



**User's Manual  
for  
Microvessel Velocity OD-RT**



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## CHAPTER 1 – INTRODUCTION

### 1.1 ABOUT CIRCUSOFT INSTRUMENTATION

To best understand why the Microvessel Velocity OD-RT system was designed the way it was, it is important to know a little about the underlying philosophy of CircuSoft Instrumentation. At CircuSoft we believe that the age of cumbersome instrumentation based on complicated and expensive hardware is past. What is moving to take its place is the personal computer. A laboratory computer running sophisticated software contains the power to operate a large number of devices in the laboratory. Since the computer's processor is doing most of the hard work, the hardware portions of the instrumentation can be made much smaller and less expensive. This approach can save valuable bench space. In addition, added functionality can easily be built into new versions of the software, making upgrading the equipment much easier.

### 1.2 DETERMINING BLOOD VELOCITY

The system we have designed is used for determining the red blood cell velocity in individual microvessels. There are several documented techniques for determining red blood cell velocity. The method used in this system is sometimes referred to as optical Doppler. This is actually somewhat of a misnomer, but it is useful for giving a basic idea of the system's operation. The next few sections will discuss the basics of the theory behind this method.

#### *1.2.1 OPERATING PRINCIPLES*

The optical Doppler method is also known as the dual-slit photometric method for determining red blood cell velocity. The method gets its name because it uses a pair of small photodiodes to collect information about blood flow rates. By placing a translucent membrane of a surgically prepared animal under a light microscope, an experimenter can project the image of a blood vessel onto the two photodiodes. These photodiodes are positioned sequentially in the direction of the blood flow. As a particle or group of particles in the blood stream flow past the light source in the microscope, the light intensity detected by the photodiodes will change. Since the photodiodes are arranged sequentially, the upstream photodiode will see a change in the light intensity first. This change in intensity will be followed closely in time by a corresponding change in the second photodiode. If the two photodiodes are in sufficiently close proximity to one another, the light intensity signals will be very similar but time-shifted. The job of the instrumentation is to determine the time shift between the two signals. The velocity can then be calculated using this time shift and the effective distance between the photodiodes.

You can probably tell from this description why optical Doppler is a misnomer. The shift of the light due to the movement of the red blood cells is not measured. The signals are time shifted simply because the detectors have a finite distance between them.

Some systems do use laser Doppler to measure perfusion, but this is a different technique and generally does not give blood velocity in a single vessel.

### *1.2.2 EARLIER INSTRUMENTATION*

Traditional velocimeters relied on sophisticated analog and digital electronics to read data from the photodiodes and to do the cross correlation. You may be familiar with the velocimeters produced by IPM. In many devices such as these, the sampling parameters were either fixed in the hardware or were adjusted by turning knobs on the instrument. Output was in the form of a gauge or analog signals that could be sent to a strip chart. Needless to say, this instrumentation was most frequently large and cumbersome, had little adaptability, and was difficult to move and recalibrate. Some laboratories also used other types of devices featuring high-speed film or video analysis hardware. Both of these options were exceptionally expensive, and the results were most often calculated well after the experiment was over. Although these older devices gave good results if used properly, there was much that could be improved using modern electronics and computers.

### *1.2.3 HOW WE IMPROVED VELOCIMETERS*

What we have done to velocimeters is reduce the price, decrease the size, increase the adaptability, and improve the data collection. It sounds like a lot, but the power of modern computers and digital electronics has made it possible. The Microvessel Velocity OD-RT gives real-time velocity information in both graphical and numerical formats that can be conveniently stored digitally for later analysis. Instead of turning knobs and reading dials on the hardware, you can interact with this system by clicking and dragging in Microsoft Windows. With our system you have complete control over all of the sampling and correlating parameters through the software. The system is also small and portable. A calibration on a new microscope can be done in a matter of minutes, making it possible to carry the system easily from lab to lab.

## CHAPTER 2 – SYSTEM COMPONENTS

### 2.1 DATA ACQUISITION UNIT

The Data Acquisition Unit (DAU) is the part of the device that interfaces with your microscope. The unit consists of a funnel-shaped aluminum microscope adapter, an image viewing screen, and the aluminum sensor housing. The unit is designed to fit into an eyepiece socket or available optical port on your microscope. Under normal operation, the image from the microscope is projected onto the viewing screen through a pair of lenses inside the DAU. A small portion of the image in the center of the screen is also projected onto a pair of photodiodes inside the sensor housing. The light intensity signal is pre-amplified inside the sensor housing and sent to the Signal Processing Unit.

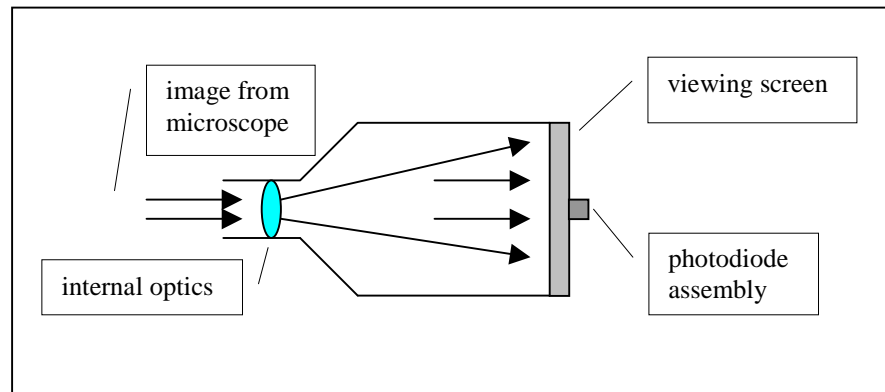


Figure 2.1 – Data Acquisition Unit Schematic

### 2.2 SIGNAL PROCESSING UNIT

The Signal Processing Unit (SPU) is the part of the velocity system that receives the data from the DAU and sends it to your computer in a useable format. The front of the SPU has a power switch and a LED power indicator. The back of the SPU has a serial port for interfacing with the computer, two ports for DAU's, and a socket for the power cable. The SPU amplifies and digitally samples the input signals from the DAU using parameters supplied by the software. The signals are then sent to the computer via a serial cable.

### 2.3 SOFTWARE

The Velocity OD-RT software is your interface with the velocity system. The software tells the computer how to communicate with the SPU, performs the calculations to determine velocity, and outputs the results. The many features of the software are discussed in later chapters.

## CHAPTER 3 – INSTALLATION

The first step to using your velocity system is to setup the hardware and install the software. The entire process should not take more than an hour. You will not need any special tools, but you will need a serial cable extender if your computer and microscope are more than about 15 feet apart.

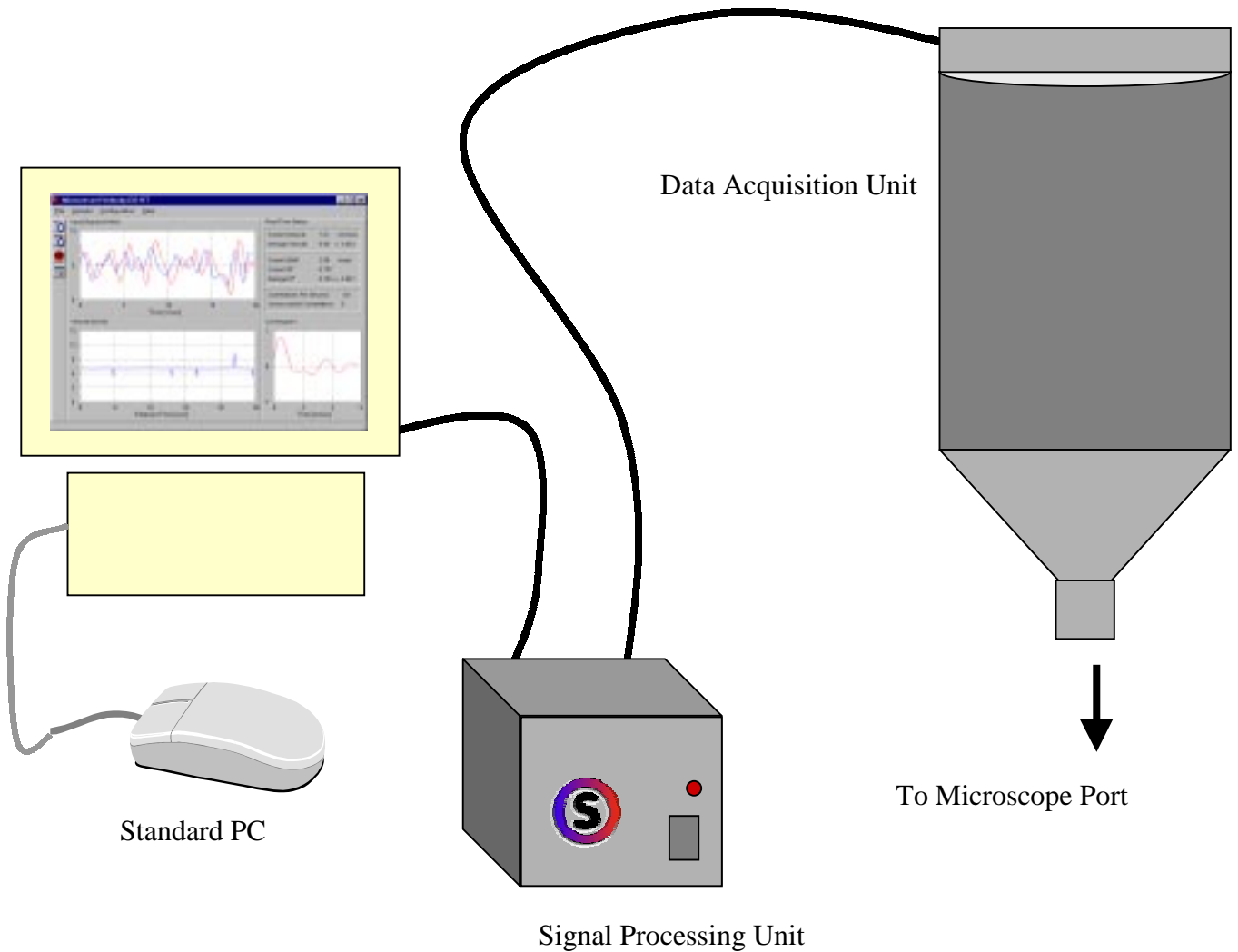


Figure 3.1 - Velocity System Connectivity Diagram

### 3.1 HARDWARE SETUP

The overall layout of the velocity system is shown in Figure 3.1. If your computer and microscope are far apart, it is best to place the SPU near the microscope.

1. Identify an available port on your microscope. If no port is available, you can temporarily remove an eyepiece and use the socket. The DAU is designed so that it can easily slide in and out of the ports. If you are using the eyepiece port, you will need to find the image of interest, remove the eyepiece, and insert the DAU to measure velocities.
2. If the DAU does not fit snugly in the port, you will need to use one of the adapter sleeves to increase the diameter of part of the DAU that fits into the port. Test which of the included adapter sleeves best fits your microscope. The DAU should not wobble, but should be able to rotate freely. Press this adapter sleeve firmly onto the adapter of the DAU.
3. Place the SPU on a dry area of the laboratory bench within six feet of where the DAU will be used. Use the cable with the six-pin DIN adapter to connect the SPU to the DAU. The first connector is on the side of the photodiode housing box on the DAU, and the second is on the back of the SPU and is labeled "Velocimeter."
4. Next, identify a free serial port on your computer. Most 486 computers will have a 9-pin serial port as COM1 and a 25-pin as COM2. Frequently COM1 will be used by the mouse, and COM2 will be available. Most Pentiums will have two 9-pin serial ports. COM1 is usually the top, and both will often be available. If you must use COM2 and you have a modem installed, you may run into complications. See Chapter 4 and Appendix I for more detailed information concerning this part of the installation.
5. Connect the 25-pin end of the serial cable to the back of the SPU and the 9-pin end to free serial port on the computer. If the port on the computer has 25 pins, use the 25- to 9-pin adapter.
6. Finally, connect the power supply to the back of the SPU.

#### **IMPORTANT:**

In order to use this system, you *must* have a good DC power supply to your microscope. The 60 Hz signal from an AC power supply will completely drown out the useful input signals from the blood image. Similarly, the 60 Hz noise from overhead lights will also interfere with the input signal. You will need to dim the surrounding lights while sampling. It is not hard to see if you are getting 60 or 120 Hz interference by simply viewing the input signals.

The system works best if you have a strong light in your microscope. Find out what the DC voltage rating for your microscope bulb is and use an appropriate power

supply. The DAU and SPU both have powerful amplifier signal amplifiers, but too little light intensity will create a lot of problems. The most notable will be noise in the input signal. The correlation is not as reliable when the input signals are noisy. If you do not have enough light intensity to see a clear image on the viewing screen of the DAU when the system is operating, you will probably need a more powerful bulb.

### **3.2 SOFTWARE INSTALLATION**

The software requirements on your computer are not great, but you do need the following as a minimum:

- Windows 95, Windows NT 4.0, or later versions of either operating system
- An available serial port
- 800x600 resolution on your monitor
- A 486 processor or better
- 2 megabytes of free hard disk space

A recommended system would include the following:

- A Pentium processor
- 20 megabytes of RAM
- A color printer (for hardcopies of the results)

You do not need a dedicated computer for the system, but a faster computer will give you significantly better performance.

Install the software the same as you would install any Windows software. Put the diskette into any floppy drive. Then either run "Setup.exe" or go to Add/Remove Software from the Start Menu. Follow the directions that come up. We recommend that you put a shortcut to the program on your desktop for easy access.

## CHAPTER 4 – SETUP AND CALIBRATION

### 4.1 DETECTING THE SPU

In order for the SPU to interact with the software, the computer must know on which communications port the SPU is installed. To simplify this process, the software can probe all the communications ports to look for the SPU. Before running the probe, the SPU must be connected to the computer with the supplied serial cable and plugged in as described in the Hardware Installation Section. If you have more than one serial port available, choose the first one. If you are having trouble identifying the serial ports, please refer to your computer's manual.

Although you will need to complete the setup and calibration before you use the system, we recommend that you read Chapters 5 and 6 before continuing with this section. You will understand the steps you are taking much better if you do.

#### 4.1.1 RUNNING THE PROBE TO DETECT THE SPU

Start up the Velocity OD-RT software by clicking on the icon, or selecting it from the Start menu. If this is the first time running the software, it will display a window asking if you want to configure the hardware. If you have skipped this option before, you will need to go to the Probe Ports option in the Configuration menu. This will bring up the Setup Com Port dialog shown in Figure 4.1.



Figure 4.1

Check to see that the SPU is plugged in and turned on before pressing the Probe button. The software will check each port and stop once it has found the hardware. Figure 4.2 shows the dialog that will appear if the probe is successful.



Figure 4.2

After clicking OK, the system will be configured to communicate with the SPU.

If the SPU was not connected correctly or there was a conflict within the system, you will see a dialog similar to the one shown in Figure 4.3.

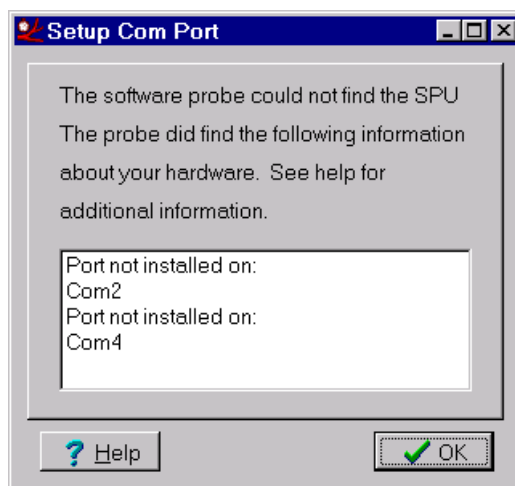


Figure 4.3

As the software probed the ports, it gathered information and will display it here. The software will give a list of probable conflicts within the computer. Because of the wide variety of hardware, it is sometimes difficult to tell exactly which ports are available, and the information displayed might not exactly conform to your hardware setup.

The next step is to check all connections and/or switch the serial cable to another available port. If you still get this dialog after switching ports, you may need to do some reconfiguration of your computer. A detailed explanation of solutions is available in Appendix I.

### 4.1.2 MANUALLY SETTING THE COM PORT

If you already know to which port the hardware is connected, you can tell the software directly. This could be useful if you are having problems with the probing routine. Simply bring up the Hardware Setup Dialog (Figure 4.3) from the Configuration menu. Then select the correct communications port from the ones available.

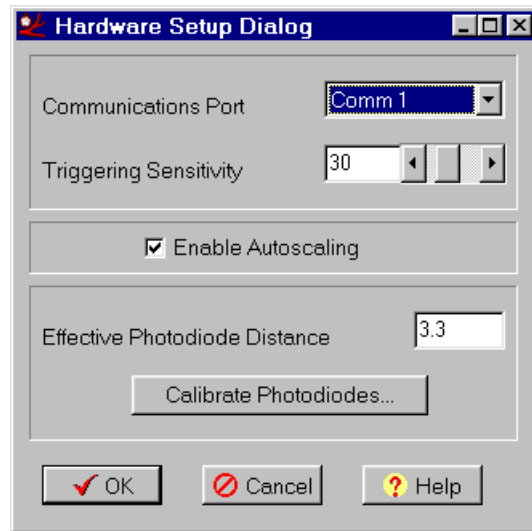


Figure 4.3

## 4.2 CALIBRATION

The calibration for this system is designed to be quick and easy. You will need only a reticle slide. If you are using a 20x objective, we recommend a reticle slide with a mark spacing of 0.01 mm. Basically, we will be using the known spacing between the increments on the reticle slide to figure out the effective photodiode spacing on your system.

### 4.2.1 HOW IT WORKS

As the reticle slide is moved on the microscope stage, the image of the markings on the slide will create signal peaks that are detected by the system. The spacing of the marks on the reticle divided by the time between two peaks from the same photodiode is the velocity that the reticle slide is moving. The time between two peaks caused by the same reticle marking on different photodiodes is the time shift due to the spacing between the photodiodes. By multiplying the time shift by the velocity, we determine the effective photodiode spacing.

Most of this is done automatically by the software. By following the calibration procedure given below, you will reach a dialog box similar to the one shown in Figure 4.4. You will need to enter the correct reticle spacing in the space on the right. The blue and red signals indicate the signals from the two different photodiodes. Each peak

corresponds to a mark on the reticle. The blue signal corresponds to the lead photodiode. It is important that you can identify signals caused by the same mark on the reticle. Find the first blue peak from the left. The top of this peak is Point A. The very next blue peak moving to the right is Point B. This first red peak after Point A is Point C. It is crucial that you can identify what these points are or the spacing factor will be calculated incorrectly. Once you see how the first set is found, any set of three points determined in the same way will work. Just be sure that you pick a point A first and find the other two relative to this point. See Figure 4.4 for reference.

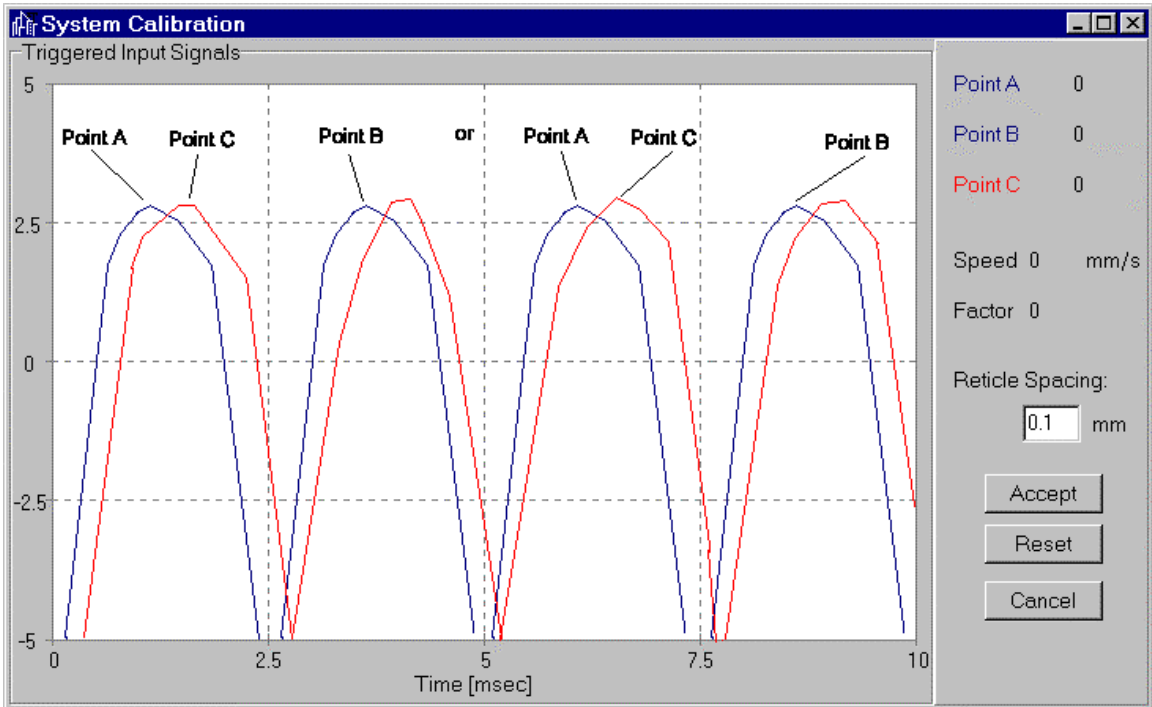


Figure 4.4 – Simulated Calibration Data

#### 4.2.2 CALIBRATION PROCEDURE

Follow this procedure to calibrate your system. This only needs to be done once, unless you change something like the objective magnification. Also, the effective photodiode separation might vary somewhat from microscope to microscope, so you will need to recalibrate if you move the system around.

1. Turn on your SPU and start the velocity software.
2. Place a reticle slide under your microscope and find the markings through the eyepiece.
3. Insert the DAU into an available port. If no ports are available, you will need to remove an eyepiece and use this socket.

4. Dim the overhead lights and turn up the microscope lamp to maximum. Refocus the microscope so that the reticle markings are visible on the viewing screen of the DAU. Rotate the DAU so that the reticle markings are perpendicular to the arrow indicating flow direction on the photodiode housing.
5. Bring up the Hardware Setup Dialog from the Configuration menu. Deselect Auto-Scaling if the box is checked.
6. Adjust the gain on the lower left of the program window to about 25 dB.
7. Select View Input from the Sample menu.
8. Move the reticle slide smoothly back and forth so that the image moves parallel to the arrow indicating flow direction. It is usually easiest to move the entire stage. The markings should still be perpendicular to the flow direction as you move the reticle. You should see peaks in the input graph as you move the markings on the reticle past the photosensors.
9. Adjust the gain so that the peaks fit within the range of the input graph.
10. Position the image of the reticle so that with a smooth movement you can make the markings move past the photosensors in the direction indicated by the arrow on the DAU.
11. Bring up the Hardware Setup Dialog again. This time click on the Calibrate Photodiodes button. A dialog will come up indicating that the software is waiting for a trigger. If the window shown in Figure 4.4 comes up before you move the slide, you will need to press cancel and reduce the triggering sensitivity in the Hardware Setup Dialog.
12. With a smooth, uniform movement, slide the reticle so that the markings move past the photodiodes in the direction of the flow arrow.
13. If the hardware was triggered, a window such as Figure 4.4 will come up automatically. If it was not, cancel the dialog indicating that the software is waiting and increase the triggering sensitivity in the Hardware Setup Dialog. It may take a few tries to get the triggering sensitivity correct. Repeat these steps while adjusting the speed you move the reticle until you have several peaks visible in the window as shown in Figure 4.4.
14. Using the mouse, click on the top of the peak that is Point A. Next click on Point B and then Point C. Try to click on corresponding points in the three peaks. The calibration factor is calculated on the screen. If you wish to accept this factor, click on the Accept button. However, we recommend that you press the Reset

button and pick a new Point A, B, and C. This will recalculate the factor. Keep track of the numbers you are getting and take an average to enter manually later.

It is be a good idea to repeat the calibration procedure until you get fairly good uniformity in the calibration factors the software is calculating. With a 20x objective, the factor is in the ballpark of 3.5 for most of the microscopes we have tested. Do not worry too much if the number seems to vary a tenth or two from calibration run to calibration run. If you have come up with an average value and wish to enter it manually, simply type the number into the appropriate space on the Hardware Setup Dialog.

# CHAPTER 5 - BASIC OPERATION

## 5.1 SOFTWARE OVERVIEW

### 5.1.1 OUTPUT PANELS

The software is designed to provide a visual control over the data collection and a graphical and numerical readout of the real-time results. The main window has four primary panels. The upper left panel is a graph of the raw input signals from the DAU. These signals basically indicate the light intensity in each photodiode as a function of the time it was sampled. If the system is working properly, this graph should show two similar but time-shifted signals much like the ones in Figure 5.1 when the photodiodes are positioned over a blood vessel and the software is running.

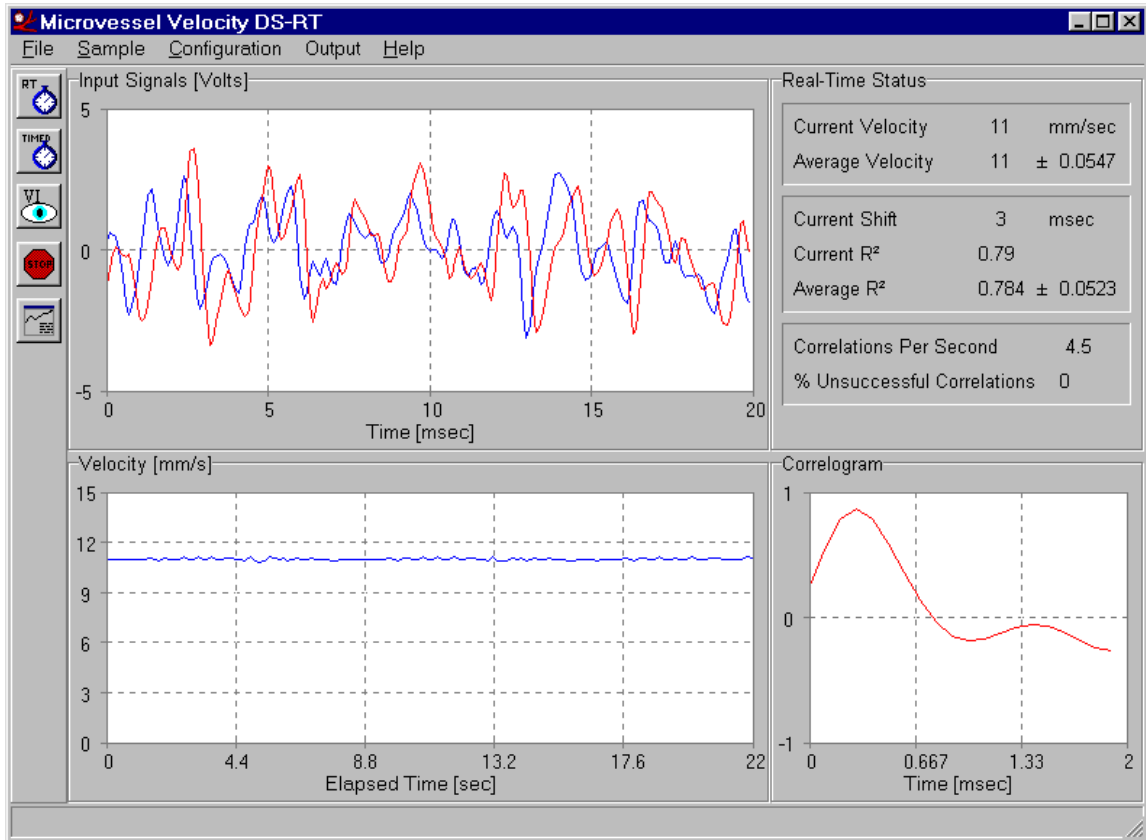


Figure 5.1

The input window is provided primarily as a diagnostics tool. If there is no signal in this window, the unit is not setup properly.

The lower left window gives a graphical output of the measured velocity as a function of time. The most recent velocities appear on the left and move to the right. A

dynamic time scale is provided on bottom of the graph. You can change the scale on this window by right-clicking anywhere on it.

The lower left panel gives the result of the cross-correlation. The left axis displays the strength of the correlation ( $R^2$ ) as a function of the amount the signals were shifted. The highest peak corresponds to the actual time shift between the two signals shown in the input window.

Many of the graphical results are also presented in a numerical format on the upper right panel. The Real-Time Status window displays the instantaneous velocity, shift, and  $R^2$  values. How quickly these values are updated depends significantly on the speed of your computer. The Correlations Per Second readout shows how many velocity points are being calculated per second. On a Pentium 200 this value is about ten. A 486 may only give about two correlations per second. The status window also shows a running average of the velocity and  $R^2$ . The installation defaults to averaging the last twenty points, but you can change this as shown in Chapter 6.

### 5.1.2 MENU OPTIONS

All of the commands needed to operate the velocity system are available from the main menu. This section will discuss the commands needed for basic operation. The advanced features are discussed in the next chapter.

*File / New Session* – This command resets the software and prepares for a new velocity run.



*Sample / View Input* – This command simply displays the input from the DAU in the input graph. This is useful for checking the strength of the input signal or for repositioning the photodiodes. A shortcut button as shown is available for this command on the speed bar.



*Sample / Real Time* – This command starts the real-time velocity calculation. This is the most common mode of operation. In this mode the software cycles rapidly between reading from the device and correlating the data. In this manner velocities are calculated several times per second. A shortcut button is also available on the speed bar for this feature.

*Configuration / Sampling Options* – This item brings up the Standard Setup Dialog. This is the only dialog that needs to be accessed on a regular basis. The Standard Setup Dialog allows you to specify certain parameters for the sampling. There are two basic methods of using this dialog. For the needs of most users the Preset Parameter Options are sufficient. If you would like to learn more about setting Custom Parameters, see Chapter 6.

The three preset options are for high, medium, and low velocities. Changing between these three options depending on what range of velocity you plan to measure automatically configures three important parameters: sampling frequency, correlation set size, and correlation range. The sampling frequency is the number of data points read per second, the correlation set size is the number of data points read and

correlated per cycle, and the correlation range optimizes the calculations for the appropriate velocity range. The velocity ranges given beside each preset option are not absolute, so the software will measure velocities slightly outside the ranges.

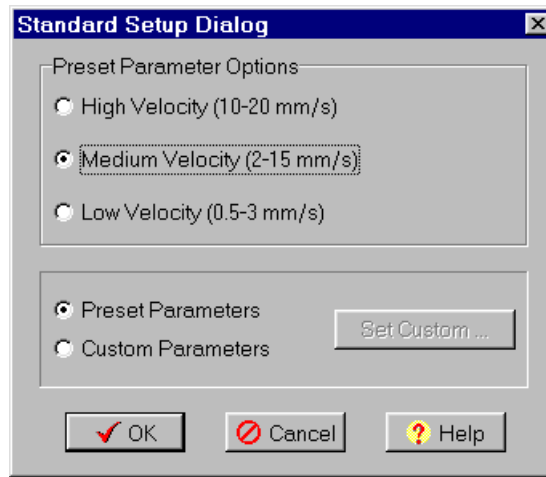


Figure 5.2 – Standard Setup Dialog



*Output / Output To Disk* – This feature allows you to output the real-time velocities to a file as they are being recorded. This is useful if you prefer to import your data into a spreadsheet at a later time. Be aware, however, that it will slow down the sampling somewhat.

When you select to output to disk, you will be prompted for a file name. The data are saved in a text format for convenience. Once you have selected a file name, the program is ready to output velocities to this file. When you start real-time correlation, the software will continue to write each velocity point, the time in seconds elapsed since the first point was recored, and the correlation strength until you stop sampling.



*Output / Velocity Graph* – This option allows you to view a summary of the velocity points in the buffer. A separate window will come up showing a graph of the most recent velocity points. The speed bar command for this feature is the last button from the top with the graph image on it.

From within the summary graph window you can then make a hardcopy of the results or save them to disk. To make a hardcopy, select Print from the Options item in the window menu. The program will then display a Print dialog to configure the printer. To save the data in the window to the disk, select Save to Disk. In the save dialog simply type a filename. The software saves the data as a text file so that you can import it into any spreadsheet program.

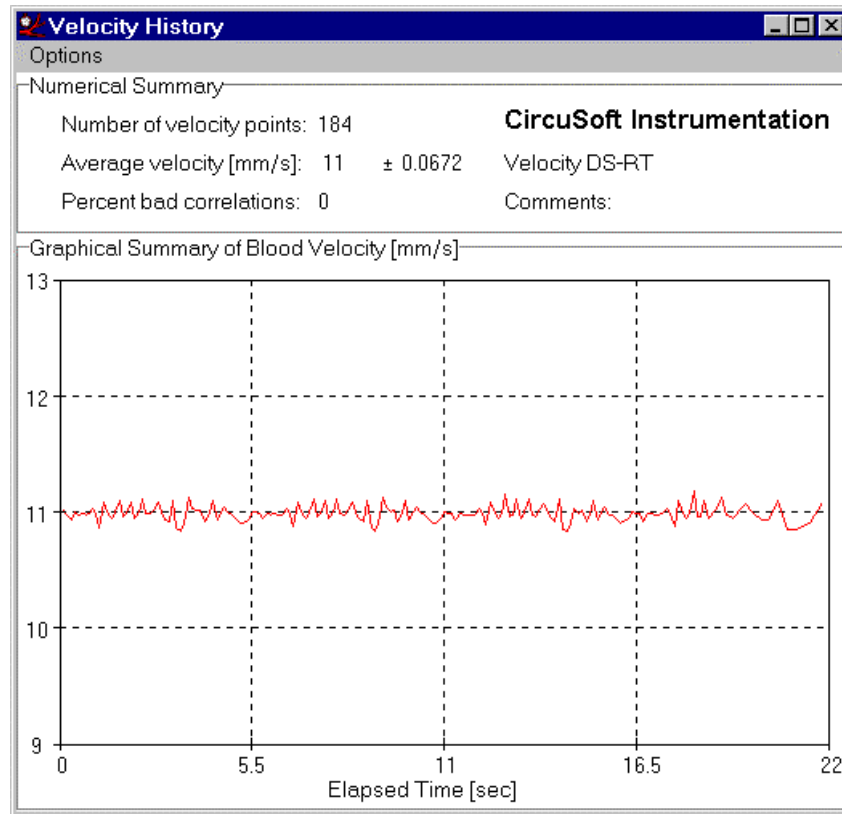


Figure 5.3 – Summary Graph

## 5.2 OPERATING THE DAU

Once the software is running and configured and a specimen is in place under the microscope, you will need to position the DAU correctly to begin reading velocities. In order to use the system you *must* have a DC microscope lamp and you must dim the overhead lights (see Chapter 3). If you are using an eyepiece port to mount the DAU, you will need to exchange the eyepiece with the DAU while measuring velocities. Once the DAU is in place, you can refocus the microscope so that you can see the same image on the DAU viewing screen as you saw through the eyepiece.

The most important part of using the DAU is lining the photodiodes up correctly with the blood flow. The photodiodes are centered in the aluminum sensor housing on top of the viewing screen. The line on the viewing screen indicates the axis along which the photodiodes are aligned. The arrow indicates the direction of blood flow. Move the microscope stage until the region of the vessel you want to measure is under the photodiodes. You will not be able to see this region anymore on the view screen since it will be under the photodiode housing. Then turn the entire DAU until the direction of blood flow aligns with the photodiode axis and is in the same direction as the arrow. Now you are ready to begin reading velocities.

### 5.3 READING VELOCITIES

The following is a summary of the steps you will need to follow to measure velocity once the system is installed and configured. We are assuming that you already have a specimen surgically prepared and mounted so that you can see a microvessel clearly through the eyepiece of your microscope. These steps will seem like common sense once you have done them once or twice.

1. Turn on the SPU. The light on the front panel should come on.
2. Start the velocity software.
3. Go to *Configuration / Sampling Options* in the software menu. Select one of the preset parameter sets. Stick with Medium if you are unsure.
4. To be sure the system is communicating properly, click on View Input. You should see strong, 60 Hz signals from any AC light source in the room.
5. Now turn off or dim the overhead lights until this signal disappears.
6. Find the vessel of interest on your specimen by moving the stage around.
7. Replace the eyepiece with the DAU if necessary.
8. Turn up your microscope lamp intensity to maximum.
9. Refocus the image on the DAU viewing screen.
10. Align the photodiodes with a vessel and make sure the blood flow is in the right direction.
11. Check the Input Graph to be sure you are getting good signals.
12. Click the Real-Time Correlation button on the software to begin measuring velocities.
13. Click on the Stop button when you are done.

If you have complications during any of these steps, check the troubleshooting section in the Appendix.

## CHAPTER 6 – ADVANCED FEATURES

These advanced features allow an advanced user to get the most adaptability out of his system. If for some reason you modify these parameters to the point where nothing works anymore, you can always reset the defaults. Every time you exit, the current parameter values are written to a file so that they can be reset next time you start. To restore the defaults, go into the directory where the software was installed and delete the “velocity.cfg” file. Next time you start the software the defaults will be reset.

### 6.1 CUSTOM PARAMETERS

If you wish to have more control over the parameters controlling the data collection and correlation, you will need to manually adjust the values in the Custom Parameters Dialog Box. To get to this dialog, go to the Standard Setup Dialog (*Configuration / Sampling Options*) and click on the Custom Parameters radio button. The Set Custom button will become enabled as shown in Figure 6.1.

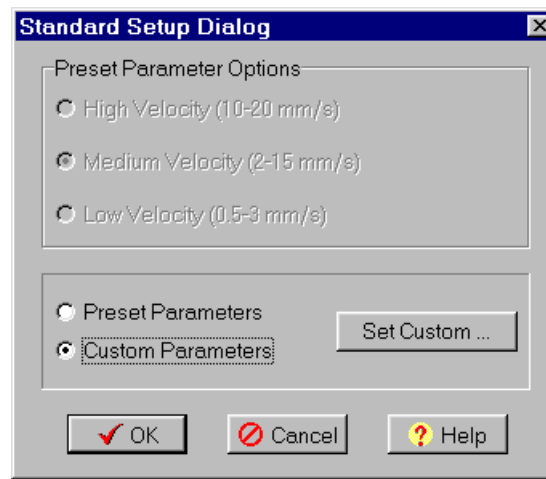


Figure 6.1

Clicking the Set Custom button will bring up a new dialog box. This dialog has two tabbed screens, Basic and Additional.

#### 6.1.1 CUSTOM PARAMETERS: BASIC

The Custom Parameter Dialog with the Basic page visible is shown as Figure 6.2. This page controls all of the features that would have been automatically set by the Preset Option groups. On the bottom of the pages there is a formula for how the velocity is calculated. The diode separation is already fixed by the calibration, but you can optimize the velocity calculation using the other parameters in the formula. As you can see from this formula, to measure higher velocities you will need to sample at a higher frequency. The hardware can sample at up to 15000 Hz. You can select an available frequency from this dialog.

A higher velocity will return a smaller shift since it will take less time for a particle to move between the sensors. However, you do not want too small of a shift because it will introduce large variability to your measurements. For example, if you set up your parameters so that the calculated shift moves between one data point and two data points from one correlation to the next, you will see your velocity oscillate 100%. Try to have a shift of at least five points. You can select a minimum and maximum value for the shift to increase the program's performance. If you know approximately what velocity range you will be measuring, you may be able to narrow the range of shifts that the program tests. Once you know the approximate velocity, pick a frequency and plug it in to the equation to figure out your approximate shift and adjust the parameters accordingly. Be warned that if the actual shift is outside the range you pick, the program will probably return an incorrect velocity. Keep an eye on your Correlogram. You should see a distinct peak in the middle of the shift range. The axis scale on the Correlogram is just the shift in points divided by the sampling frequency.

You may also want to experiment with the correlation set size. This is the number of data points the hardware reads and the software correlates. You should see a few peaks in your Input Graph data in order to get reliable correlation results. At higher velocities you will have more peaks than at lower velocities. You may need to increase your set size when measuring slower flows. Making your correlation set size or correlation range too large will significantly slow down the frequency response (cycle time) of your system.

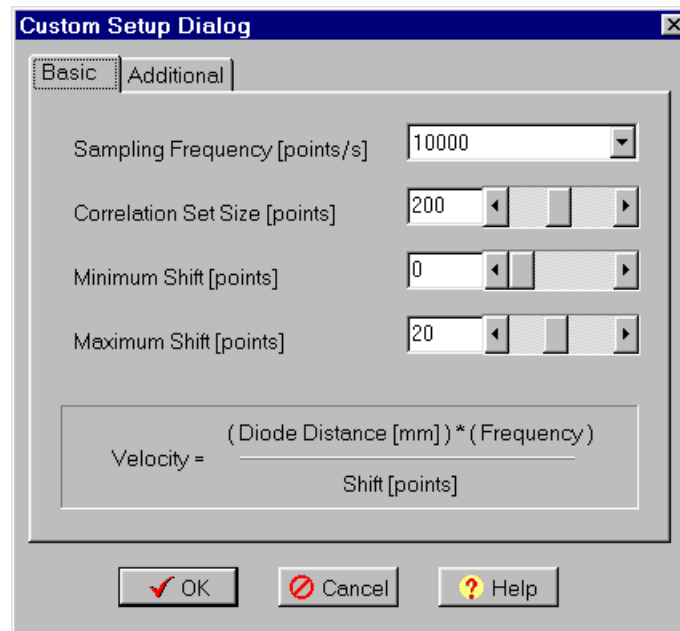


Figure 6.2

Just for reference, here are the values for the preset option sets:

	<i>Low Velocity</i>	<i>Medium Velocity</i>	<i>High Velocity</i>
Sampling Frequency [Hz]	2500	10000	15000
Set Size [points]	300	200	100
Maximum Shift [points]	30	20	15
Minimum Shift [points]	0	0	0

As you can see, they are fairly arbitrary and leave the advanced user plenty of room for optimization.

### 6.1.2 CUSTOM PARAMETERS: ADDITIONAL

The Additional page has even more features that allow for optimization of the system. This page is shown in Figure 6.3.

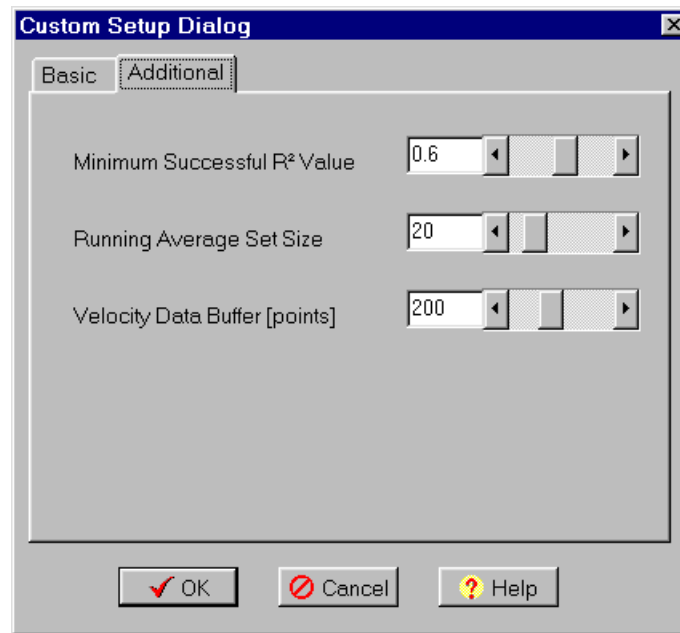


Figure 6.3

The cross correlation algorithm uses an  $R^2$  value to determine whether a correlation is successful or not. The default value of 0.6 is very generous. If you have clean input signals, you should be able to increase this to 0.8 quite comfortably. Once again, watch your Correlogram to see how well your system is operating and how close you are running to the minimum value.

The running average set size simply controls how many velocity points go into calculating the running average. You can adjust this to your liking. The velocity data buffer controls how many velocity points are held in memory. All the points held in

memory are displayed on the Velocity Graph. This is also the number of points displayed on the Summary Graph if you activate it.

## 6.2 INPUT CONFIGURATION DIALOG

The Input Configuration Dialog (Figure 6.4) controls many of the characteristics of the input signals. Generally you will only need to access this dialog for troubleshooting reasons, but it is good to be aware that the features described below are available.

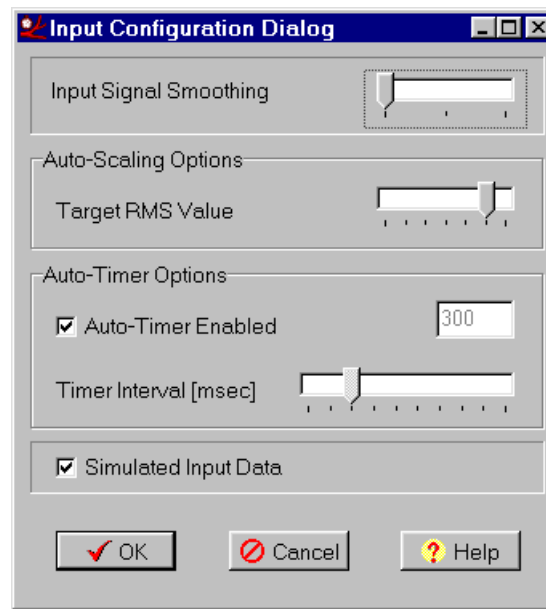


Figure 6.3 – Input Configuration Dialog

### 6.2.1 INPUT SIGNAL SMOOTHING

If your input signal contains high-frequency noise which cannot be eliminated by repositioning the hardware or cables, you may want to employ some smoothing. Smoothing simply averages a point with surrounding points to reduce noise. The system defaults to one-point smoothing (no smoothing). You can choose to use three- or five-point smoothing by moving the sliding control to the right.

### 6.2.2 TARGET RMS VALUE (AUTO-SCALING)

The Auto-Scaling is a hardware feature that automatically scales the input to the appropriate level for the calculations. This ends up being roughly the full y-axis range of the Input Graph. If the hardware is not scaling properly because of irregular or unusual input signals, you can change the RMS goal for the Auto-Scaling routine. Reducing the target RMS value will reduce the amplification. This may be necessary for a sparser signal.

You can also turn the Auto-Scaling off completely if it is giving you trouble. Auto-Scaling is a check box in the Hardware Setup Dialog (Figure 4.1). Once the Auto-Scaling is disabled, a scroll bar will appear on the lower left of your speed bar. You can then manually adjust the hardware amplification gain.

### *6.2.3 AUTO-TIMER FEATURE*

The Auto-Timer is a feature implemented to allow the software to adapt to the speed of your system. A correlation cycle will take a characteristic amount of time depending on the speed of your computer. A correlation cycle consists of reading data from the hardware buffer, performing the software cross-correlation and related calculations, and outputting the data to the screen. Surprisingly, the graphics output is most frequently the bottleneck of the cycle. The timer cycle must take a little longer than the correlation cycle in order to give Windows time to function properly. The Auto-Timer automatically adjusts the duration of the timer interval based on how quickly the previous cycle was completed. If you wish to manually adjust the timer interval, you can do so by deselecting the Auto-Timer feature. The slider for the timer interval will become active and you change the value. Remember that a slower computer will need a larger timer interval. If your computer is having trouble getting more than two cycles per second, you need a faster machine.

### *6.2.4 SIMULATED DATA*

The simulated data is strictly a learning and demonstration tool. If you are curious to see the effect of any of these parameters on prerecorded data, you can turn Simulated Data on. Instead of reading from the hardware, the software will now read from a file of data recorded at 5000 Hz from a venule in a mouse cremaster.

## APPENDICES

### APPENDIX I – SERIAL COMMUNICATIONS

The external serial ports on PC's generally provide the easiest method for attaching hardware. However, if the PC has not been setup with full access to these ports or internal hardware has been installed conflicting with these ports, it can be slightly difficult and frustrating to get things working. In most newer PC's (Pentiums and higher) these conflicts are rare.

#### *TROUBLE-SHOOTING*

If you have run the automatic port probe, and it failed to find the hardware, you may still be able to configure the device manually. On some computers (usually only older models) the autoprobe will not work. Proceed to the manual configuration section before trying other options.

If the probe could not find the SPU on any of the available external serial ports (usually only COM1 and COM2) and a manual configuration failed, you have a conflict of some kind. It will either be a piece of hardware communicating on the port you need (such as a modem), or the port is not installed. It will physically be there, but the hardware does not see it.

#### *MANUAL CONFIGURATION:*

If you know you have an available communications port, and the probe failed, you can set it manually. Go to the Hardware Setup option under the Configuration menu. Select the port to which you have attached the hardware and select OK. If you do not see any input from the SPU (i.e. a centered line when the DAU is not attached), try closing the program and restarting it. If this still fails, you will need to check that the port is properly installed and that there are no hardware conflicts.

#### *PORT INSTALLATION CHECK:*

The first thing to check (and easiest to change) is to see if the ports are installed. Under Windows95, double click on the System icon in the control panel. Select the Device Manager Tab, and Click on the Ports icon. If you see both COM1 and COM2 listed, without an X over either, all ports are installed correctly. You will need to proceed to the Resolving Conflicts section to proceed. If one is missing, you will have to set up the hardware to recognize it. This must be done in the either in the BIOS (the computer's startup routine) or on jumpers on the I/O card. Only on 486's have jumpers that may need adjusting, and it is very rare that the ports are not already installed. However, if you are in this situation, you will need to use your computer's manual to install the ports.

The setup routine can only be accessed during computer startup. The opening screen after the computer is tuned on will state how to enter the setup. Often it is the

delete or F10 key, but it will vary from computer to computer. Once in the setup utility, you must page through the options to locate the serial port options. If you have a manual for your computer, use it here! Once you have setup the serial port, it is still possible that there is a conflict with the port. If you still cannot access the port, or other hardware stops working, you will have to reconfigure that hardware. See the Resolving Conflicts section for more info.

#### *RESOLVING CONFLICTS:*

Often computer manufactures will place internal serial devices on COM ports usually reserved for the external ports. This most commonly occurs with modems. To check for a conflict, simply bring up the properties on your modem. This can be done by going to the modem section of the Control Panel, or by clicking modem properties under dialup networking. If your modem (or other serial device) is on the COM port you need to use, you will need to reconfigure the device. This may involve resetting jumpers or software configuration. Either way, it is best to consult the manufacture's manual for more information. If you have reconfigured the device and the velocity system still cannot find the hardware, it is possible that the external port is not installed. If so, proceed back to the Port Installation Check.

## **APPENDIX II – COMMON PROBLEMS**

Here is a list of some common problems and their solutions.

### *SOFTWARE STOPS WORKING PROPERLY*

For some reason, Windows software has a tendency to crash inexplicably on occasion. If your software stops working in any way, try closing the program and restarting it. If it continues to crash, it may be time to reboot your machine.

### *HIGH VARIABILITY IN VELOCITY MEASUREMENTS*

If the velocity seems to be jumping around a lot, you are probably running at too low of a shift. Try increasing the sampling frequency or choosing a higher velocity range from the preset options. Try to keep a shift of at least five points. Remember that the scale on the Correlogram is the shift divided by the sampling frequency.

### *SHIFT TOO HIGH/LOW*

If the shift is too high (greater than about 25) you will need to decrease your sampling frequency. If the shift is too low (less than 5) you will need to increase your sampling frequency. Too high of a shift may give incorrect velocities if the actual shift is greater than 30. Too low of a shift will introduce variability in the measurements.

## *No SIGNAL*

The most difficult problem to diagnose is a lack of signal from the SPU. If you click View Input, and you do not see lines of any kind on the input graph, there is a problem. The following is a list of things you can try. This list assumes that the system has worked before, but stopped for some reason. If the system has never worked, you most likely have a serial communications problem and need to see Chapter 4 and Appendix I.

1. Test the system by holding the DAU near an AC light source. You should see a 60 Hz signal if you click View Input.
2. If not, make sure the SPU is turned on and has power. Try turning it off and back on again.
3. Try closing the program and restarting it.
4. Check all of the connections to the system components.
5. If something has changed in your computer setup, check for a serial communications conflict.

If none of these work, your system may have been damaged and will need repair. Please contact CircuSoft.

## **APPENDIX III – TECHNICAL SUPPORT**

Technical support is available from CircuSoft if you have problems with the system. We will be able to address most problems associated with calibration, installation, and use of the system. Be aware, however, that it may be difficult for us to diagnose problems associated with your computer hardware since all configurations are different. For these types of problems it is best to contact your computer manufacturer.

email: [support@circusoft.com](mailto:support@circusoft.com)

fax: (919) 854-1929

ATTN: Support