NEWTON
RESEARCH LABS

Software Component
Users Guide

S202-9200
Stereo Color Tracking

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INTRODUCTION

Welcome to the Users Guide for your Newton Research Labs Software Component. You will find the simplicity and ease of use of this Software Component User Interface to be unparalleled in the machine vision field.

This guide covers the installation, set-up and use of Newton Labs Software Component **No.S202-9200**.

The basic S202 Software Component has been optimized for Color Stereo Tracking with a Newton Labs Model 9200 Vision System.

This Users Guide contains information on the following subjects:

STANDARD NEWTON LABS VISION SYSTEMS FEATURES

Settings for the **S202-9200** Software Component

IMPLEMENTED MODEL: 9200

Feature		Setting
Ethernet		*Not Implemented in this Software Component*
DB9 Serial RS232 Configuration Connector		Used in Set-up and Configuration Mode Disconnect for operation
DB37 Digital Inputs	Input 1	*Not Implemented in this Software Component*
DB37 Line Lock/Sync Input		*Not Implemented in this Software Component*
DB37 Digital Outputs		*Not Implemented in this Software Component*
DB37 Serial RS422 Data Output		Used for tracking output (See **Serial Output Page**)
Newton Labs Imager		2–4160 Newton Labs Imager
Imager Output		Imager Output available- NTSC Format
Video Output		Shows Objects of Trained Color
Front Panel LEDs	Busy	Green after power on self-test
	Pass/Fail	*Not implemented in this Software Component*
	Sync/Trigger	*Not implemented in this Software Component*

INSTALLATION AND SET-UP

SYSTEM REQUIREMENTS

Laptop or PC – Pentium 100 or faster, operating system Windows 95 or higher, 800 x 600 color display screen.

USER INTERFACE INSTALLATION

1. Start Windows.
2. Insert the Newton Labs Software Component CD-ROM into drive (*****).
3. Press Start on the Task bar and select Run.
4. From the Run dialog box, select (or type) (*****):\Setup and click OK.
5. Follow the screen instructions.

***** Insert your CD-ROM drive letter.

POWER UP DISPLAY

When the Newton Labs Vision System is first powered up, it will perform a self-test and feature detection. When the system has completed the self-test, the **BUSY** LED on the front panel will illuminate Green.

POWER FLUCTUATIONS

The Model 9200 Newton Labs Vision System requires relatively stable AC power. If the system is installed in an area where the AC power is not stable and is subject to severe fluctuations and/or discontinuity, the use of an Uninterruptable Power Supply may be required.

Should a rapid power fluctuation take place and the Newton Labs Vision System appears not to be operating correctly, turn off the main power switch on the front panel for 5 seconds and then turn the system back on.

QUICK START GUIDE

These directions assume use of a standard NTSC video monitor with BNC connector.

1. Connect laptop or PC to the Newton Labs Vision System and turn on the Vision System
2. Install Software Component on laptop or PC
3. Start Software Component

   The Software Component User Interface will automatically connect to the Newton Labs Vision System. If it does not connect:

   Go to *Connection Menu*

   1. Select **Configure–** Select Com Port.

   2. Select **Connect**

   3. If no connection is made after properly selecting the Com port, see Appendix A for help.

4. Go to the **Information Page**

   1. The Newton Labs Software Component will automatically confirm that the Software Component is the correct one for the connected Newton Labs Vision System
   2. If the information page does not show the correct serial number, you will not be able to continue. A display box will inform you of the conflict. Contact your Newton Labs Authorized Distributor to obtain the correct Software Component.

5. Attach and focus the imagers

   1. Attach the two Model 4160 imagers to Model 9200
   2. Attach video monitor to one of the Imager Out connectors on the Model 9200
   3. Use the monitor image to inspect imager output for focus and imager placement. Repeat for the other imager. Alternatively, the **Monitoring Page** can show a real time view from the imager.

Note for using the color tracking system under fluorescent lighting conditions:
Fluorescent light can distort the color of the object to be tracked, and this may affect the consistency of the tracking. When the color of the object to be tracked is similar to the surrounding background color, use the “line lock” feature on the camera to assure consistency and accuracy. If the color of the object to be tracked is in good contrast to the background color, it should not be necessary to use the “line lock” feature.

6. Go to the **Tracking Calibration Page**

    1. For each imager, adjust *Hue* and *Hue Variation* to match desired tracking color range for each colored object.
    2. To view the training output attach a video monitor to the Video Out connector and place the object to be tracked in front of the imager. The video output will show in white all regions that are detected to match the tracking color range you have selected.
    3. Adjust parameters until a solid tracking is obtained. You may need to turn off "Track Bright Colors Only" and adjust the minimum acceptable Saturation and Brightness values if the color you are tracking is not bright.

7. Go to the **Serial Output Page**

    1. For each imager, set baud rate and which object properties you wish to be output.
    2. Select the number of objects to track, and minimum object size.

8. *File Menu* **Save Settings**

    Save to File

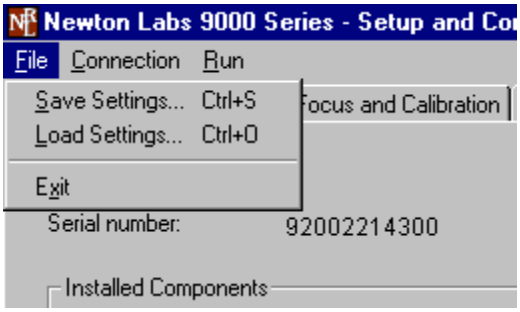
9. *Run Menu* **Start Running**

10. *Connection Menu* **Disconnect**

11. *File Menu* **Exit**

USER INTERFACE BASICS

FILE MENU

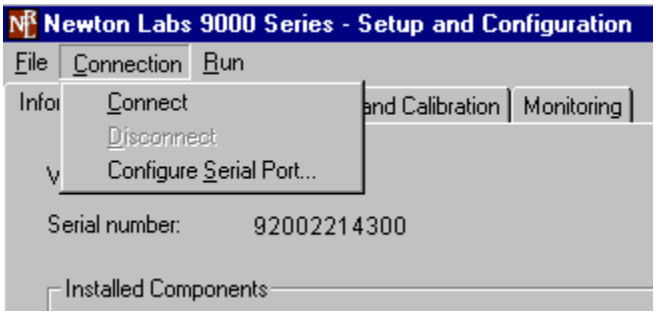


Save Settings–Saves currently selected settings to a file on the laptop or PC you are using. A dialog box will ask for a file name and location. It is highly recommended that you save the settings after a successful setup.

Load Settings–Opens previously stored settings file and loads those settings into the User Interface.

Exit–Closes the Software Component User Interface

CONNECTION MENU

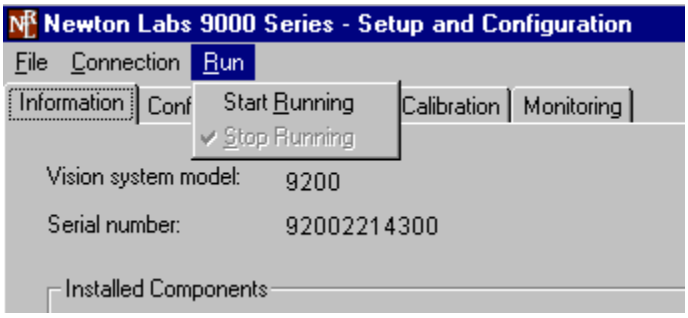


Connect–Connects the Newton Labs Software Component User Interface to a Newton Labs Vision System. *This option must be selected first in any setup session.*

Disconnect–Disconnects the Newton Labs Software Component User Interface from a Newton Labs Vision System.

Configure Serial Port–Select the communications port the Vision System is connected to.

RUN MENU

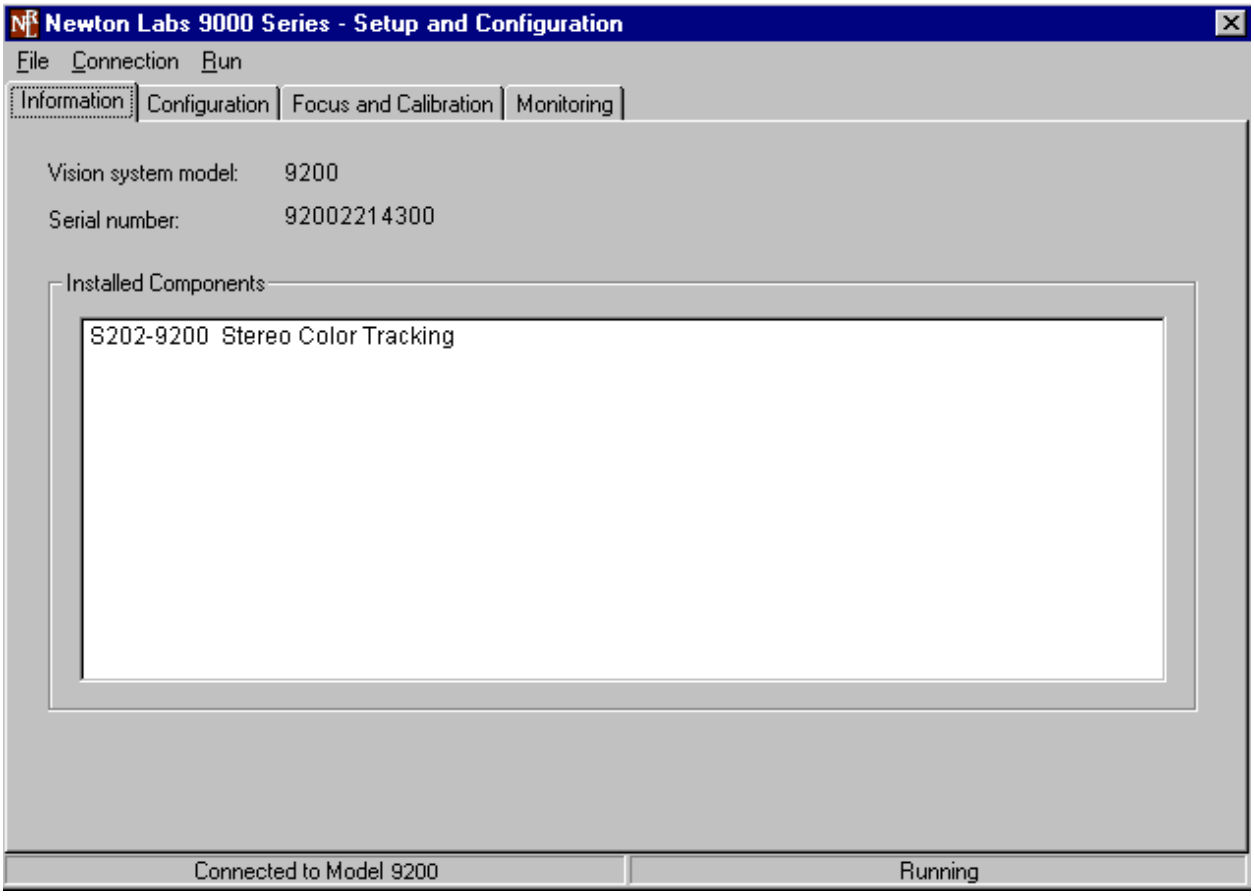


Start Running–Start reporting tracking information over the Data Output Serial Port
Stop Running– Stop reporting tracking information over the Data Output Serial Port

Tracking parameters may be changed regardless of whether tracking is currently running.

SYSTEM INFORMATION PAGE

- Vision System Model
- Serial Number
- Installed Components



Vision System Model

The Newton Labs Software Component User Interface reads and automatically identifies the Model number of Newton Labs Vision System to which it is connected.

Serial Number

The Newton Labs Software Component User Interface reads and auto identifies the Serial number of Newton Labs Vision System to which it is connected. If the Software Component is not correct for that serial number, a display box will appear. Contact your Authorized Newton Labs Distributor for the correct Software Component.

Installed Components

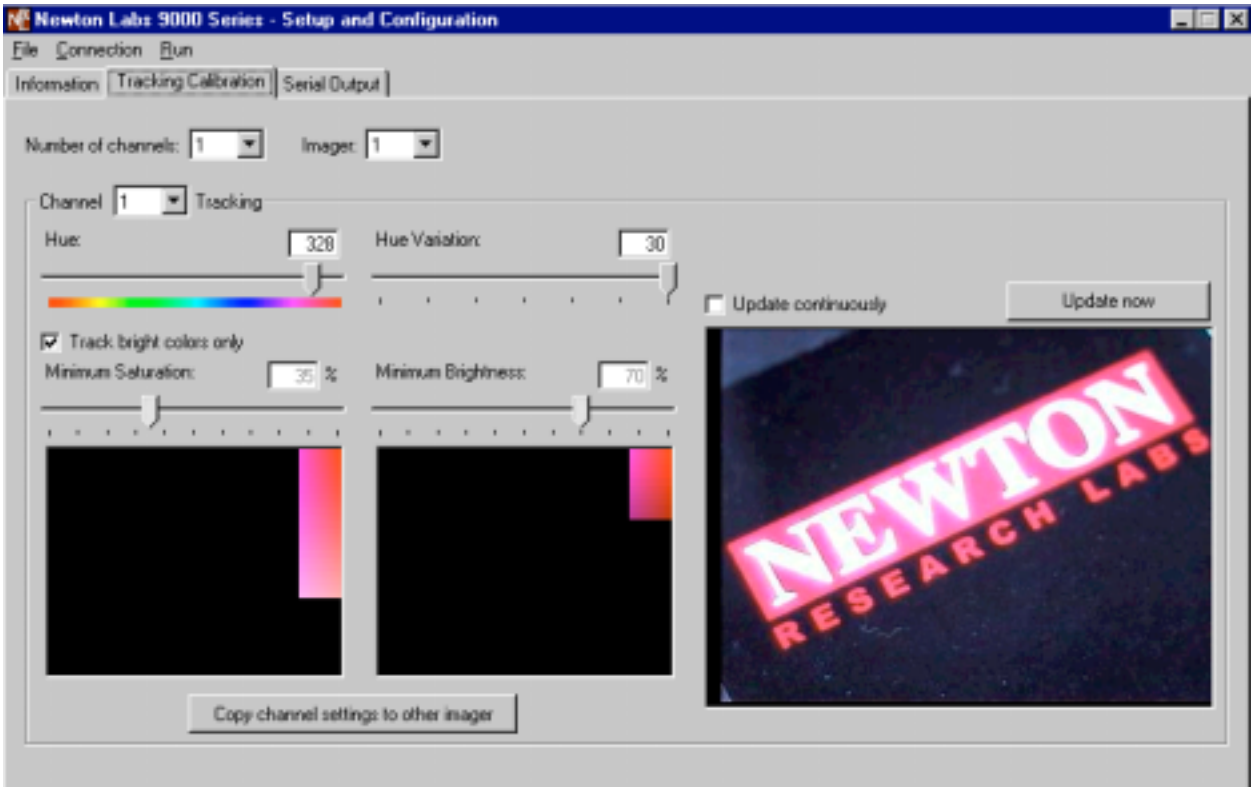
Since many final applications require several Newton Labs Software Components, this table identifies which of the Newton Labs Software Components have been included in this application.

TRACKING CALIBRATION PAGE

The Tracking Calibration Page allows you to view the picture from one imager and set the color range of the objects to be tracked.

Color selection is primarily performed by adjusting the *Hue* and *Hue Variation* to be tracked. *Hue* sets the actual color, while *Hue Variation* configures how much the color can vary and still be tracked.

To view the training output attach a video monitor to the Video Out connector and place the object to be tracked in front of the imager. The video output will show in white all regions that are detected to match the tracking color range you have selected. Adjust *Hue* and *Hue Variation* to try to get a solid training.



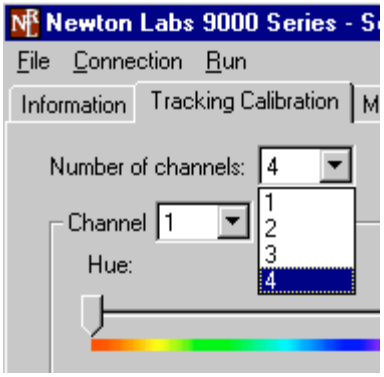
Usually, *Track bright colors only* can be turned on, which configures the Saturation and Brightness ranges to their default values. If, however, Hue and Hue Variation are insufficient for obtaining a solid image, turn off *Track bright colors only* and modify the Saturation and Brightness ranges. Saturation is the property of how "intense" versus how "washed out" a color is. For example, red is more saturated than pink, and pink is more saturated than white. You can get a good feel for these adjustments by watching the recognized color range under each slider.

- Update Imager continuously—When this box is checked, continuous updates of the imager video are output on the right of the page. The speed of the video update is limited by the speed of the serial connection and the data demand of the video image may slow tracking operation. It is often useful to use the Update Imager Now button.
- Update Imager Now—This button instantly updates the video image at the right of the page when it is pressed. Use of this button, rather than the Update Imager continuously check box, allows tracking to function at full speed.

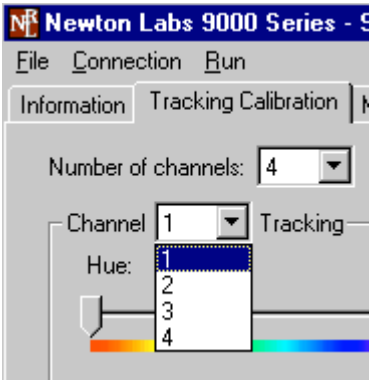
For applications where maximum tracking speed is required, a monitor may be attached to the Imager Output connector for viewing the picture from the Imager.

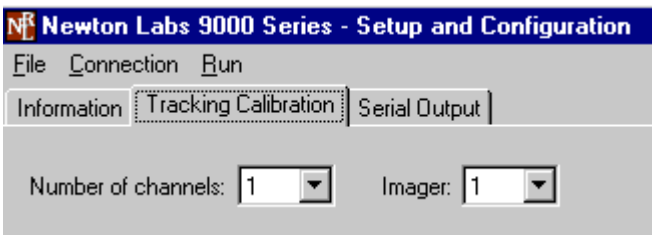
TRACKING CALIBRATION PAGE CONT.

Select the number of channels equal to the number of colors you wish to train (up to 4).



Select one of the four available channels to train each color (up to 4 colors).





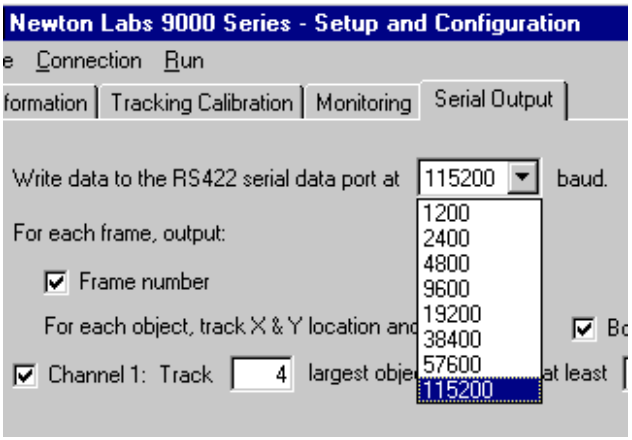
Select either of the two imagers

SERIAL OUTPUT PAGE

While the Vision System is running, data is transmitted via the RS422 data port for each video frame and for each object being tracked per imager. Which data is calculated and reported can be configured in the Serial Output Page. Note: To optimize tracking speed, select only those data measurements (Bounding box, Aspect ratio, etc) that are required.

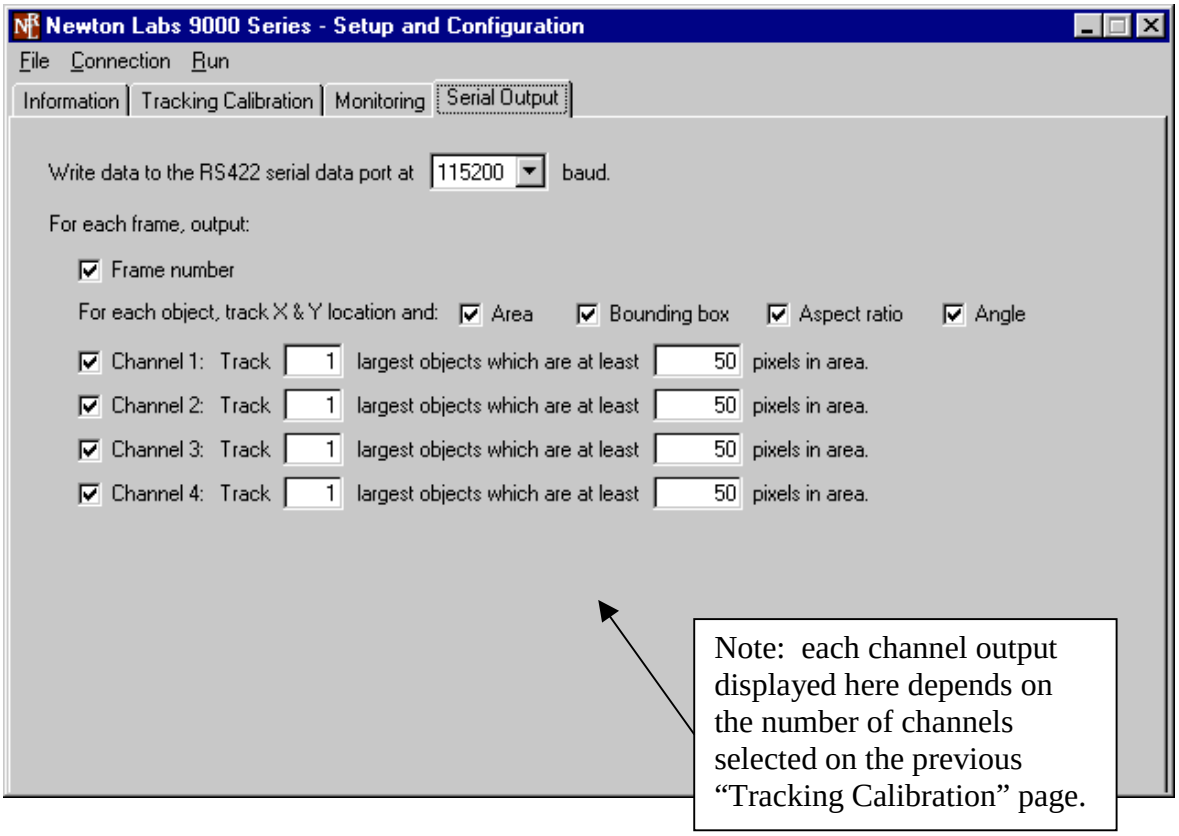
BAUD RATE

The output baud rate may be chosen from a list of standard baud rates. The default baud rate is 115200. Baud rates lower than 38400 are not recommended as they provide insufficient bandwidth for tracking at full speed.



OBJECT TRACKING BASICS

After determining all pixels in the input image that match the specified color range, the Newton Labs Vision System coalesces groups of contiguous pixels into tracked objects. Various calculations on these objects can be reported, and restrictions can be placed on the number of objects reported per frame, as well as the minimum object size required.



Notes:

1. When settings for Channels 1–4 are established, the settings affect both imagers.
2. The noisier the image (degree of static interference), the slower the update may be.
3. The system can stereo track up to 20 objects before a loss of speed may occur.
4. Deselect the measurements (Bounding box, Aspect ratio, etc) which are not of interest in order to optimize the overall speed of the system.
5. Fluorescent light can distort the color of the object to be tracked, and this may affect the consistency of the tracking. In fluorescent lighting conditions and where the object to be tracked is similar to the surrounding background color, use the line lock feature on the camera to assure consistent tracking results. If the color of the object to be tracked is in good contrast to the background color, it should not be necessary to use the "line lock" feature.

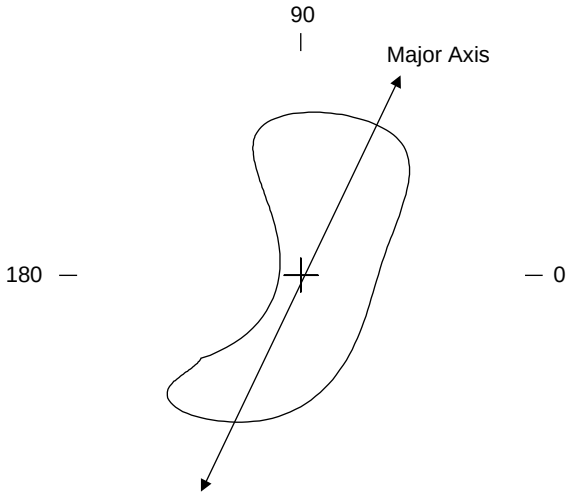
The following information can be computed for each object:

- **Centroid**. This is the weighted center of the object. X and Y coordinates are returned. X=0, Y=0 is the upper left corner of the image, and X=639,Y=479 is the lower right corner of the image.

- **Area**. This is the number of detected pixels that comprise an object.

- **Bounding Box**. The bounding box consists of four numbers, the top, left, bottom, and right borders of the object. The bounding box is "inclusive"; the left and right numbers represent the exact minimum and maximum X coordinates, while the top and bottom numbers represent the exact minimum and maximum Y coordinates.

- **Angle of Orientation**. To compute the angle of orientation, first the major axis of the object is computed. For a typical object, the major axis aligns "lengthwise," as shown in the following diagram:



Note that the major axis goes two directions; there is no "forwards" or "backwards". The angle of orientation is reported as a number from 0 to 180 degrees. If the Newton Labs Vision System tracks an object with no major axis (i.e. a perfectly round circle), the angle information is of no use. (Aspect Ratio can be consulted to determine if this is the case.)

- **Aspect Ratio**. After finding the major axis, the Newton Labs Vision System can then compute the "aspect ratio", which is the ratio of moments about the major axis and the axis perpendicular to the major axis (the minor axis). Roughly speaking, if an object is three times longer than it is wide, the aspect ratio will be reported as 3. For objects with no major axis (i.e. a perfectly round circle), the aspect ratio is 1. Angle of Orientation calculations are undefined for aspect ratios equal to 1, and tend to be extremely sensitive to small perturbations for aspect ratios close to 1. If Angle of Orientation is important, be sure that the object being tracked has a clear major axis.

SERIAL DATA FORMAT

The data from each frame consists of a line of numbers separated by spaces. The line begins with the character "^" and ends with a carriage return / linefeed. Imager 1 is reported first. The data from Imager 1 is followed by a "/" (forward slash). Imager 1 is separated from imager 2 by a "/".

Numbers are reported in the following order:

- (If requested) Frame number. The frame number is reported as a decimal integer between 0 and 4294967295 (2^{32}-1). After reaching 4294967295, the count will wrap back to 0. (This would take a little more than two years of continuous running).

Next is the tracking data for each color channel. Each channel shows a sequence of numbers for each object tracked, followed by a semicolon ";". When multiple objects are reported, the values are concatenated on the same line.

- X position of object centroid (ranges from 0 to 639)
- Y position of object centroid (ranges from 0 to 479)
- (If requested) Area of object, in pixels (ranges from 0 to 640x480, or 307200)
- (If requested) Four numbers denoting the bounding box, in the order: *left, top, right, bottom*. Left and right range from 0 to 639, and top and bottom range from 0 to 479.
- (If requested) Aspect ratio of object. Range starts at 1, with no maximum.
- (If requested) Angle of orientation (in degrees). Ranges from 0 to 180.

APPENDIX A

COMMUNICATION TROUBLESHOOTING

Problems Communicating with the 9000 Series	
♦ The user interface will not connect with the 9000 Series	Try the following first: ♦ Wait 30 seconds and try reconnecting. ♦ Check all connections. ♦ Make sure only one copy of the software component is running on the laptop or PC. ♦ Make sure that no other software (e.g. Palm Desktop) is using the serial port. ♦ Try to connect using another COM port. ♦ Turn off the computer, restart, and try again. If the above suggestions do not provide results, follow the procedures below to further troubleshoot communications: STEP 1: Establish communications via a communications terminal program. HyperTerminal can be used to debug system communications. You can use the HyperTerminal program as follows: Start HyperTerminal: Click the Start button, choose Run, type in Hypertrm.exe and click OK. A dialog box will appear with the words "Connection Description" in the title bar. Type NRL9000 in the name field. Under "Connect Using", click "Direct to Com ..." and choose the COM port you are using to connect to the 9000 Series. Try using COM 1, if you are using a PS-2 mouse. If you have a serial mouse, try COM 2. If you are not sure which COM port to use, repeat until you determine the right one. Select the appropriate communications port.

PROBLEMS COMMUNICATING WITH THE 9000 SERIES (CONTINUED)	
♦ The user interface will not connect with the 9000 Series (continued)	A dialog box will appear listing the properties for the com port selected. Set the com port properties to 115,200, 1 stop bit, Flow Control-Hardware The HyperTerminal program will display a white box. Press the space key (several times). An "OK" will appear each time you press space as long as the PC is communicating with the 9000 Series through HyperTerminal. If successful communications with the 9000 Series have been established, skip to Step 4. STEP 2: Check the wiring There may be a problem with the RS-232 cable or the laptop/PC. Make sure the wiring is correct. STEP 3: Make sure the computer is working properly If you are not able to obtain control over a COM port on the PC, check with your system administrator for help. If you are able to get control over a COM port, and you have checked all wiring and connections, go to Step 4. STEP 4: Power down the 9000 Series and power up again normally. STEP 5: Establish communications with the 9000 Series using the software component. Disconnect from the terminal mode in the program you are using. Use the software component to try to connect to the 9000 Series. If you still cannot establish communications using the terminal mode and/or the software component after reloading the software and establishing that there are no problems with the wiring or PC, go to Step 6. STEP 6: Call your Newton Labs Authorized Distributor Arrange with your local distributor to substitute a working 9000 Series and laptop to determine where the problem exists.

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