9-72) for the title text.

- **Title Colour Drop List** Select the title text colour from the "Title Colour" drop list.

- **Name Text Field** An annotation is identified by its name. Video refers to the name whenever an annotation needs to be referenced textually (e.g., in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **Tick Format** Allows you to specify a format string (minus the parentheses) to determine the format of the tick text. Blank is the default. For more information, see Format Codes in Using IDL.

- **X and Y Location Sliders** Use the "X Location" and "Y Location" sliders to designate the X and Y location of the colour bar. Adjust the slider value by clicking in its bar or dragging its knob to the desired location. Moving the slider to the left and right moves the colour bar up or down in the Visualisation window.

  X Slider: left=left, right=right

  Y Slider: left=down, right=up

- **Width and Height Sliders** Use the "Width" and "Height" sliders to designate the width and height of the colour bar.

  Note: If the width is larger than the height, the colour bar is horizontal; if the height is larger than the width, the colour bar is vertical.

- **Tick Direction Options** Select the desired direction for the tick marks ("Up" or "Down").

- **Minor Ticks Slider** Use this slider to fix the number of minor tick marks between the major tick marks. Adjust the slider value by clicking in its bar or dragging its knob to the desired value.

- **Major Ticks Slider** Use this slider to fix the number of major tick marks along the colour bar axis. Adjust the slider value by clicking in its bar or dragging its knob to the desired value.

- **Major Tick Length Slider** Use this slider to designate the length of the major tick marks. Adjust the slider value by clicking in its bar or dragging its knob to the desired length (0 - 100)

- **Minor Tick Length Slider** Use this slider to designate the length of the minor tick marks as percent of the major tick marks. Adjust the slider value by clicking in its bar or dragging its knob to the desired length (0-100
- **Show Axis Option** Select this option to show the axis of the colour bar.
- **Show Outline Option** Select this option to show the outline of the colour bar.
- **Outline Thickness Slider** Use this slider to set the thickness of the colour bar outline. Numbers range from 1 to 10 pixels.
- **Axis Thickness Slider** Use this slider to set the thickness of the colour bar axis. Numbers range from 1 to 10 pixels.
- **Outline Colour Drop List** Select a colour for the colour bar outline/axis from the "Colour" drop list.
- **Hidden Checkbox** Select this option to hide the colour bar from view.

  Note: To make a hidden annotation visible select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all Visualisations, annotations and elements. Select the hidden element and click the "Edit" button. Deselect the Hidden option in the Properties dialogue.
- **Tick Font Drop List** From the "Tick Font" drop list, select a tick font for the colour bar.
- **Tick Font Size Slider** Adjust the "Tick Font Size" slider to the desired character size (9-72).
- **Tick Text Colour Drop List** From the "Tick Text Colour" drop list, select the tick text colour.

14.3 Presentation of video data as surface plot

Select the "Live_Surface" option from the visualisation window to present the image as surface. The image should be redrawn as surface plot as shown in Fig. 37. If you select a surface by double-clicking in the Visualisation

window, the dialogue controls as shown in Fig. 38 appears in the Properties dialogue allowing you to modify the properties of the surface. This section describes the dialogue controls and how to use them.

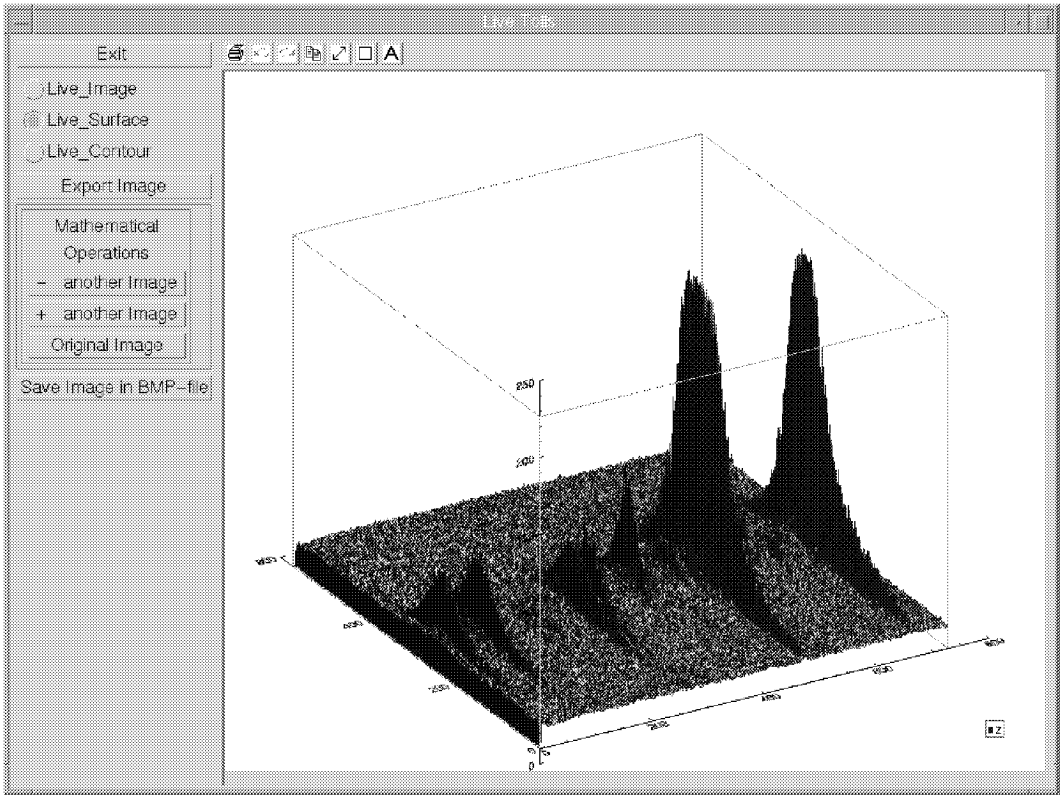

Fig. 37. Surface plot in the visualisation window

- **Name Text Field** A surface is identified by its name. Video refers to the name whenever a surface needs to be referenced textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **Minimum Value Slider and Text Field** Use the "Minimum Value" slider or text field to limit the displayed data. Data values less than this value will not be displayed. The default value is the minimum value of the data.

- **Maximum Value Slider and Text Field** Use the "Maximum Value" slider or text field to limit the data you display. Data values larger than this value are not displayed. The default value is the maximum value of the data.

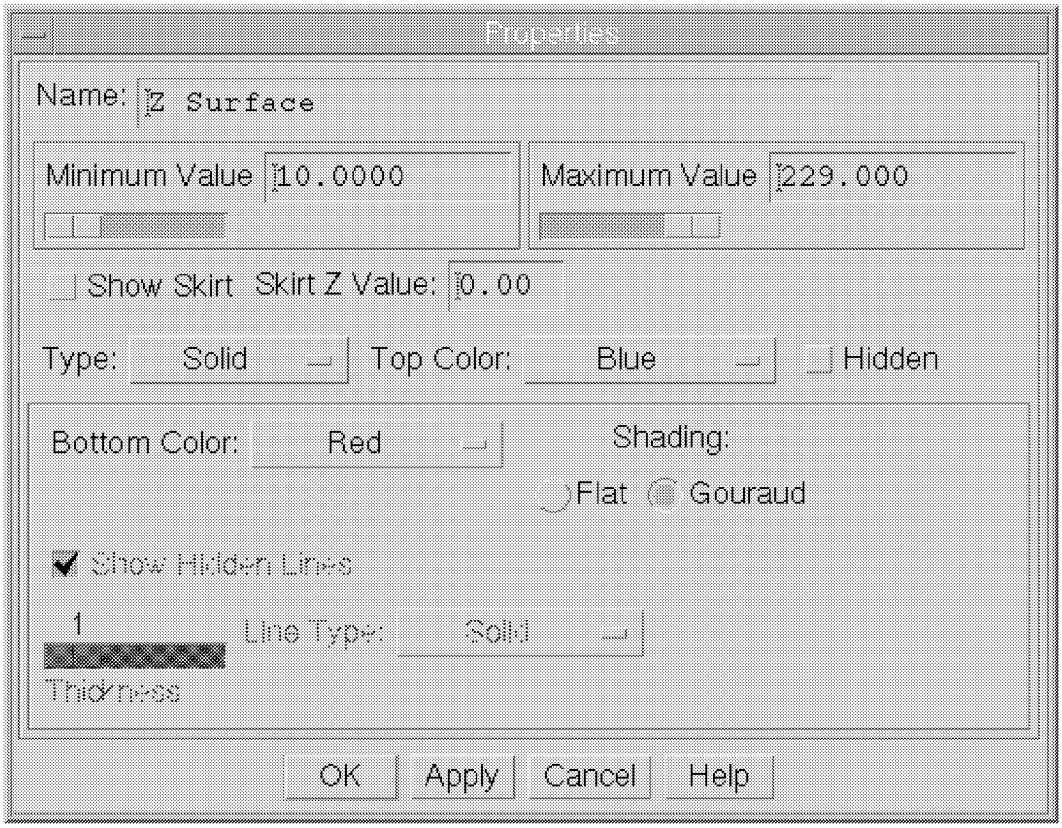

Fig. 38. Dialogue to modify the surface properties

- **Show Skirt Checkbox** Select "Show Skirt" to display a "skirt" around the surface at the given Z value.

- **Skirt Z Value Text Field** Enter the value at which the skirt around the surface should be displayed. The Z value is expressed in data units.

- **Top Colour Drop List** Select a colour for the upper side of the surface from the "Top Colour" drop list. This is the only colour used if the surface type is not "Solid".

- **Hidden Checkbox** Select this option to hide the selected element from view.

  Note: To make a hidden graphic element visible select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all elements of all Visualisations. Select the hidden element and click the "Edit" button. Deselect the Hidden option in the Properties dialogue.

- **Type of Surface Drop List** Select the desired style for displaying the visible surface from the "Surface Type" drop list. Options: Point, Mesh (wire), Ruled (XZ), Ruled (YZ), Lego (wire) and Lego (solid). Lego (wire) and Lego (solid) produce stacked histogram-style plots. Each data value is rendered as a box covering the XY extent of the cell and with a height proportional to the Z value.

- **Bottom Colour Drop List** Select a colour for the underside of the surface from the "Bottom Colour" drop list. This option is only available for solid surfaces.

- **Shading Options** Select "Flat" or "Gouraud" to specify the shading style of Solid or Lego (solid) type surfaces. Gouraud shading interpolates intensities from each vertex along each edge of a surface. Gouraud shading usually results in a smoother appearance but needs more computional time.

- **Show Hidden Lines Checkbox** Select the "Show Hidden Lines" checkbox to draw lines that are "behind" other lines in the surface. Not showing hidden lines will increase the time necessary for displaying a surface. This option is not available for the surface type "Solid".

- **Line Type Drop List** From the "Line Type" drop list, select a type for the line. Options: solid, dotted, dashed, dash dot, dash dot dot, and long dashes. This option is particularly useful when working with several plots in the Visualisation window.This option is not available if the surface type is "Solid".

- **Thickness Slider** Use this slider to designate the thickness of the line. Adjust the slider value by clicking in its bar or dragging its knob to the desired thickness. The range is from 1 to 10 pixels. The thickness is displayed above the slider. This option is particularly useful when working with several lines in the Visualisation window.This option is not available if the surface type is "Solid".

14.4 Presentation of video data as contour plot

Select the "Live_Contour" option from the visualisation window to present the image as contour plot. The image should be redrawn as contour plot as shown in Fig. 39.

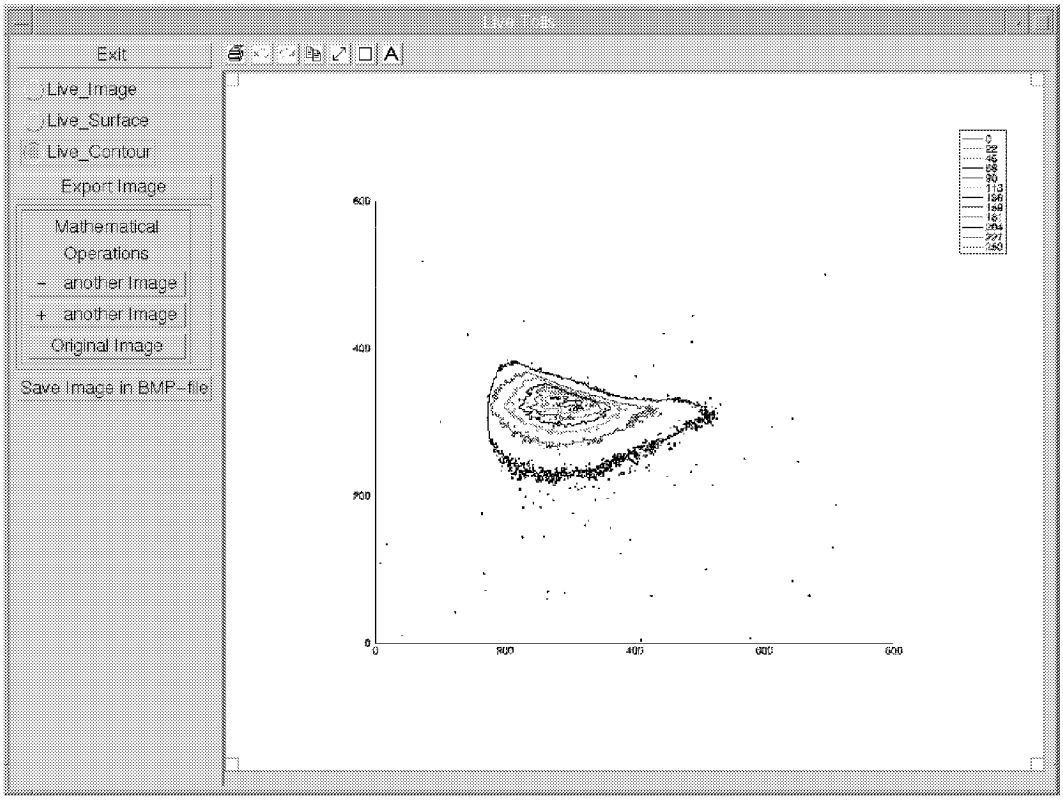

Fig. 39. Contour plot in visualisation window

If you select a contour by double-clicking in the Visualisation window, the dialogue controls appear in the Properties dialogue allowing you to modify the properties of contours.

- **Name Text Field** A contour is identified by its name. Video refers to the name whenever a contour needs to be referenced textually (for example in lists or for processing error messages). A name is required and must be unique within the Video application.

  To enter a new name, click in the "Name" text field and edit the name.

- **Hidden Checkbox** Select this option to hide the selected element from view.

  Note: To make a hidden graphic element visible select the Visualisation Manager option from the Edit menu. The Visualisation Manager Window appears listing all elements of all Visualisations. Select the hidden element and click the "Edit" button. Deselect the Hidden option in the Properties dialogue.

- **Number of Levels Text Field** Enter the desired number of contour levels desired in the "Number of Levels" text field.

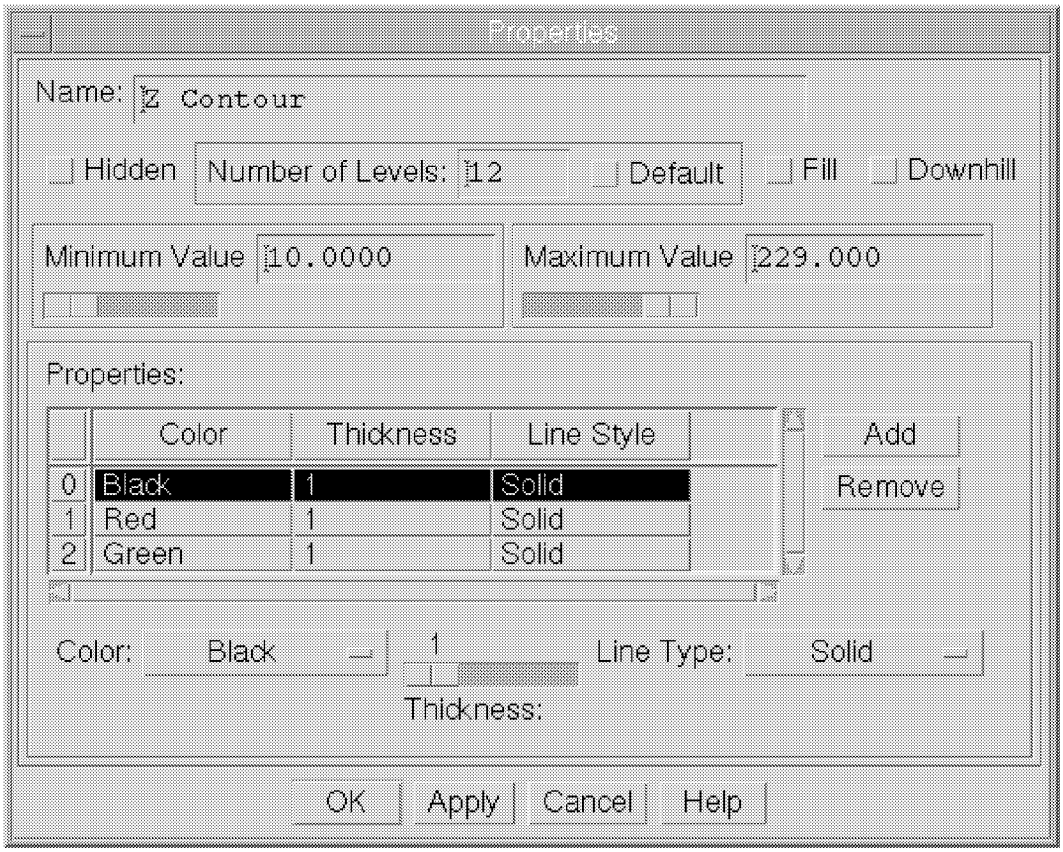

Fig. 40. Dialogue window to modify the contour properties

- **Default Checkbox** Click on this box to set the default of the Number of Levels text field.

- **Fill Checkbox** Select this option to fill the contours with solid colour lines.

- **Downhill Checkbox** Select this option to make the contour lines pointing "downhill" towards the lower-valued data.

- **Minimum/Maximum Values** Enter the minimum/maximum values of the contour range to be displayed.

- **Properties Table** The Properties table lists the contour levels together with the colour, thickness and line style properties of each. Use the table to select a contour level you would like to modify using other dialogue controls. For example, by selecting a level listed in the table and clicking "Add", Video adds the duplicate contour to the table list.

- **Add Button** After selecting a level in the "Properties" table, click "Add" to duplicate the selected level. Video adds the duplicate contour level properties to the table list.
- **Remove Button** After selecting a level in the "Properties" table, click "Remove" to remove a selection in the "Properties" table. Video removes the level from the table list.
- **Colour Drop List** After selecting a level in the "Properties" table, select a colour from the "Colour" drop list.
- **Thickness Slider** After selecting a level in the "Properties" table, use this slider to designate the thickness of the level. Adjust the slider value by clicking in its bar or dragging its knob to the desired thickness. The range is 1 to 10 pixels. The thickness is displayed above the slider.
- **Line Type Drop List** After selecting a level in the "Properties" table, select a line type from the "Line Type" drop list. Options: solid, dotted, dashed, dash dot, dash dot dot, and long dashes.

15 Background subtraction

For background substraction, use the options menu as shown in Fig.41.

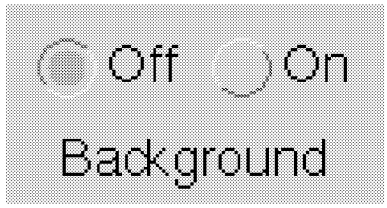

Fig. 41. Options menu for background subtraction

- Select the options "Off" to retain the background on the image.
- Select the options "On" to work with images without backround. In this case the backgroung image will be subtracted from the analysed images. If the analysed image corresponds to an even frame, the background image will be constructed from the last three even frames (average image over 3 images). Otherwise, the background image will be constructed from the last three odd frames

16 Image orientation

Fig.42 shows the toolbar in the Video menu for image orientation.

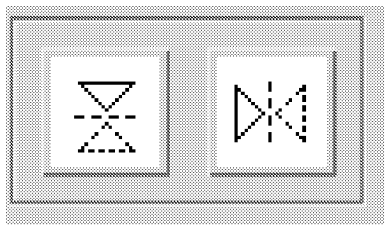

Fig. 42. Toolbar for image orientation

This toolbar has the following controls:

- Select the left button to mirror the image corresponding to the horizontal line passing through the centre of the image
- Select the right button to mirror the image corresponding to the vertical line passing through the centre of the image

17 Calibration Procedure

Spectrometers at the limiter locks 1 and 3 are coupled with CCD-cameras. So that initially, one gets spectra as a function of pixel and not directly with a nm scale (see Fig. 43).

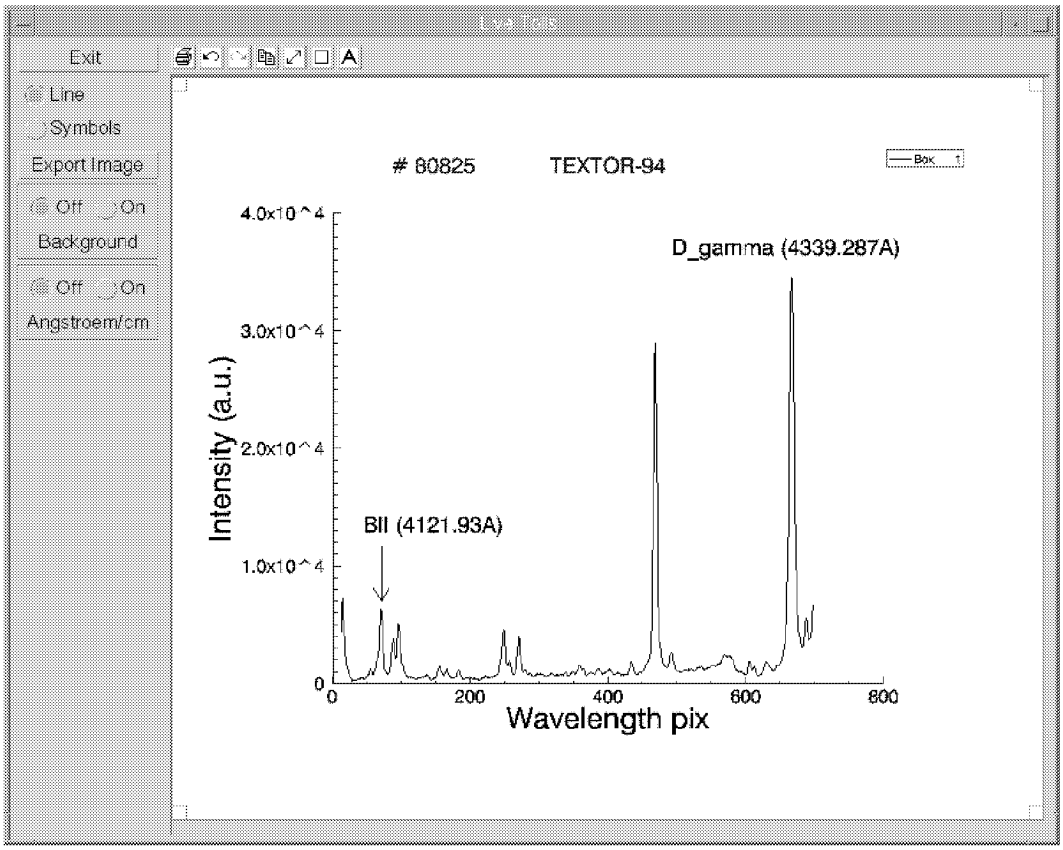

Fig. 43. Typical spectrum

Therefore the following questions arise: How large is the spectral dispersion (Å/pixel)? Which wavelength corresponds to the first pixel? To answer these questions, one needs to identify at least two spectral lines in the available spectral range. After identification of two spectral lines (see Fig. 43), the calibration can be performed in the following way

- Mark the signal (spectrum) in the signal list and select "Data Table" in the calibration menu Fig. 44 The ASCII table should appear in the "Data Table" dialogue window. Find the pixel numbers, which corresponds to the known spectral lines.
  In this example, the BII emission line corresponds to the pixel number 71, and the D_γ emission line to pixel number 666.

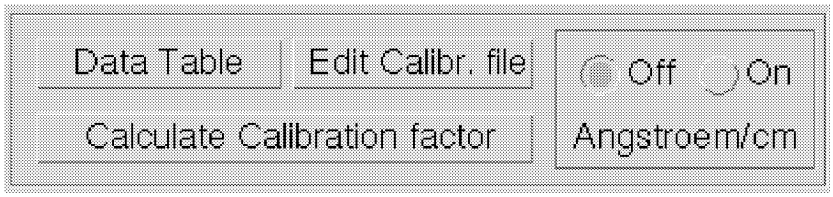

Fig. 44. Calibration toolbar

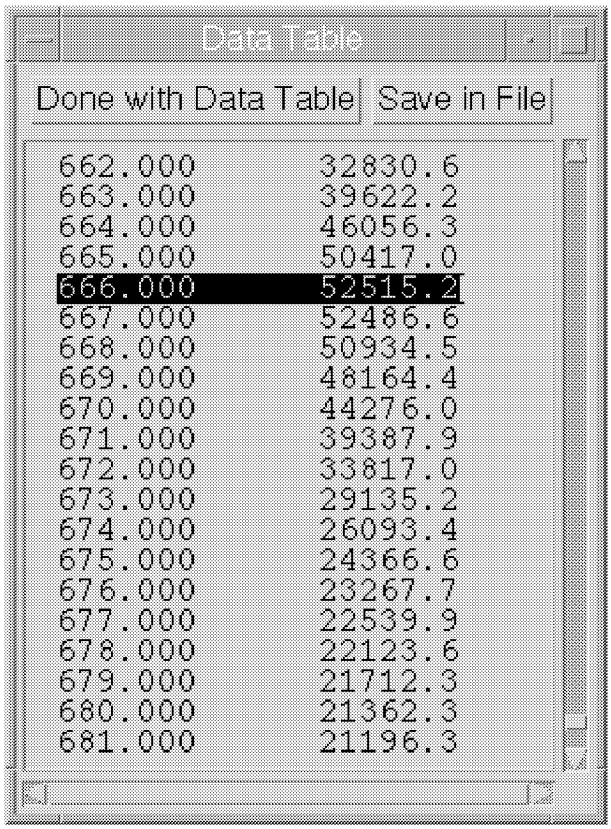

Fig. 45. Table

- Select the "Calculate Calibration Factor" button in calibration toolbar (Fig. 44). The "Spectral and Spatial Calibration" Dialogue window appears as shown in Fig. 46:

- Enter the pixel number in the "1.Pixel" field and the corresponding wavelength in the field on the right side. Enter the pixel number in the "2.Pixel" field and the corresponding wavelength in field on the right side. Enter shot number in the "shot:" field.

- Press the "Apply" button to view the spectral dispersion and wavelength corresponding to the first pixel.

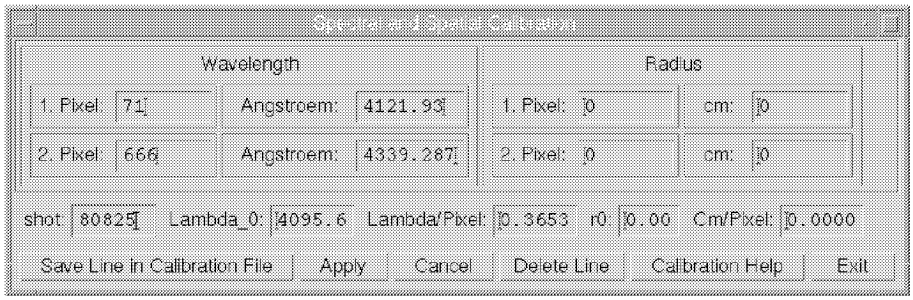

Fig. 46. Spectral and spatial calibration dialogue window

- Press "Save Line in Calibration File". The calibration data will be saved in the file "ccdspek.cal".
- To edit a calibration file press "Edit Calibr. file" button (Fig. 44). A

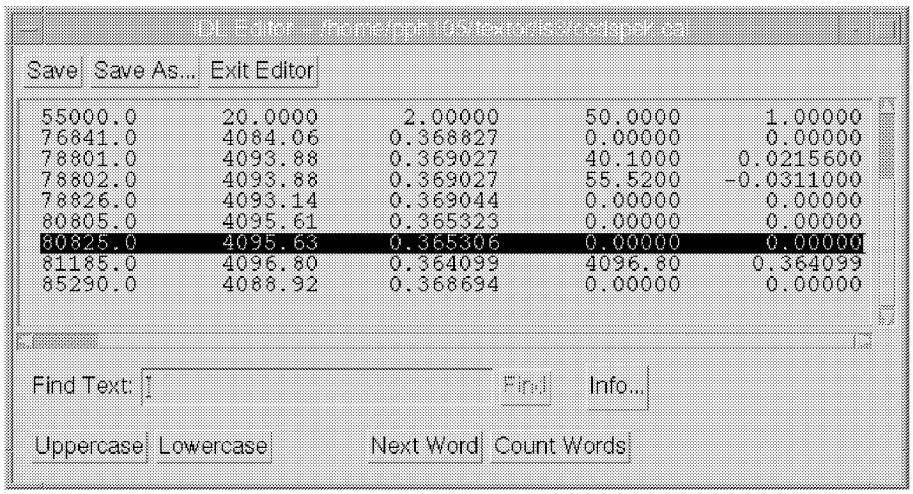

Fig. 47. calibration file editor

standard IDL editor should appear, which allows to edit the calibration file. The "Save" and "Save As" menu commands write the text files back out to the disk. The "Exit Editor" command will cause the Editor dialogue to close and return to main video menu.

To search for text in the text editor, enter the desired text into the "Find Text" field and click the Find button.

- To get a calibrated spectrum select "On" in the "Angstroem/cm" option. Press "Plot Signals" and the window with the calibrated spectrum should appear as shown in Fig. 48.

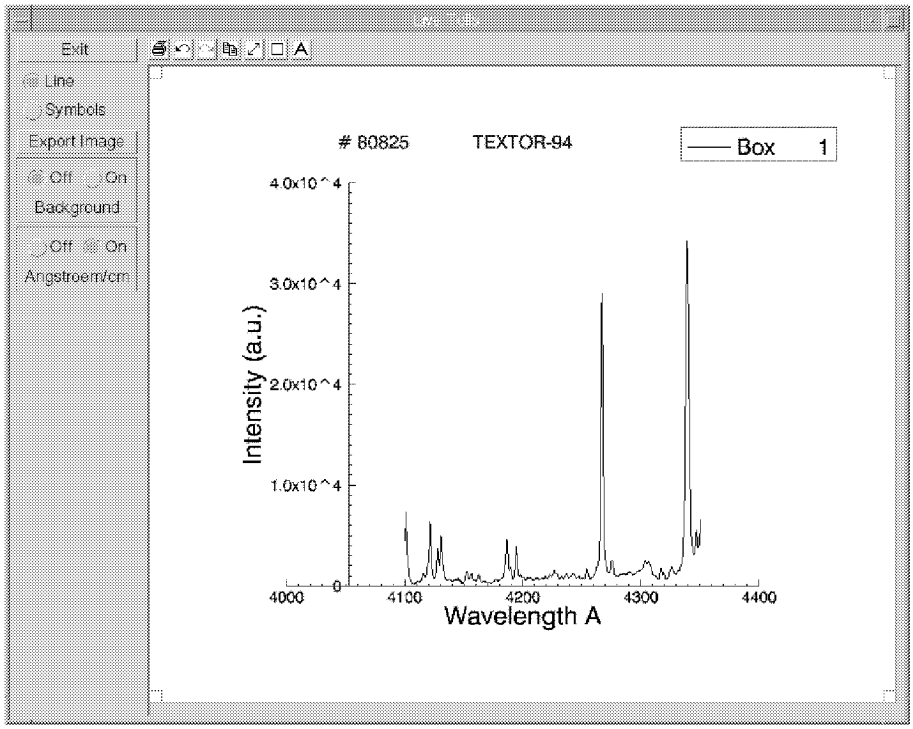

Fig. 48. Calibrated spectrum with wavelength scale

17.1 Auto Calibration

What is the difference between **Auto calibration** and **Not auto calibration** cases?

- **Auto calibration**: If the box used for estimation is elongated along a horizontal line, the spectral calibration will be used automatically. If the box used for estimation is elongated along a vertical line, the spatial calibration will be used automatically.

- **Non auto calibration**: In this case the user can choose between spectral and spatial calibration for every signal in the signal list. After selection "On" in the "Angstroem/cm" option, the Calibration Manager dialogue window should appear (see Fig. 49).

  One can choose for every box signal separately spectral or spatial calibration.

Note: To switch from "Auto Calibration" to "Non auto calibration" mode select "Off" in the "Auto Calibration" option (Fig. 5).

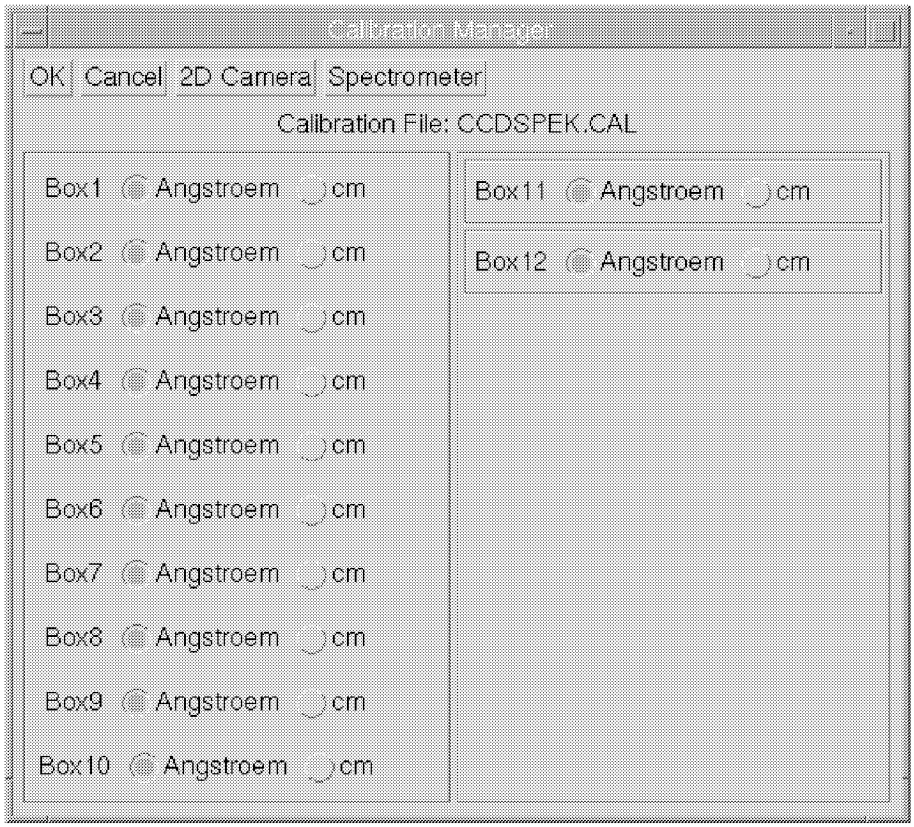

Fig. 49. Calibration manager window

18 Selection of the Colour Table

Select "XLoadcT" in the Video menu to pre-define a colour table. The "XLoadcT" window should appear.

This is a utility for the interactive manipulation of colour tables. The colour table maps the data to different colours and intensities. Its operation is similar to that of a photographic wedge. The slope and position of the wedge are manipulated to display a particular dataset in the best way.

The major controls are:

- **Stretch Bottom and Stretch Top Sliders:**
  These sliders control the "contrast" of the colour tables and their values are given in percentage of full intensity. The colour table wedge is "stretched" so that values equal to or less than "Stretch Bottom" are set to the lowest colour table entry, which is usually black. Values equal to or larger than "Stretch Top" are set to the last entry in the colour table, usually white or some other bright colour. Values between the bottom and top will be scaled linearly to the colour table.

Note: If the "Stretch Bottom" value is larger than the "Stretch Top" value the colour table is inverted.

- **Gamma Correction Slider:**
  This slider can be used to compensate according the characteristics of the used monitor. Values larger than 1.0 have a steeper contrast curve at the top end of the ramp, while values less than 1.0 have a steeper contrast curve at the bottom end of the ramp. A value of 1.0 results in a linear ramp.

- **Pre-defined Colour Table Buttons:**
  Pressing one of these buttons loads the selected pre-defined colour table. The settings of the other controls are not affected.

- **Options:**

  - Gang Sliders:
    Connects the "Stretch Bottom" and "Stretch Top". Moving one slider also moves the other one. With the sliders ganged, movement of a slider causes the other slider to track keeping the width of the wedge constant, while moving it across the range of data values. Normally, the sliders are independent. The width of the wedge is fixed when this button is depressed.
  - Top:
    When set to CLIP, values larger than the Top are set to the largest colour index. If set to CHOP, values larger than "Stretch Top" are set to colour index 0.
  - Stretch:
    When set to the default of INDICES, manipulations affect the mapping between colour indices and colour table triples. When set to INTENSITY, the mapping controls the intensity of each colour table entry. This is useful when displaying quantized images, where the pixel value is arbitrary and does not represent an intensity. In this mode, the hue and saturation remain relatively constant for a given colour index.

- **Transfer Function:**
  Selecting this mode allows an interactive editing of the mapping of

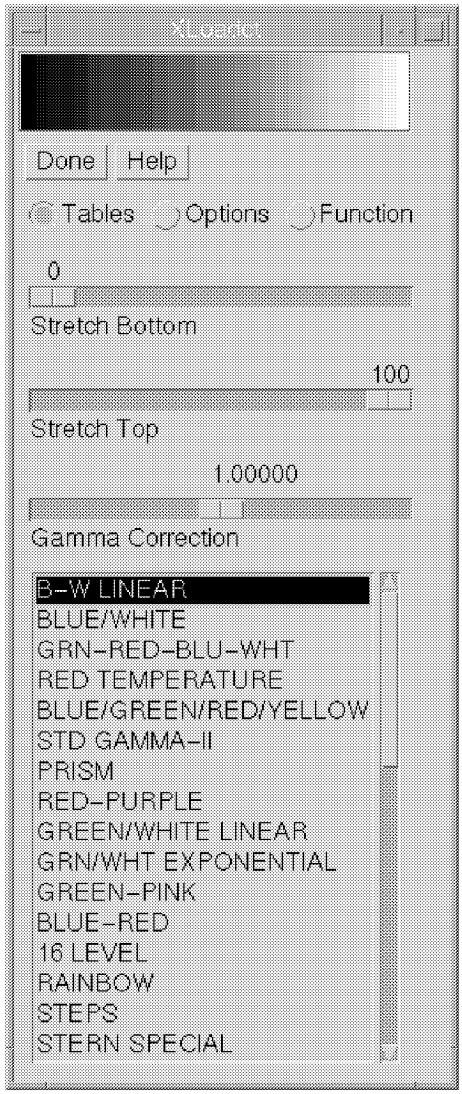

Fig. 50. A widget based utility for the interactive manipulation of colour tables.

colour table values to colour indices by dragging control points on a plot of the map. Select and move a control point by clicking and dragging on its box.

The first and last control points should be moved in the vertical direction only. Other control points can be moved anywhere within the plot as long as they are to the right of their predecessor and to the left of the next control point.

You can add a control point to the largest interval that contains no control points using the "Add Control Point" button. The "Remove Control Point" button removes the control central point in the smallest interval containing three control points.

The "Reset Transfer Function" restores a linear one-to-one transfer function.

19 Construction of a Colour Table

Select the "XPalette" in the Video menu (Fig. 5) to create a colour table interactively. The "XPalette" window should be appear as shown in Fig.51.

Fig. 51. XPALETTE dialogue window

In this dialogue, single colours can be defined or multiple colour indices between two endpoints can be interpolated.
"XPALETTE" has the following controls:

- **Left:**
  Three plots showing the current Red, Green and Blue vectors.

- **Center:**
  A status region containing:

  – 1) The total number of colours.

- 2) The current colour. XPALETTE allows to change one colour at a time. This colour is known as the "current colour" and is indicated in the colour spectrum displayed with a special marker.
- 3) The current mark index. The mark is used to remember a colour index. It is established by pressing the "Set Mark Button" while the current colour index is the desired mark index.
- 4) The current colour. The special marker used in the colour spectrum display prevents the user from viewing the colour of the current index, but it is visible here.

A panel of control buttons whith the following functions:

- Done:
  Exits XPALETTE dialogue window.
- Predefined:
  Starts XLOADCT to allow selection of one of the predefined colour tables. Note that if you change the colour map via XLOADCT, XPALETTE is not always able to keep its display accurate. This problem can be overcome by pressing the XPALETTE "Redraw" button after changing things via XLOADCT.
- Help:
  This text is displayed.
- Redraw:
  Completely redraws the display using the current state of the colour map.
- Set Mark:
  Set the value of the mark index to the current index.
- Switch Mark:
  Exchange the mark and the current index.
- Copy Current:
  Each colour lying between the current index and the mark index (inclusive) is transferred to the current colour.
- Interpolate:
  The colours lying between the current index and the mark index are interpolated linearly to lie between the colours of two end-points.

Three sliders (R, G and B) allowing the user to modify the current colour.

- **Right:**
  A display which shows the current colour map as a series of squares. Colour index 0 is at the upper left. The colour index increases monotonically by rows going left to right and top to bottom. The current colour index is indicated by a special marker symbol. There are 4 ways to change the current colour:
  - 1) Press any mouse button while the mouse pointer is over the colour map display.
  - 2) Use the "By Index" slider to move to the desired colour index.
  - 3) Use the "Row" Slider to move the marker vertically.
  - 4) Use the "Column" Slider to move the marker horizontally.

The new colour tables are saved in the COLOURS common block and loaded to the display.

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A Note to a conversion program to 3D–TEXTOR format

A program *convert* is available to convert the data from 3D-AIX format into 3D-TEXTOR format. This short idl program can be found on the Workstation IPPPWW in the [HUBER] directory. To use this program locally on another machine, it is necessary to copy into this location the following files:
[huber]convert.com
[huber]shots_convert.sav
[huber]SAVE_3D_NEW.EXE
The program "Convert" can be started by the following command:
@*convert*
The convert program should appear as shown in Fig.52.

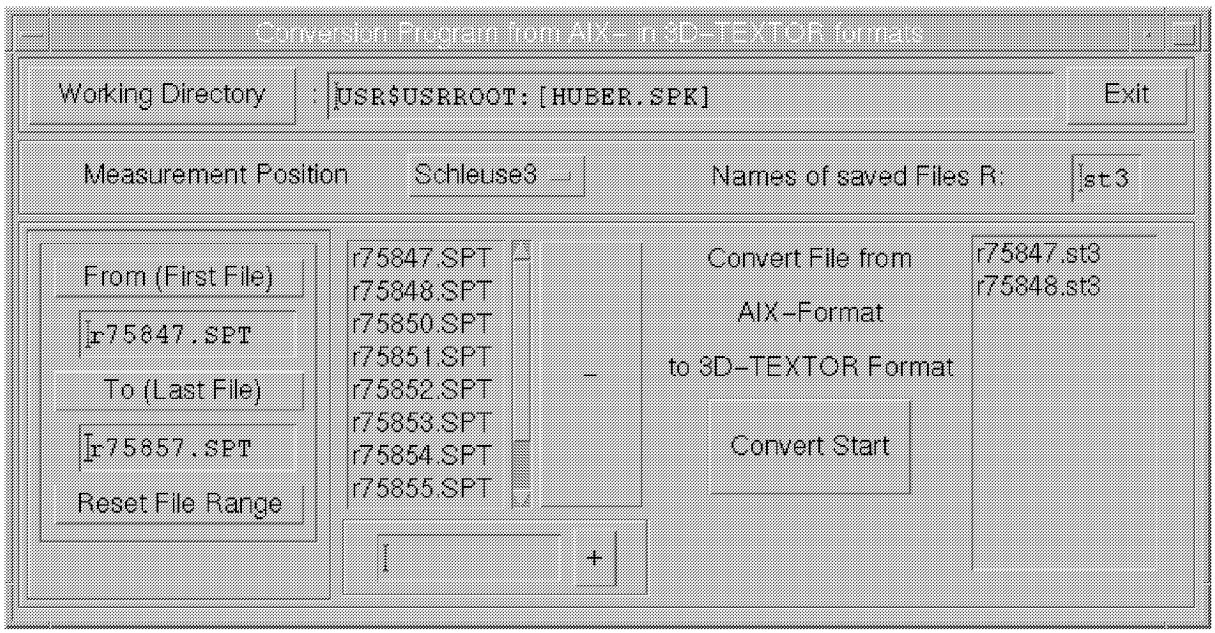

Fig. 52. Convert program from AIX–format into 3D–TEXTOR format

The conversion program is described in the following:

- **Working Directory** Select "Working Directory" button from Program menu to define the working directory (the evaluated data will be saved in this directory)
- **Measurement Position drop list** Select the measurement position: Schleuse3, Schleuse1 etc. The program should propose for every location the extension for converted files (result of this program). The

proposed extension should appear in the "Names of saved Files R:" field.
Note: This proposed extension can be changed

- **From (First File) Field** Enter a name of file into the "From (First File)" box to designate the start file for evaluation. You can also select the start file name from the dialog menu by pressing the "From (First File)" button. **Note:** The file must be have the form, for example, r75849.spt, r75849.sl3: at first letter "r", then shot number, point and extension.

- **To (Last File) Field** Enter a name of file into the "To (Last File)" box to designate the last file name for evaluation. You can also select the last file name from the dialog menu by pressing the "To (Last File)" button.

- **Reset File Range Button** To reset the selected file range press the "Reset File Range" Button.

- **File List Field** By selection of file range with "From File" and "To File" options the selected files appear in the "File List Field".

- **Plus Button** If one or more files are selected, you can add a new file to the already selected file list. Insert the wanted file name in the field on the left side from "Plus Button" and Press "Plus Button". The file name should appear in the file list.

- **Minus Button** To delete one or more files from the selected file list, mark the file name to be deleted and press "Minus" button.

- **Convert Start Button** If working directory, extension and files range are defined, press "Convert Start" button to start the conversion. The converted files should appear in the converted file list filed on the right side of program.