Riverside Research Institute

To: Users of new data acquisition system
From: Jeff Ketterling
Date: November 6, 2000
Subject: How to use LabVIEW based software for acquiring RF data.

This memo discusses the operation of the LabVIEW software used to acquire RF data from a Hitachi or B&K ultrasound scanner. A brief overview of the hardware, wiring connections, and installed software is also included. The LabVIEW software permits the acquisition, viewing, and saving to disk of a collection of scans. The data can be viewed as individual files or as a collection of thumbnails. The data is saved to disk in the RRI EYE file format.

1 Hardware

1.1 Wiring Overview

The operation of the software requires the installation of two PCI cards in the host computer. These are a GaGe 12100 50 Ms/S 12 bit A/D card and a National Instruments PCI6601 counter/timer card. The GaGe card allows for RF data acquisition and the 6601 card permits proper triggering so data acquisition begins at the start of a video frame. In addition to the two PCI cards a small break out box is needed to properly route the signals between the ultrasound scanner and the host computer.

The wiring connections are shown in Fig. 1. Both a frame sync and vector sync line go from the Hitachi (only vector sync if using a B&K) to the break out box. The trigger output from the break out box and the RF line from the Hitachi go to the GaGe PCI card in the host computer. A B&K system has no frame sync and also has a TGC line going to CH. B of the GaGe board. Finally, a ribbon cable from the 6601 card connects to the break out box.

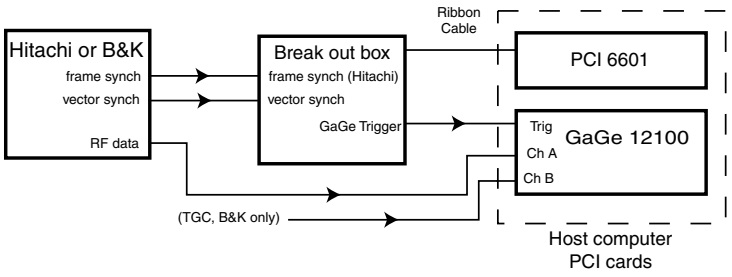


Figure 1: Wiring diagram for equipment using Hitachi system. Note that for a B&K system, wiring is identical except there is no frame sync line.

1.2 Operational Overview

The 6601 PCI card provides the key to the data acquisition system by allowing data to be taken at the start of a video frame. This is accomplished using a single counter for the Hitachi. The counter is armed via a hardware trigger when the frame sync goes from high to low. The counter then generates a single output pulse every time the vector sync goes from high to low.

Triggering for the B&K is similar except that a second counter is used to generate a frame sync pulse. This is necessary because the B&K does not provide a frame sync. The frame sync is created

by taking advantage of the fact that the the vector sync pulses for a single frame are separated by some "dead" time. The duration of the dead time is just under 28 ms when the B&K is operated at 10 frames/s and a resolution of 6. By generating a non-resettable 75 ms pulse on the falling edge of the vector sync signals, a frame sync can be created that lines up with the first vector after several video frames have passed.

The 6601 PCI card also allows for triggering on a single vector sync to assist in probe calibration. This is done by using a single counter. The frame sync triggers the counter and then the edges of the vector sync are counted on the counter's source to generate a delayed pulse. For example, to extract the 5th vector, five falling edges are counted on the source before an output pulse is generated. One output pulse is generated for every frame and thus only one RF scan line is captured for each frame.

The triggers generated by the 6601 initiate data acquisition on the GaGe 12100. When a scan is taken, the GaGe acquires the full number of vectors (scan lines) for a single video frame, and then the data is transferred to the host computer. The data is available for viewing until saved and deleted.

Note that for the B&K, TGC data is also taken on Ch. B of the GaGe card. Thus, the GaGe board requires a deeper memory for a B&K than for a Hitachi. The GaGe board operates in dual channel mode for a B&K, while the Hitachi operates in single channel mode. However, if a rapid series of frames needs to be captured, the B&K TGC signal can be ignored and the GaGe board operated in single channel mode. The amount of memory available on the GaGe board determines how many consecutive frames of video can be captured.

2 Software

2.1 Clinical Version

The software will already be installed on the host computer in most circumstances. This section is meant more as a reminder of what to install if starting a new system from scratch. The actual working piece of software will normally be a Run-Time only LabVIEW application named GetProstateData. The run-time engine version of LabVIEW 6i needs to be installed on the host computer in order to run the software. The files daqdrv, lvanlys.dll, lvdaq.dll, and serpdrv need to be in a folder named *data* in the same directory as GetProstateData. NI-DAQ, which contains the drivers for the 6601 card, and GaGe drivers also need to be installed.

2.2 Research Version

The research version of the software permits calibration data to be taken, allows modification of low level parameters, and provides a few additional features. If the software is a Run-Time only version, than no additional software is needed. However, if it is the full, modifiable code, LabView 6i is needed. In addition, all relevant VI libraries must be present on the host computer.

3 Using Software to Acquire data

3.1 Features in Clinical Version

The operation of the data acquisition software GetProstateData is straightforward and uses controls that are familiar from commonly used software applications. The software is executed by double clicking the application GetProstateData. A shortcut will normally be on the desktop and in the Windows Start menu. When the application is executed, a window opens (Fig. 2) with the software already running.

Before taking new data, enter the parameters for *Patient Info, Operator Initials*, and *Transducer ID*. These parameters will be placed in the saved EYE files. *RRI ID* is limited to 6 characters and

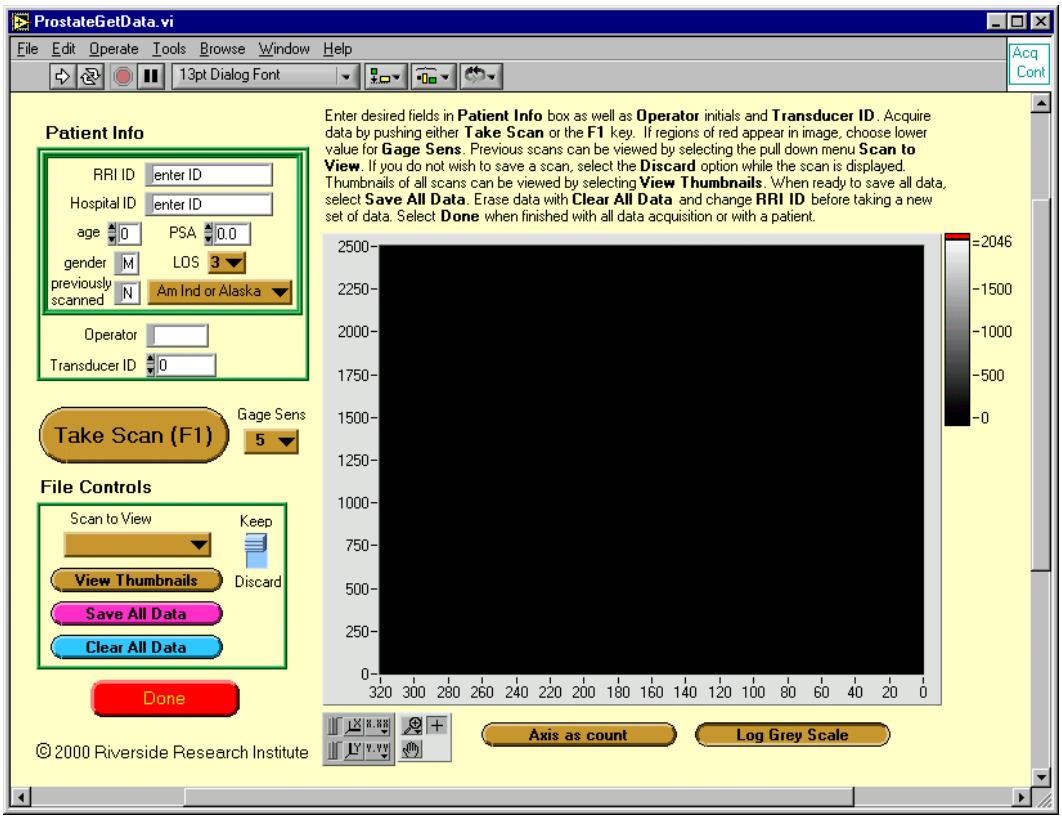
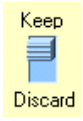


Figure 2: User interface of GetProstateData.

will form the base name of all the saved files. *Hospital ID* is limited to 10 characters and operator initials to 4 characters.

Data is acquired by pressing **Start Scan** or pushing the **F1** key. Once acquired, the data will appear in the plot window of Fig. 2 and the computer will beep. **A color of red in the plot means the digitizer was saturated. Choose a lower value for** *Gage Sens* **until no red is visible.** Each time a new scan is captured with GetProstateData, the display is updated. To view a previous scan, go to the *Scan to View* Control, select it by clicking on it with the mouse, and choose the file you want to view (Fig. 3). The switch next to the name of the case being viewed 

indicates whether or not the data will be saved. **If no data is received, an error message will be displayed. Erase all the data if no scans prior to the error need to be saved.**

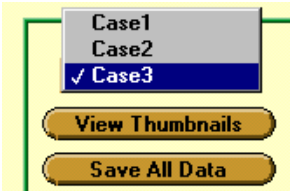


Figure 3: Select case to view by using pop up menu.

Selecting *View Thumbnails* will show small thumbnail images of the acquired scans with the file name overlaid on the image. The images are in sector format. Once all data has been acquired, select *Save All Data* to save the data as EYE files. A dialog will inform the user that all the data has been saved and that it is now safe to delete it from temporary memory. Then select *Erase All Data* to delete all of the data and start a new data acquisition. Another dialog will prompt the user to confirm that the data should really be erased.

To exit the program select *Done*. A prompt will check to see if the user really wants to quit and then another prompt will ask if the data should be sent to RRI via FTP. A window will indicate that an FTP operation is in progress. An email will also be sent to RRI to indicate data has been transferred. Once data has been sent via FTP it will be moved to a folder named Previous Scans on D:\ and the GetProstateData program will close automatically. Data that has not yet been sent or that has just been captured is saved in a folder named Current Scans on D:\. **If a problem occurs during the FTP process, the program may crash but the data will not be deleted. It will be sent the next time FTP and Quit is selected.** If no FTP option is available in the software, data will need to be copied either manually or with a separate application (described below) to a Zip disk.

Two features are included to modify how the data is viewed in the display window. These buttons are located below the display. *Axis as count* can be altered to *Axis as range*, changing the axis hash marks to a range in mm. This is meant to allow features of the image to be related to a distance. The other option, *Linear Grey Scale* or *Log Grey Scale*, changes the display mapping to show less or more contrast. Neither setting effects the data acquisition or how data is saved to EYE files.

An option may also be present to take a series of consecutive frames. If so, the number of frames is determined by the depth of GaGe memory and how much data is in each frame. The data is acquired as described above. All the frames are viewable as thumbnails but only the first frame is displayed in Fig. 2. The file naming convention takes the RRI ID and appends the scan number followed by a letter a and then a number for each consecutive frame. For example, if the RRI ID is Q22r and there are 4 consecutive frames per scan, then the naming would be Q22r1a1, Q22r1a2, etc. for the first scan and Q22r2a1 etc. for the second scan. The thumbnail images will show all of the captured data and have the proper file name overlaid.

3.2 Features in Research Version

The research version of the software looks just like Fig. 2 except two additional features are added. One allows the low level settings of the digitizer to be modified. This feature is essential when first setting up a system to ensure that all the default parameters for later use are properly chosen. The low level parameters are accessed via a control panel that looks much like an oscilloscope. A control selects which vector line to view and the RF data from this line is displayed as an RF trace.

The other option of the Research Version allows data to be taken either as a single frame or a single vector. The single vector setting is meant to acquire calibration files as an image with the same vector line taken over multiple frames.

3.3 Saving data to Zip disk

A small LabView application named SaveToZip will also have a short cut on the desktop to streamline the process of copying files to a Zip disk and and moving files from the Current Scans folder to the Previous Scans folder. When the application is run, a window will open indicating that files are being copied to the Zip disk. Two possible warnings may arise: one if no Zip disk is present in the Zip drive, and one if the Zip disk cannot hold all of the new files being copied. If a warning is given, press OK, and run the program again after taking the appropriate corrective action. When SaveToZip has run successfully, an email will automatically be sent to RRI indicating data has been captured. **Make sure the Zip drive light is off before ejecting the Zip disc. Files may still be copying, even if the SaveToZip program has closed.**

Simple overview of LabVIEW data acquisition software

These are the steps to take data:

1. Double click **GetProstateData** on the desktop to start the RF data acquisition application. The application user interface (pictured below) will open and start running.

2. Enter parameters in the *Patient Info* box.

3. Push *Take Scan* or *F1* when ready to take data. A beep will indicate when the data has been acquired. If red appears in the image, lower *Gage Sens*, *Clear All Data* and take another scan. (A small amount of red may be acceptable.)

4. Take as many scans as needed. Or take test scans, and then select *Clear All Data* before taking final data that will be saved.

5. Previous scans can be viewed by using the *Scan to View* control. All of the scans can be viewed as thumbnails by selecting *View Thumbnails*.

6. Scans that do not need to be saved can be excluded by choosing *Discard* next to the scan number shown in the *Scan to View* control.

7. When ready to save data, select *Save All Data*. A prompt will indicate when data is saved.

8. The data can now be cleared by pushing *Clear All Data*. A prompt will ensure that the data should really be deleted. A new *RRI ID* can now be entered and more data taken.

9. To exit the program, select *Done*. A window will open asking whether to really quit. An option may also be present for quiting and FTPing data to RRI. If data can be FTPed, a window will open while data is being sent to RRI. If not, the program will close.

10. Newly acquired data is stored in a folder called Current Scans on D:\. If data is FTPed successfully to RRI it will be transferred to a folder named Previous Scans on D:\. If no FTP option is available, the data in the Current Scans folder should be transferred to a Zip disk and the Previous Scans folder with the **SaveToZip** application on the desktop. Zip disks should then be sent to RRI.