

# Rowe Technologies, Inc.

## PyAutoWaves User Guide

PyAutoWaves 1.8.0

Rev. D



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| Date       | Author | Rev | App Rev | Comments   |
|------------|--------|-----|---------|--|
| 04/23/2019 | Rico   | A   | 1.1.0   | Initial Writing.   |
| 5/02/2019  | Rico   | B   | 1.1.0   | Added more details to selected bin.  |
| 7/13/2019  | Rico   | C   | 1.7.0   | Added Range Tracking. Fixed Plotting   |
| 7/27/2019  | Rico   | D   | 1.8.0   | Added QC for Velocity Data.<br>Added option to replace pressure with vertical beam data. |

Rev. D



# About this Guide

The Rowe Technologies Inc. PyAutoWaves User Guide is for administrators and users of the Rowe Technologies Inc. PyAutoWaves software, Acoustic Doppler and Imaging technologies.

The following related documents for the Rowe Technologies Inc. instruments are available:

- RTI ADCP DVL User Guide

## CONTENTS

|                                      |    |
|--------------------------------------|----|
| Overview .....                       | 10 |
| Quick Start .....                    | 11 |
| Wave Setup .....                     | 13 |
| Number of Ensembles in Burst .....   | 13 |
| Number of Ensembles in Average ..... | 14 |
| New Avg File (Hours).....            | 15 |
| Output Directory .....               | 15 |
| Additional Config Options .....      | 15 |
| WAVES.....                           | 15 |
| AWC.....                             | 16 |
| PLOT Options.....                    | 16 |
| Wave Setup .....                     | 17 |
| Selected Bins .....                  | 17 |
| Correlation Threshold .....          | 20 |
| Height Source .....                  | 20 |
| Pressure Sensor Height .....         | 20 |
| Pressure Sensor Offset.....          | 21 |
| Latitude .....                       | 21 |
| Longitude .....                      | 21 |
| Vertical Beam Data .....             | 21 |
| Monitor View .....                   | 23 |
| Burst Ensemble Count .....           | 23 |
| Average Ensemble Count .....         | 24 |
| Wave Files.....                      | 24 |
| Waves Burst File Viewer .....        | 25 |
| Terminal .....                       | 26 |
| Serial Comm Port .....               | 26 |

|                                |    |
|--------------------------------|----|
| Scan Button .....              | 26 |
| Serial Baud Rate .....         | 26 |
| Serial Connect Button .....    | 27 |
| Disconnect Button .....        | 27 |
| ADCP Output .....              | 27 |
| ADCP Input .....               | 28 |
| Additional Commands .....      | 28 |
| ADCP Buttons .....             | 29 |
| Start Ping Button .....        | 29 |
| Stop Ping Button .....         | 29 |
| BREAK Button .....             | 30 |
| Clear Button .....             | 30 |
| Record Button .....            | 30 |
| Playback .....                 | 31 |
| Plots .....                    | 32 |
| Water Height Plot .....        | 32 |
| East Velocity Plot .....       | 32 |
| North Velocity Plot .....      | 32 |
| Velocity Magnitude Plot .....  | 32 |
| Water Direction Plot .....     | 33 |
| Burst MATLAB File Format ..... | 34 |
| TXT .....                      | 34 |
| LAT .....                      | 34 |
| LON .....                      | 34 |
| WFT .....                      | 34 |
| WDT .....                      | 34 |
| WHP .....                      | 35 |
| WHV .....                      | 35 |

|                                     |    |
|-------------------------------------|----|
| WUS .....                           | 35 |
| WVS .....                           | 35 |
| WZS.....                            | 36 |
| WB0 .....                           | 36 |
| WB1 .....                           | 36 |
| WB2 .....                           | 37 |
| WB3 .....                           | 37 |
| WZ0.....                            | 37 |
| WHG.....                            | 37 |
| WPH .....                           | 38 |
| WRL.....                            | 38 |
| WPS.....                            | 38 |
| WTS.....                            | 39 |
| WHS .....                           | 39 |
| AVERAGE CSV Format .....            | 40 |
| Data Type.....                      | 40 |
| Excel Pivot Tables .....            | 42 |
| WaveForce AutoWaves .....           | 44 |
| AutoWaves Setup .....               | 45 |
| Data Type .....                     | 45 |
| Automatic or Windows Updates .....  | 46 |
| Data Processing Import Modify ..... | 46 |
| Output Files – Save Data To .....   | 47 |
| Save Plots .....                    | 48 |
| Export .....                        | 48 |
| paramater File name.....            | 49 |
| Run.....                            | 49 |
| Data Processing .....               | 50 |



|                    |    |
|--------------------|----|
| Config File .....  | 51 |
| PLOT Options ..... | 51 |
| IP.....            | 51 |
| PORT .....         | 51 |
| LIVE.....          | 51 |
| RATE .....         | 51 |
| BUFF_SIZE.....     | 52 |

## OVERVIEW

Rowe Technologies Inc. PyAutoWaves software is used to configure, communicate and view live and recorded data from acoustic dopplers and imaging instruments.

Supported **communication** to the doppler and imaging device for Pulse are serial (RS-232, RS-485 and RS-422). The user will connect the instrument to their computer and PyAutoWaves will establish communication with the instrument. With communication established, the user can then configure and record data from the instrument.

PyAutoWaves will allow the user to **view and record live data** from the instrument. This is typically called working with a *Direct-Reading* instrument. Reviewing the live data will allow the user to verify communication with the instrument and allow the user to validate the data. After configuring the instrument, the user can then see in real time the changes made to verify all instrument commands are set properly. When the user is satisfied with the data from the instrument, the user can then use PyAutoWaves to record the live data. The data will be recorded to binary raw file (RTB), AutoWaves MATLAB file and CSV average file. These file types are different and have their own benefits for each user. Refer to the file format sections to get more information on the file formats.

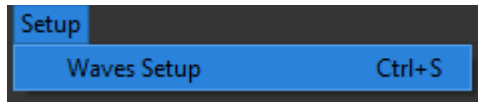
PyAutoWaves will allow the user to **configure** an instrument. Before recording data, the user may need to modify the commands to the instrument to account for the specific environment they are in. Pulse assist the user in choosing the proper options for each command in the instrument. Pulse will help the user understand the consequences for each command change which can include loss in range, increased power consumption and increased data output size.

Pulse will allow the user to **recover data** from the instrument after a deployment. Instruments that recorded data internally are typically called *Self-Contained* instruments. When a Self-Contained instrument is recovered, the data is stored within the instrument on a SD memory card. PyAutoWaves will playback the data and convert it to the correct formats.

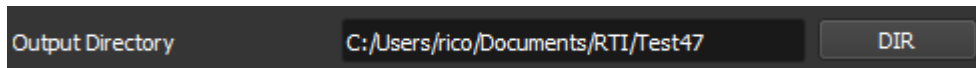
## QUICK START

- Open the application
- On the menu bar, select

Setup->Wave Setup



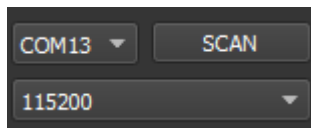
- Set the Output Directory to the location where you want the data stored.



- Close the Setup window



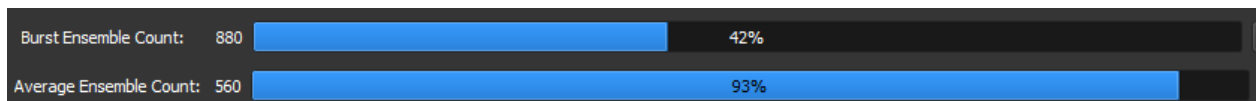
- Set the Terminal COMM port and Baud rate



- Click the Connect button



- Data will begin to stream in, and the progress bars should begin to update



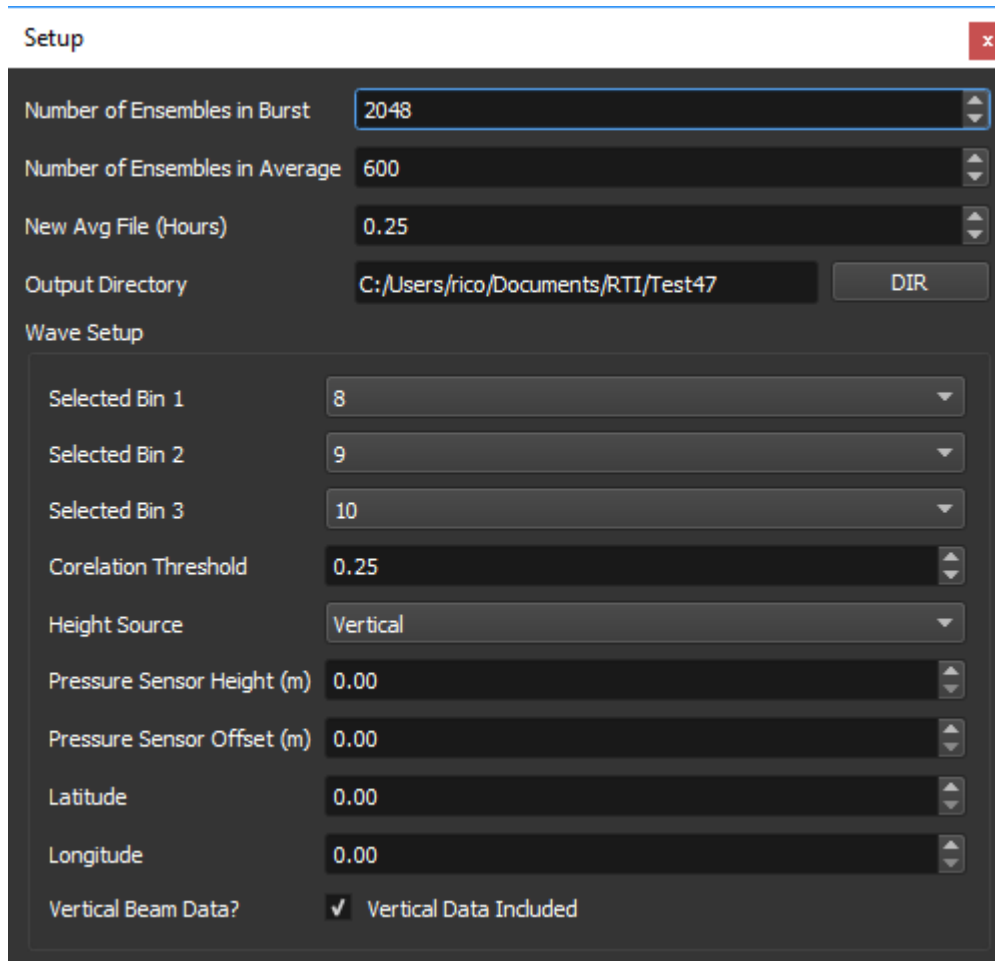
- Open any of the plots under the menu bar option Average Water

| Average Water           | Setup  |
|-------------------------|--------|
| Water Height Plot       | Ctrl+H |
| East Velocity Plot      | Ctrl+E |
| North Velocity Plot     | Ctrl+N |
| Velocity Magnitude Plot | Ctrl+N |
| Water Direction Plot    | Ctrl+N |

- Open WaveForce AutoWaves to begin monitoring the Output Directory

## WAVE SETUP


The Wave Setup window allows the user to configure the application. This will set how the data is collected and where the data is stored. Most of the settings can be changed to see live updates.



The screenshot shows the 'Setup' window with a red close button in the top right corner. The window contains several configuration fields:

- Number of Ensembles in Burst:** A numeric input field with the value 2048.
- Number of Ensembles in Average:** A numeric input field with the value 600.
- New Avg File (Hours):** A numeric input field with the value 0.25.
- Output Directory:** A text input field containing 'C:/Users/rico/Documents/RTI/Test47' and a 'DIR' button to the right.
- Wave Setup:** A section containing several sub-fields:
  - Selected Bin 1:** A dropdown menu showing '8'.
  - Selected Bin 2:** A dropdown menu showing '9'.
  - Selected Bin 3:** A dropdown menu showing '10'.
  - Corelation Threshold:** A numeric input field with the value 0.25.
  - Height Source:** A dropdown menu showing 'Vertical'.
  - Pressure Sensor Height (m):** A numeric input field with the value 0.00.
  - Pressure Sensor Offset (m):** A numeric input field with the value 0.00.
  - Latitude:** A numeric input field with the value 0.00.
  - Longitude:** A numeric input field with the value 0.00.
  - Vertical Beam Data?:** A checkbox labeled 'Vertical Data Included' which is checked.

### NUMBER OF ENSEMBLES IN BURST



This block shows a close-up of the 'Number of Ensembles in Burst' field, which is a numeric input field with the value 2048.

This option sets the number of ensembles in a burst. It is assumed the ADCP will be outputting data continuously at a minimum of 1Hz. A typical burst length should last at least 15 minutes. The user needs to determine how many ensembles is close to 15 minutes.

Default values are:

1Hz = **1024** ensembles = 17 minutes

2Hz = **2048** ensembles = 17 minutes

4Hz = **4096** ensembles = 17 minutes

Once this number is reached, a MATLAB file will be generated. This MATLAB file will then be processed by AutoWaves to generate a Waves report.

The MATLAB file will be shown in the file tree in the application. This file can be double clicked and viewed in the software.

---

*This value will count the number of pairs of ensembles, not individual ensembles. A typical SeaWAVE ADCP will come with 5 beams. This counter will assume that the 4 beam and vertical beam are interleaved in the output with the vertical beam ensemble coming after the 4 beam ensemble. So, the counter will count every vertical beam ensemble. This will make it look like the Burst count and Average count do not match.*

*If no vertical beam data is included, uncheck the checkbox "Vertical Data Included" in Setup.*

---

Default: **2048 Ensembles**

---

NUMBER OF ENSEMBLES IN AVERAGE

Rev. D



Number of Ensembles in Average 600

This option sets the number of ensembles in an average. A CSV is generated that contains an average for a period. This period is determined by the number of ensembles in this option and the data output rate. Calculating how many ensembles to use is again like the example above.

Default: **600 ensembles**

---

#### NEW AVG FILE (HOURS)

New Avg File (Hours) 0.25

This option sets how often a new CSV file should be generated in hours. The value can be a decimal number so it can be less than one hour. When this value is met, a new CSV file is created. The CSV file also has a maximum size of 16MB, so whichever is reached first.

---

#### OUTPUT DIRECTORY

Output Directory C:/Users/rico/Documents/RTI/Test47

DIR

Specify the directory where all the data will be recorded. This includes the MATLAB and average CSV file. All the plots will be saved here also. If you turn on recording the serial port, the recorded serial data will also be recorded to this directory.

When you tell WaveForce AutoWaves to monitor a folder, you want it to monitor this folder.

#### ADDITIONAL CONFIG OPTIONS

Where the Application is located, there is also an config.ini file. Within this file are additional configurations in addition to the options above.

---

#### WAVES

Rev. D



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#### 4B\_VERT\_PAIR

This option is used to determine if the data will include 4beam and vertical beam data. The data processing waits for a pair of 4 beam and vertical beam data. If there is no vertical beam data, then set this to “false” so that it will not look for the vertical beam data.

---

#### REPLACE\_PRESSURE\_WITH\_VERTICAL

If the pressure data has any issues, you can replace the pressure data with the vertical beam range track data. The pressure sensor may have not been zeroed using the CPZ command or there may be debris in the pressure sensor. So this will give an alternative for AutoWaves to use for the vertical height. This will only replace the values in the WZP in the MATLAB files. The CSV will not be affected.

---

#### AWC

Average Water Column

---

#### MAX\_FILE\_SIZE

Set the maximum file size for the CSV file. There are two ways the CSV file size is limited. One way uses this option. The other option is the CSV\_MAX\_HOURS. The description of this is above.

---

#### PLOT OPTIONS

---

##### IP

You should leave this value alone unless you need to manually set an IP address. This IP address will automatically be set when the application starts up with the computers IP address so that you do not need to figure it out.

---

##### PORT

This is the port to view the live plots on the web browser. You can change the port from default if this port is already taken on your computer.



---

## LIVE

You can turn on or off the live plotting using this value. Set it “true” to turn on live plotting. Set it to “false” to turn off live plotting. If you do not need the live plotting, or the resources on your computer are limited, you can turn it off here.

---

## RATE

This is the rate the web browser will be updated with new data. If new data is available, the plot will be updated with the latest data. The value is in milliseconds. 1000 = 1 second. You can adjust this number to see the plot update faster. If the update is too fast and it is causing the application to run slow, you can adjust this number.

---

## BUFF\_SIZE

This is the maximum number of points it will buffer before displaying the data. If you set the rate to be a very large number like 1 hour, this value will limit how many points it will buffer up to display on the screen.

---

## MAX\_POINTS

This value sets the maximum number of points that will be displayed on the plots. When the points exceed this value, the plot will then start to scroll, removing the oldest point and adding in the point.

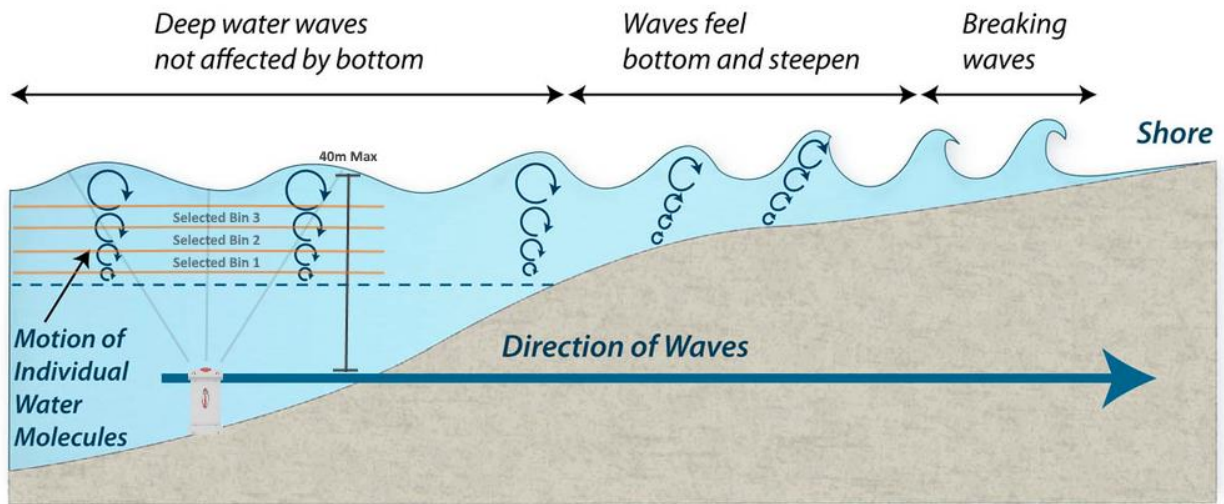
---

## WAVE SETUP

These options are specific to the generation of a Burst. These values are used to process the data and give the data context.

---

## SELECTED BINS



When selecting the beams, you want to make sure you select the beams towards the surface that will not see any bubbles and are not affected by the wind. So these bins, must be a couple meters below the surface. The selected bins will vary based off your configuration.

Ex:

If you are in 40m of water. The bin size is 1m. The first bin beings at 2m (Blank). Then you want the "Selected Bin 3" should be around 37m. So you would select bin 35  $((37m - 2m) / 1m)$ . You can set "Selected Bin 2" to 34 and "Selected Bin 1" to 33.

#### SELECTED BIN 1

Selected Bin 1

8

The first selected bin should be the bin closest to the ADCP (bottom) that is close enough to the surface to see the orbital motion of the water. The first bin should be considered the deepest bin selected and the smallest bin number.

You want to select 3 points in the wave motion. The first bin should be the bottom most portion of the bin. The second selected bin is the middle of the wave. The last bin is the top of the bin, but below the surface. The bin should not be too close to the surface, because the wind and bubbles will affect the data.

Rev. D



This bin should be within the range of the data. If you set the ADCP to have 30 bins. This value should not exceed 30.

Default: **Bin 8**

---

#### SELECTED BIN 2

The second selected bin should be the bin closest to the ADCP (bottom) that is close enough to the surface to see the orbital motion of the water. The second bin should be considered the middle bin selected and should be 1 to 3 bins larger than the first selected bin.

You want to select 3 points in the wave motion. The first bin should be the bottom most portion of the bin. The second selected bin is the middle of the wave. The last bin is the top of the bin, but below the surface. The bin should not be too close to the surface, because the wind and bubbles will affect the data.

This bin should be within the range of the data. If you set the ADCP to have 30 bins. This value should not exceed 30.

Default: **Bin 9**

---

#### SELECTED BIN 3

The third selected bin should be the bin furthest from the ADCP (bottom) that is close enough to the surface to see the orbital motion of the water. The third bin should be considered the top bin selected and should be 1 to 3 bins larger than the second selected bin.

You want to select 3 points in the wave motion. The first bin should be the bottom most portion of the bin. The second selected bin is the middle of the wave. The last bin is the top of the bin, but below the surface. The bin should not be too close to the surface, because the wind and bubbles will affect the data.

This bin should be within the range of the data. If you set the ADCP to have 30 bins. This value should not exceed 30.

Default: **Bin 10**

---

## CORRELATION THRESHOLD

Correlation Threshold 0.25

This is a screening threshold to exclude data. If the correlation value for a bin is less than this value, then mark it as bad and do not use it in any calculations. A correlation of 100% is perfect data. Realistically, you will see the correlation around 80%.

Default: **0.25**

---

## HEIGHT SOURCE

Height Source Vertical

Select the source to give the wave height, other than the pressure sensor. The user will choose between one of the beams, or the vertical beam. This will be stored with the MATLAB file.

The vertical beam is directly above the ADCP, where the other 4 beams are measured at an angle and not directly above the ADCP. But the 4 beams can be used as a backup or alternative.

Vertical  
Pressure  
Beam 0  
Beam 1  
Beam 2  
Beam 3

Default: **Vertical Beam**

---

## PRESSURE SENSOR HEIGHT

Pressure Sensor Height (m) 0.00

This will set the depth of the transducer below the surface of the water in meters. This is used to know the environmental settings of the ADCP. This value will be stored in the WHP of the MATLAB file used in the WaveForce calculations.

Default: **0.5 m**

---

#### PRESSURE SENSOR OFFSET

Pressure Sensor Offset (m) 0.00

If there is a known pressure offset, this value can be used to add to the pressure value. If no pressure data is used, this can also be used to force a pressure value. The value is in meters

Default: **0.0 m**

---

#### LATITUDE

Latitude 0.00

Latitude position in decimal degrees. This is used for reference only.

---

#### LONGITUDE

Longitude 0.00

Longitude position in decimal degrees. This is used for reference only.

---

#### VERTICAL BEAM DATA

Vertical Beam Data? ☒ Vertical Data Included

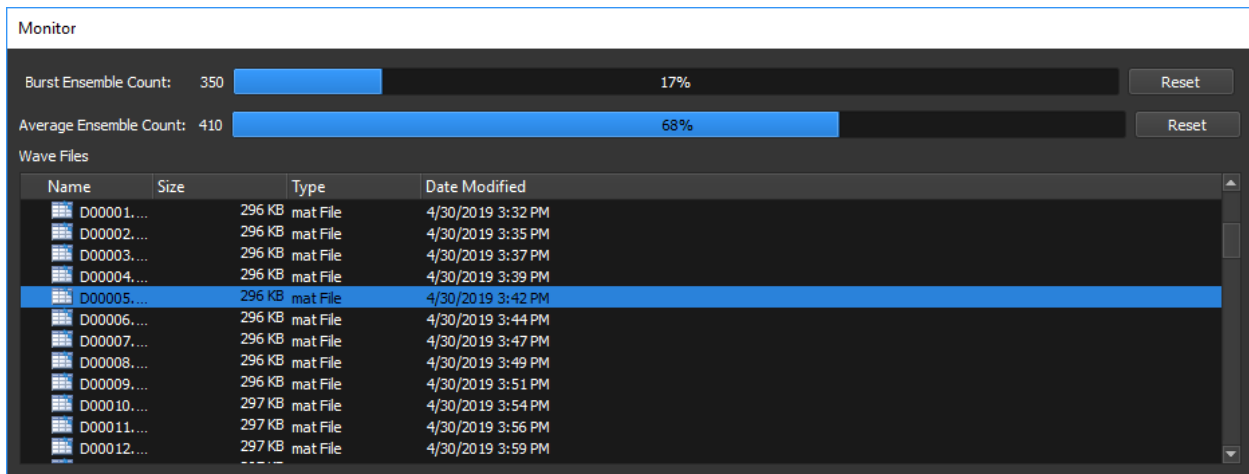
When calculating the number of ensembles to process in a burst, it is assumed that the ensembles will be received interleaved with 4 beam and vertical beam ensembles. This means that the ensembles will come in pairs. First a 4-beam ensemble, then a vertical beam ensemble. And this sequence will continue. The software counts the number of pairs. When the number of pairs is met based off the "Number of Ensembles in Burst" setup value, a burst value will be generated. But if the data is not coming as a pair, uncheck this box, so it will not look for the vertical beam. If you also notice that the burst ensembles are not progressing, uncheck this box.

Default: **Check (Vertical beam included)**

Rev. D



## MONITOR VIEW



The Monitor view monitors the progress of the file creations. There are 2 files that are generated by this software: the MATLAB burst file and the Average CSV file.

The MATLAB burst file is used to be processed with WaveForce software like Wavector and AutoWaves. This data is collection of data taken during a period of time, usually around 15-17 minutes. The WaveForce software will create a waves report based off the data within the MATLAB file.

The Average CSV file is an average of data over a period of time. The period of time is set in the SETUP section based off the number of ensembles. The data is stored in a CSV format. The CSV data will then be plotted.

The progress bars show the status of how many ensembles are remaining before a file is generated. It also gives you feedback that data is being received.

There is also a file tree to show you all the files generated in the output folder. The MATLAB files can be double clicked to view the content of the file.

This window can be moved around and resized.

## BURST ENSEMBLE COUNT



This will count the number of ensembles that are accumulated towards making a MATLAB burst file. The count is typically counting pairs of ensembles. A 4-beam ensemble and a vertical beam ensemble. The vertical beam ensemble should always be after the 4-beam ensemble to ensure the count is correct.

The reset button will clear the ensembles buffered to generate the MATLAB file and the progress bar will start over collected ensembles. This is useful if settings have changed and you do not want to keep the old data.

## AVERAGE ENSEMBLE COUNT



This will count the number of ensembles that are used to create the Average CSV file. The average will be appended to the end of the CSV file. Eventually a new CSV will be created, either after the file reaches 16MB or the “New Avg File” setting is met.

The reset button will clear the ensembles buffered to generate the CSV file and the progress bar will start over collected ensembles. This is useful if settings have changed and you do not want to keep the old data.

## WAVE FILES

| Wave Files |        |          |                   |
|------------|--------|----------|-------------------|
| Name       | Size   | Type     | Date Modified     |
| D00000.... | 296 KB | mat File | 4/30/2019 3:30 PM |
| D00001.... | 296 KB | mat File | 4/30/2019 3:32 PM |
| D00002.... | 296 KB | mat File | 4/30/2019 3:35 PM |
| D00003.... | 296 KB | mat File | 4/30/2019 3:37 PM |
| D00004.... | 296 KB | mat File | 4/30/2019 3:39 PM |
| D00005.... | 296 KB | mat File | 4/30/2019 3:42 PM |
| D00006.... | 296 KB | mat File | 4/30/2019 3:44 PM |
| D00007.... | 296 KB | mat File | 4/30/2019 3:47 PM |
| D00008.... | 296 KB | mat File | 4/30/2019 3:49 PM |
| D00009.... | 296 KB | mat File | 4/30/2019 3:51 PM |
| D00010.... | 297 KB | mat File | 4/30/2019 3:54 PM |
| D00011.... | 297 KB | mat File | 4/30/2019 3:56 PM |
| D00012.... | 297 KB | mat File | 4/30/2019 3:59 PM |
| D00013.... | 297 KB | mat File | 4/30/2019 4:01 PM |
| D00014.... | 297 KB | mat File | 4/30/2019 4:04 PM |

A file tree will display all the files in the output directory. This will allow the user to monitor that files are being generated for each burst and average. Also, when AutoWaves generates a file, the data will be seen in this window.

The burst MAT files can be double clicked. When double clicked, a window will appear displaying all the data in the MAT file. The user can then review the results of the burst.



WAVES BURST FILE VIEWER

Waves Data: C:/Users/rico/Documents/RTI/Test48/D00000.mat

C:/Users/rico/Documents/RTI/Test48/D00000.mat  
04/25/2019 13:36:08.810000, Record No. 0, SN01300000000000000000000000000000453  
Time Between Ensembles (sec): 0.43  
Time of First Ensemble: 2019-04-25 13:36:07  
Latitude: 0.0  
Longitude: 0.0  
Pressure Sensor Height (m): 0.0

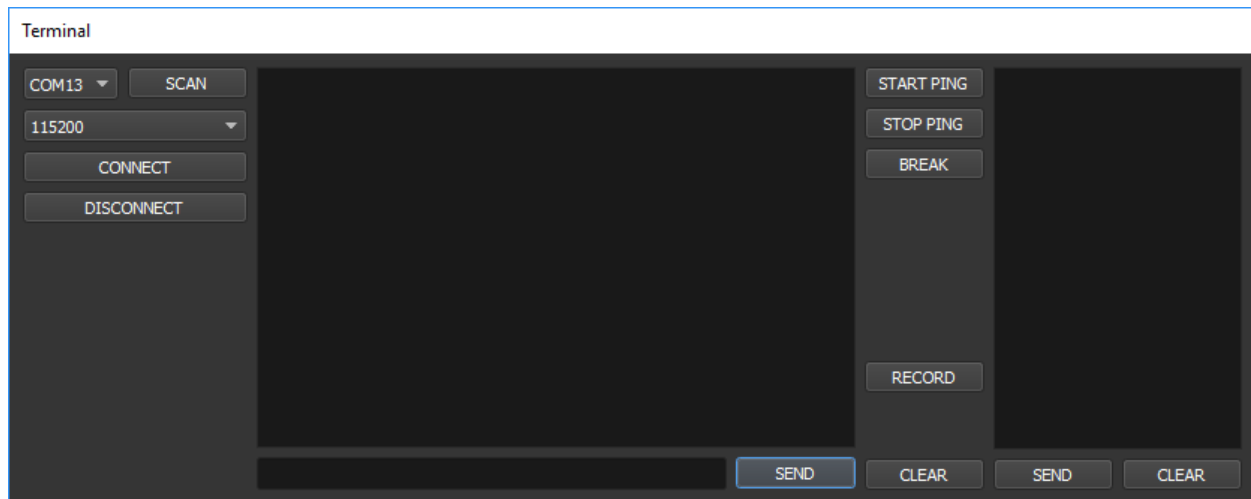
TextSelected Bin DepthRangeAverage RangeSelected RangeWater TempBeam Velocity Be

wr0, wr1, wr2, wr3, wrz

|    | Beam 0 | Beam 1 | Beam 2 | Beam 3 | Vertical Beam |
|----|--------|--------|--------|--------|---------------|
| 1  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 2  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 3  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 4  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 5  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 6  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 7  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 8  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 9  | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 10 | -1.0   | -1.0   | -1.0   | -1.0   |               |
| 11 | -1.0   | -1.0   | -1.0   | -1.0   |               |

This viewer allows the user to view the burst. The user can review the date and time the file was generated. The user can review all the values for the burst. The ranges and velocities are included in the data.

## TERMINAL



The terminal allows the user to connect to the ADCP through the serial port. It allows the user to configure the ADCP and see data output. It allows the user to record the raw serial data.

---

### SERIAL COMM PORT

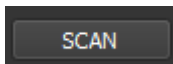
Set the serial port COMM port.



---

### SCAN BUTTON

This button will scan for any available COMM ports on the user's computer.



---

### SERIAL BAUD RATE

Set the serial baud rate.



Rev. D

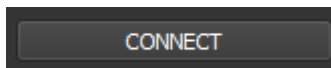
---

## SERIAL CONNECT BUTTON

Once the serial port options are selected. Click the Connect button to make a serial connection to the ADCP. Once a connection is made, if the ADCP is configured to output data, then you will start to see data output in the terminal. If you do not see any data, click the BREAK button to wakeup the ADCP and see a wakeup banner. If you see the wakeup banner, you can then configure the ADCP and click the START PING button to begin outputting data. If you see garbage output when you click the BREAK button, then your baud rate is most likely incorrect. Review the link to set your serial port correctly.

[http://rowetechinc.co/wiki/index.php?title=ADCP\\_Communication](http://rowetechinc.co/wiki/index.php?title=ADCP_Communication)

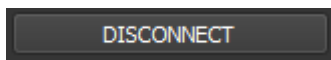
[http://rowetechinc.co/wiki/index.php?title=ADCP\\_Quickstart](http://rowetechinc.co/wiki/index.php?title=ADCP_Quickstart)



---

## DISCONNECT BUTTON

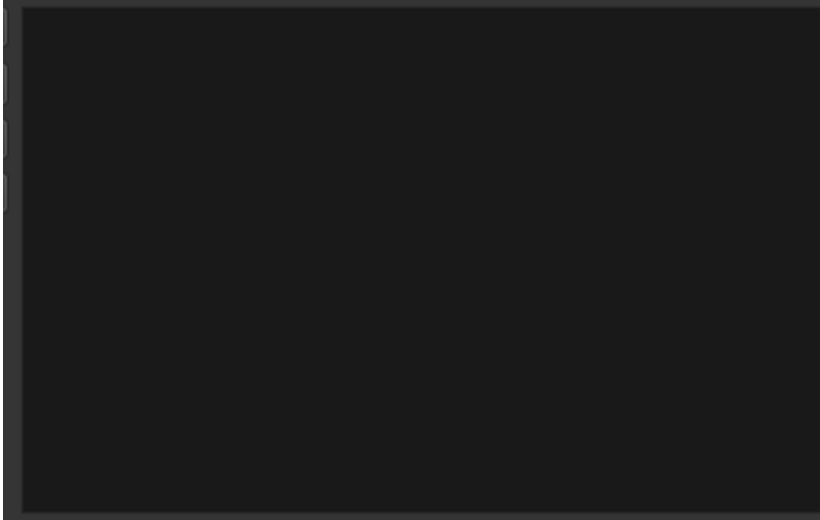
Disconnect the serial port. This used to disconnect the serial port freeing it so other applications can use the serial port.



---

## ADCP OUTPUT

As data is received, you will see characters displayed in the terminal. The characters are not human readable unless the ADCP is set to DVL, ASCII or a special mode.



---

#### ADCP INPUT

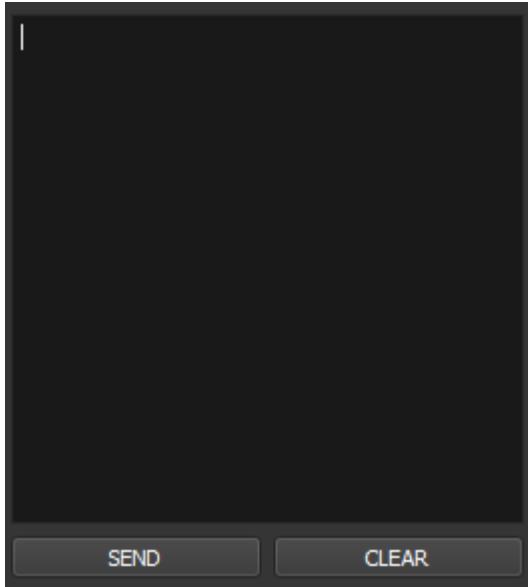
This textbox allows the user to enter in a command to send to the ADCP. The textbox will remember passed commands. Once the command is entered into the textbox, press the SEND button to send it to the ADCP.



---

#### ADDITIONAL COMMANDS

This will allow the user to load a file of additional commands. It will also allow the user to reuse a set of commands.



## ADCP BUTTONS

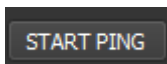
These buttons are common commands sent to the ADCP. They include starting and stopping pinging, sending a BREAK and a CSHOW.



---

### START PING BUTTON

This button will send the command to the ADCP set the current time to the ADCP and to start pinging. The current time is sent to so the ADCP has a date and time. Then the START command is sent to start pinging.



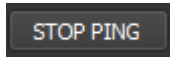
---

### STOP PING BUTTON

Rev. D



This button will send the command to the ADCP to stop pinging.

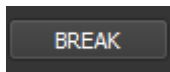


---

#### BREAK BUTTON

This button will send a BREAK to the ADCP. The BREAK is used to wakeup the ADCP. The ADCP will output a banner message when the BREAK is received.

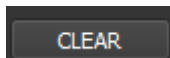
First a hard BREAK is sent to the ADCP. A hard BREAK is a hardware BREAK. If no banner is received from the ADCP, a soft BREAK is sent to the ADCP. A soft BREAK is a software BREAK where the command BREAK is sent. If neither of these commands wakeup the ADCP, then most likely there is an issue with the connection to the ADCP.



---

#### CLEAR BUTTON

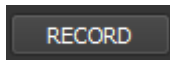
This button will clear the ADCP serial output display.



---

#### RECORD BUTTON

This button allows the user to record the raw serial data. This is useful for post processing the data. The raw data can be played back with the settings changed to generate new Burst MAT files and Average CSV files.



## PLAYBACK

Playback is used to reprocess the raw data. It is also used to generate any plots.

Select all the RAW RTB (Rowe Tech Binary) ensemble files you would like to include in the processing. The files can be burst files or continuous files. Once the files have been selected, the processing will begin automatically.

| File     | Average Water | Setup  |
|----------|---------------|--------|
| Playback |               | Ctrl+P |
| Exit     |               | Ctrl+Q |

## PLOTS

| Average Water           | Setup  |
|-------------------------|--------|
| Water Height Plot       | Ctrl+H |
| East Velocity Plot      | Ctrl+E |
| North Velocity Plot     | Ctrl+N |
| Velocity Magnitude Plot | Ctrl+N |
| Water Direction Plot    | Ctrl+N |

### WATER HEIGHT PLOT

The height data is based off the height source chosen when the MATLAB file was created. It was either one of the 4 beams or the vertical beam. The plot's data is generated by the latest CSV Average data.

### EAST VELOCITY PLOT

Plot the east velocity values for the selected bins. These values are found from the Earth Velocity data in the binary data. The velocities are plotted for each sample at the selected bin. The plot's data is generated by the latest CSV Average data.

### NORTH VELOCITY PLOT

Plot the north velocity values for the selected bins. These values are found from the Earth Velocity data in the binary data. The velocities are plotted for each sample at the selected bin. The plot's data is generated by the latest CSV Average data.

### VELOCITY MAGNITUDE PLOT

Plot the East/North magnitude for each selected bin. The plot's data is generated by the latest CSV Average data.



## WATER DIRECTION PLOT

Plot the East/North direction for each selected bin. The plot's data is generated by the latest CSV Average data.

## BURST MATLAB FILE FORMAT

This will give a description of all the variables in the MATLAB file format. Each MATLAB file will be a collection of ensembles called a burst. The number of ensembles within the burst is based off the CBI command. There will be 3 selected bins to collect the data from each sample (ensemble).

### TXT

This will give a text description of the burst. This will include the record number, the serial number and the date and time the burst started.

**Data Type:** Text

**Rows:** 1

**Columns:** Text Length

txt = 2013/07/30 21:00:00.00, Record No. 7, SN013B0000000000000000000000000000

### LAT

The latitude location where the burst was collected.

**Data Type:** Double

**Rows:** 1

**Columns:** 1

lat = 32.865

### LON

The longitude location where the burst was collected.

**Data Type:** Double

**Rows:** 1

**Columns:** 1

lon = -117.26

### WFT

First sample time of the burst. The value is in hours of a day.  $WFT * 24 = \text{hours}$ .

**Data Type:** Double

**Rows:** 1

**Columns:** 1

wft = 7.3545e+05

### WDT

Time between each sample. The time is in seconds.

**Data Type:** Floating Point

**Rows:** 1

**Columns:** 3

wdt = 0.50000

WHP

Pressure sensor height in meters.

**Data Type:** Floating Point

**Rows:** 1

**Columns:** 3

whp = 0.65000

WHV

Wave cell depth in meters. This is the wave height for each selected bin.

**Data Type:** Floating Point

**Rows:** 1

**Columns:** 3

whv =

1.1501 2.1501 2.6501

WUS

East velocity values for each selected bin. The values are in meters per second.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns:** 3

wus =

4.1217e-01 -5.3776e-01 -1.1071e+00  
4.2764e-01 -8.8026e-01 -1.6288e+00  
6.0827e-01 1.0991e-01 -2.0296e-01  
...

WVS

North velocity values for each selected bin. The values are in meters per second.

**Data Type:** Floating Point

**Rows:** Number of Samples

Rev. D



**Columns: 3**

WVS =

|             |            |             |
|-------------|------------|-------------|
| -6.5988e-02 | 9.4322e-01 | -1.1511e+00 |
| 1.4117e-01  | 4.4475e-01 | 5.6886e-01  |
| 7.5457e-01  | 4.9238e-02 | 1.4024e-01  |

...

WZS

Vertical velocity values for each selected bin. The values are in meters per second.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns: 3**

WZS =

|             |             |             |
|-------------|-------------|-------------|
| -5.1074e-01 | -2.2284e-01 | 7.4548e-02  |
| 3.7416e-02  | 9.5439e-04  | -2.1598e-01 |
| 1.5141e-01  | -1.2996e-01 | -9.9256e-03 |

...

WB0

Beam 0 beam velocity values for each selected bin. The values are in meters per second.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns: 3**

wb0 =

|             |             |             |
|-------------|-------------|-------------|
| 1.0128e+00  | -1.2829e-01 | 7.5696e-04  |
| 3.6575e-02  | -6.1568e-01 | -4.6019e-01 |
| -1.1937e-01 | 9.9974e-02  | 1.4221e-01  |

...

WB1

Beam 1 beam velocity values for each selected bin. The values are in meters per second.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns: 3**

wb1 =

|             |            |             |
|-------------|------------|-------------|
| 8.2430e-01  | 6.1270e-01 | -1.2160e-01 |
| -7.7283e-02 | 6.0340e-04 | 8.8888e+01  |
| 4.6664e-03  | 8.4763e-02 | 3.0490e-01  |

...

Rev. D



## WB2

Beam 2 beam velocity values for each selected bin. The values are in meters per second.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns:** 3

wb2 =

|            |            |             |
|------------|------------|-------------|
| 1.6416e-01 | 7.9276e-02 | -5.0224e-01 |
| 8.9448e-02 | 6.6506e-02 | -1.0250e-01 |
| 1.0159e-02 | 1.8974e-01 | -2.5725e-01 |
| ...        |            |             |

## WB3

Beam 3 beam velocity values for each selected bin. The values are in meters per second.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns:** 3

wb3 =

|             |             |             |
|-------------|-------------|-------------|
| 8.8888e+01  | -5.1399e-02 | 5.8452e-01  |
| -1.9667e-01 | 3.3825e-01  | 5.0058e-01  |
| -6.3540e-01 | 1.0748e-01  | -2.1207e-01 |
| ...         |             |             |

## WZ0

Vertical beam velocity values for each selected bin. The values are in meters per second.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns:** 3

wz0 =

|             |             |             |
|-------------|-------------|-------------|
| -5.6031e-01 | -3.3704e-01 | -5.7669e-01 |
| 8.8888e+01  | -8.8736e-03 | 2.0687e-01  |
| -9.9038e-01 | -5.8064e-01 | 8.8888e+01  |
| ...         |             |             |

## WHG

The heading value in degrees for each sample.

**Data Type:** Floating Point

**Rows:** Number of Samples

Rev. D



**Columns: 1**

whg =

320.35  
320.40  
320.67  
...

WPH

The pitch value in degrees for each sample.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns: 1**

wph =

-4.1934  
-4.1980  
-4.1989  
...

WRL

The roll value in degrees for each sample.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns: 1**

wrl =

1.9210  
1.9278  
1.9021  
...

WPS

The pressure value in meters for each sample.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns: 1**

wps =

5.9431  
5.9438  
5.9442  
...

Rev. D



## WTS

The water temperature value in degrees Fahrenheit for each sample.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns:** 1

WTS =

17.004

17.004

17.004

...

## WHS

The wave height based off the wave height source selected. This can be any of the 4 beams or the vertical beam's value.

**Data Type:** Floating Point

**Rows:** Number of Samples

**Columns:** 1

WHS =

5.2956

5.3744

5.4217

...

## AVERAGE CSV FORMAT

The CSV data is represented so that it is easily viewed and graphed in Excel using Pivot tables.

The CSV data has the following column format:

```
["datetime", "data_type", "ss_code", "ss_config", "bin_num", "beam_num", "blank", "bin_size", "value"]  
2019/02/23 15:23:22.56, EARTH_VEL, 4, 1, 2, 2, 7.5, 1.245
```

## DATA TYPE

The data\_type column will state the type of data the row represents.

The following data\_type options are available:

| Date Type Name       | Desc   |
|----------------------|--|
| <b>Amp</b>           | Amplitude data                                   |
| <b>Corr</b>          | Correlation Data                                 |
| <b>BeamVel</b>       | Beam Velocity data                               |
| <b>InstrVel</b>      | Instrument Velocity data                         |
| <b>EarthVel</b>      | Earth Velocity data                              |
| <b>GoodBeam</b>      | Good Beam data (number of ensembles in average)  |
| <b>GoodEarth</b>     | Good Earth data (number of ensembles in average) |
| <b>Pressure</b>      | Pressure data (bar)                              |
| <b>XdcrDepth</b>     | Transducer Depth (Pressure data in meters)       |
| <b>Heading</b>       | Heading data                                     |
| <b>Pitch</b>         | Pitch data                                       |
| <b>Roll</b>          | Roll data  |
| <b>WaterTemp</b>     | Water Temperature data                           |
| <b>SysTemp</b>       | System Temperature data                          |
| <b>SpeedOfSound</b>  | Speed of Sound data                              |
| <b>FirstPingTime</b> | First Ping Time                                  |
| <b>LastPingTime</b>  | Last Ping Time                                   |

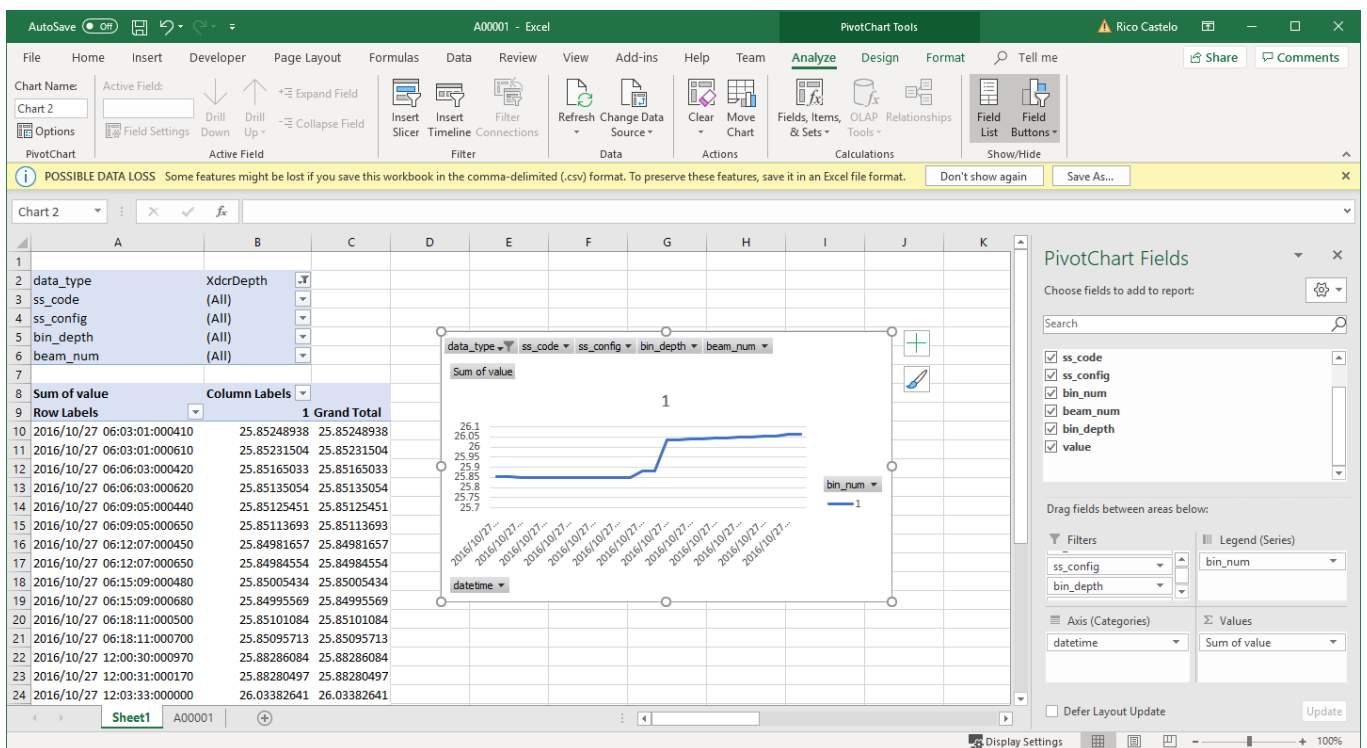


|                     |   |
|---------------------|---|
| <b>Status</b>       | System Status   |
| <b>RT</b>           | Range Tracking Range  |
| <b>BT_Heading</b>   | Bottom Track Heading  |
| <b>BT_PITCH</b>     | Bottom Track Pitch  |
| <b>BT_ROLL</b>      | Bottom Track Roll   |
| <b>BT_PRESSURE</b>  | Bottom Track Pressure   |
| <b>BT_XdcrDepth</b> | Bottom Track Transducer Depth                                 |
| <b>BT_Status</b>    | Bottom Track Status (Searching for Bottom status)             |
| <b>BT_Range</b>     | Bottom Track Range  |
| <b>BT_BeamVel</b>   | Bottom Track Beam Velocity                                    |
| <b>BT_BeamGood</b>  | Bottom Track Beams Good (number of ensembles in average)      |
| <b>BT_InstrVel</b>  | Bottom Track Instrument Velocity                              |
| <b>BT_InstrGood</b> | Bottom Track Instrument Good (number of ensembles in average) |
| <b>BT_EarthVel</b>  | Bottom Track Earth Velocity                                   |
| <b>BT_EarthGood</b> | Bottom Track Earth Good (number of ensembles in average)      |
| <b>RT_Range</b>     | Range Tracking (Range to surface)                             |
| <b>RT_Pings</b>     | Range Tracking Ping   |
| <b>RT_BeamVel</b>   | Range Tracking Beam Velocity                                  |
| <b>RT_InstrVel</b>  | Range Tracking Instrument Velocity                            |
| <b>RT_EarthVel</b>  | Range Tracking Earth Velocity                                 |
| <b>GPS_Heading</b>  | GPS Heading   |
| <b>GPS_VTG</b>      | GPS Speed of Vessel   |
| <b>NMEA</b>         | NMEA String   |
| <b>Voltage</b>      | System Voltage  |
| <b>Magnitude</b>    | Water Velocity Magnitude                                      |
| <b>Direction</b>    | Water Direction   |

## EXCEL PIVOT TABLES

Use the following options in the image below to generate plots in Excel using Pivot Tables. The user can then select which bins or subsystems quickly.

- Open the CSV file in Excel
- Click Insert->Pivot Table in the Menu
- Use the images below to select the correct options to view the data in the pivot table
- Select Insert->Chart to plot the data



Rev. D



## PivotChart Fields ▼ ✕

Choose fields to add to report: ⚙️ ▼

Search 🔍

- ☒ ss\_code ▲
- ☒ ss\_config
- ☒ bin\_num
- ☒ beam\_num
- ☒ bin\_depth
- ☒ value ▼

---

Drag fields between areas below:

|   |  |
|---|--|
| <p><b>🔿 Filters</b></p> <div>ss_config ▼ <span>▲</span></div> <div>bin_depth ▼ <span>▼</span></div> | <p><b>📊 Legend (Series)</b></p> <div>bin_num ▼</div> |
| <p><b>📏 Axis (Categories)</b></p> <div>datetime ▼</div>   | <p><b>Σ Values</b></p> <div>Sum of value ▼</div>     |

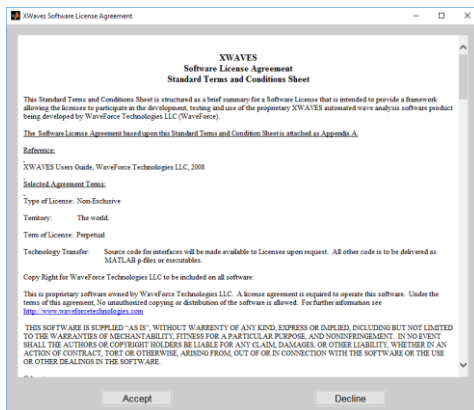
☐ Defer Layout Update Update

Rev. D

## WAVEFORCE AUTOWAVES

Ensure the WaveForce dongle is installed in the USB port. Open AutoWaves. It can sometimes take a couple of minutes for AutoWaves to load. Click Accept for the License. Then click Modify in the AutoWaves application.

Modify



Rev. D



## AUTOWAVES SETUP

**XWaves - AutoWaves - Initialization Table**

**Input Data**

Parameter Set Name: DEFAULT

Data Type: Rowe Tech Inc

☒ Automatic Update: 0.1 Interval (h)

☐ Windows Service Updates

XWaves Data File: [Browse]

NetCDF Data File: [Browse]

**Data Processing**

Import: Rowe Tech Inc Default

☐ Select Multiple Stations: 0 Selected

☐ Wave Systems: Disabled

☐ Spectral Fit: Disabled

☒ Sea State: Default

☒ Display Waitbars

☐ Error Log Option

**Output Files**

☒ Save Data (.mat) To: C:\Users\rico\Documents\RTI\Test47\autowaves.mat

Save Data Options: Single Continuous File

☒ Save Plots: 43 Selected

☐ Export Wizard: Disabled

Save Export Wizard To: [Please Select a File]

☐ Save 2D Spectra To: [Please Select a File]

☐ Save Spectral Coeff. To: [Please Select a File]

☐ Single Record per Spectral Coefficient Text File

Save BlueFat Table To: [Please Select a File]

Path to Ship Heading File: [Please Select a File]

☐ Save Wave Height Recurrence Table To: [Please Select a File]

☐ Save Wind Speed Recurrence Table To: [Please Select a File]

**EXPORT** **EXIT**

## DATA TYPE

**Data Type** Rowe Tech Inc

Data Type = Rowe Tech Inc.

Rev. D



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## AUTOMATIC OR WINDOWS UPDATES

|   |                                  |                     |
|---|----------------------------------|---------------------|
| <input checked="" type="checkbox"/> <b>Automatic Update</b> | <input type="text" value="0.1"/> | <b>Interval (h)</b> |
| <input type="checkbox"/> <b>Windows Service Updates</b>     |                                  |                     |

Select which option you want to look for updates in the folder containing the MATLAB Waves bursts. Automatic will check periodically based off the time given.

Windows Service Updates will use Windows to tell the application when an update has occurred in the folder.

---

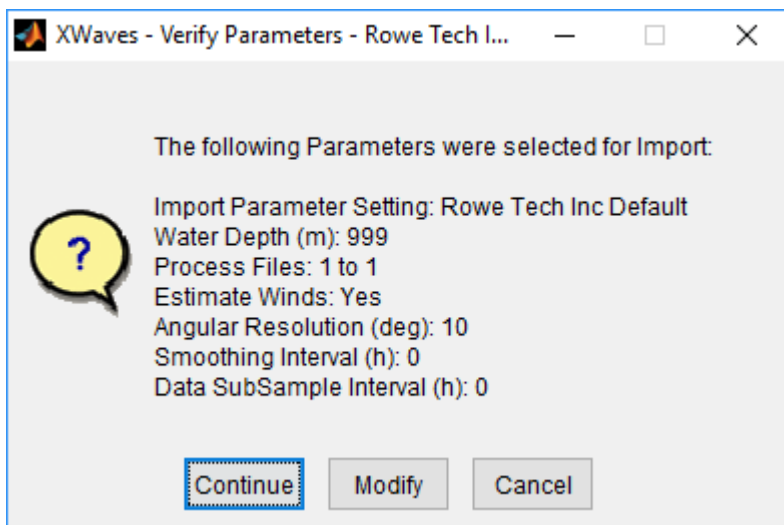
## DATA PROCESSING IMPORT MODIFY

If you want to process data already collected, you can click on the Modify button and select the files you want to reprocess.

|                        |                                       |
|------------------------|---------------------------------------|
| <b>Data Processing</b> |                                       |
| Import:                | Rowe Tech Inc Default                 |
|                        | <input type="button" value="Modify"/> |

---

## MODIFY DATA PROCESSING



Click the Modify button to modify the settings for data processing.

## IMPORT PARAMETERS

**Rowe Tech Inc** ?

**Parameter Set Name** Rowe Tech Inc Default Delete

**Estimate Winds** Yes - Select Wind File - Select

**Water Depth (m)** 999

**First File to Process** D00000.mat Select

**Last File to Process** D00241.mat Select Process All

**Angle Bins** 36 **Computed Resolution: 10 Degrees**

**Smoothing Interval (h)** 0

**Data SubSample Interval (h)** 0

SELECT CANCEL

Select the First file to begin processing. The Last File will automatically be entered in. You can modify this value, if the last few files have bad data when the ADCP was taken out of the water.

## OUTPUT FILES – SAVE DATA TO

Rev. D



|   |  |               |
|---|--|---------------|
| <input checked="" type="checkbox"/> <b>Save Data (.mat) To:</b> | C:\Users\rico\Documents\RTI\Test47\autowaves.mat | <b>Browse</b> |
| <b>Save Data Options:</b>                                       | Single Continuous File                           |               |

Click Browse and select the folder to save the data to from AutoWaves. Give the file a name. A suggested name is autowaves.mat

## SAVE PLOTS

|  |             |               |
|--|-------------|---------------|
| <input checked="" type="checkbox"/> <b>Save Plots:</b> | 43 Selected | <b>Modify</b> |
|--|-------------|---------------|

Click the “Saves Plots” checkbox then click the Modify button and select all the plots you want generated for the waves report.

**Plot Selection Table**

| Input Data  | Wave System | Climatology  | Spectral Fits | Sea State   |
|---|-------------|--|---------------|---|
| <input checked="" type="checkbox"/> Data Summary            |             | <input checked="" type="checkbox"/> Climatology Table                  |               | <input checked="" type="checkbox"/> Wave Peaks - PoT          |
| <input checked="" type="checkbox"/> Wind Speed              |             | <input checked="" type="checkbox"/> Wind Rose                          |               | <input checked="" type="checkbox"/> Wave Peaks - Annual Max   |
| <input checked="" type="checkbox"/> Wind Direction          |             | <input checked="" type="checkbox"/> Wave Height Rose                   |               | <input checked="" type="checkbox"/> Wind Peaks - PoT          |
| <input checked="" type="checkbox"/> Significant Wave Height |             | <input checked="" type="checkbox"/> Wind Scatter                       |               | <input checked="" type="checkbox"/> Wind Peaks - Annual Max   |
| <input checked="" type="checkbox"/> Peak Period             |             | <input checked="" type="checkbox"/> Height Period Scatter              |               | <input checked="" type="checkbox"/> Wave Recurrence - GPD     |
| <input checked="" type="checkbox"/> Mean Period (Tz)        |             | <input checked="" type="checkbox"/> Period Direction Scatter           |               | <input checked="" type="checkbox"/> Wave Recurrence - GEV     |
| <input checked="" type="checkbox"/> Friction Velocity       |             | <input checked="" type="checkbox"/> Height Direction Scatter           |               | <input checked="" type="checkbox"/> Wave Recurrence - Gumbel  |
| <input checked="" type="checkbox"/> Peak Direction          |             | <input checked="" type="checkbox"/> Height Period Direction 3D Scatter |               | <input checked="" type="checkbox"/> Wave Recurrence - Weibull |
| <input checked="" type="checkbox"/> Spectrogram             |             | <input checked="" type="checkbox"/> Wind Speed Histogram               |               | <input checked="" type="checkbox"/> Wave Recurrence - All     |
| <input checked="" type="checkbox"/> Frequency Spectrum      |             | <input checked="" type="checkbox"/> Wind Direction Histogram           |               | <input checked="" type="checkbox"/> Wind Recurrence - GPD     |
| <input checked="" type="checkbox"/> Direction Spectrum      |             | <input checked="" type="checkbox"/> Wave Height Histogram              |               | <input checked="" type="checkbox"/> Wind Recurrence - GEV     |
| <input checked="" type="checkbox"/> Contour 2D Spectrum     |             | <input checked="" type="checkbox"/> Wave Period Histogram              |               | <input checked="" type="checkbox"/> Wind Recurrence - Gumbel  |
| <input checked="" type="checkbox"/> Polar 2D Spectrum       |             | <input checked="" type="checkbox"/> Wave Direction Histogram           |               | <input checked="" type="checkbox"/> Wind Recurrence - Weibull |
| <input checked="" type="checkbox"/> Cartesian 2D Spectrum   |             |  |               | <input checked="" type="checkbox"/> Wind Recurrence - All     |
| <input checked="" type="checkbox"/> Wind Vectors            |             |  |               | <input checked="" type="checkbox"/> Hs-Tp Scatter - Bul       |

**Select All** **Clear All**

**Save Plots To Folder:** C:\Users\rico\Documents\RTI\Test47\ **Browse**

**Plot File Format:** Portable Network Graphics (.png)

**Frequency Axis Scaling:** Log

**SAVE** **CANCEL**

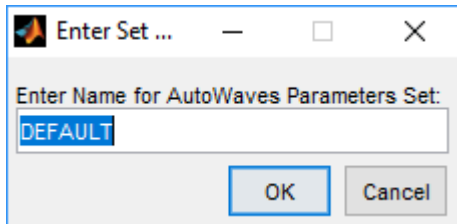
## EXPORT

Click the Export button the finish

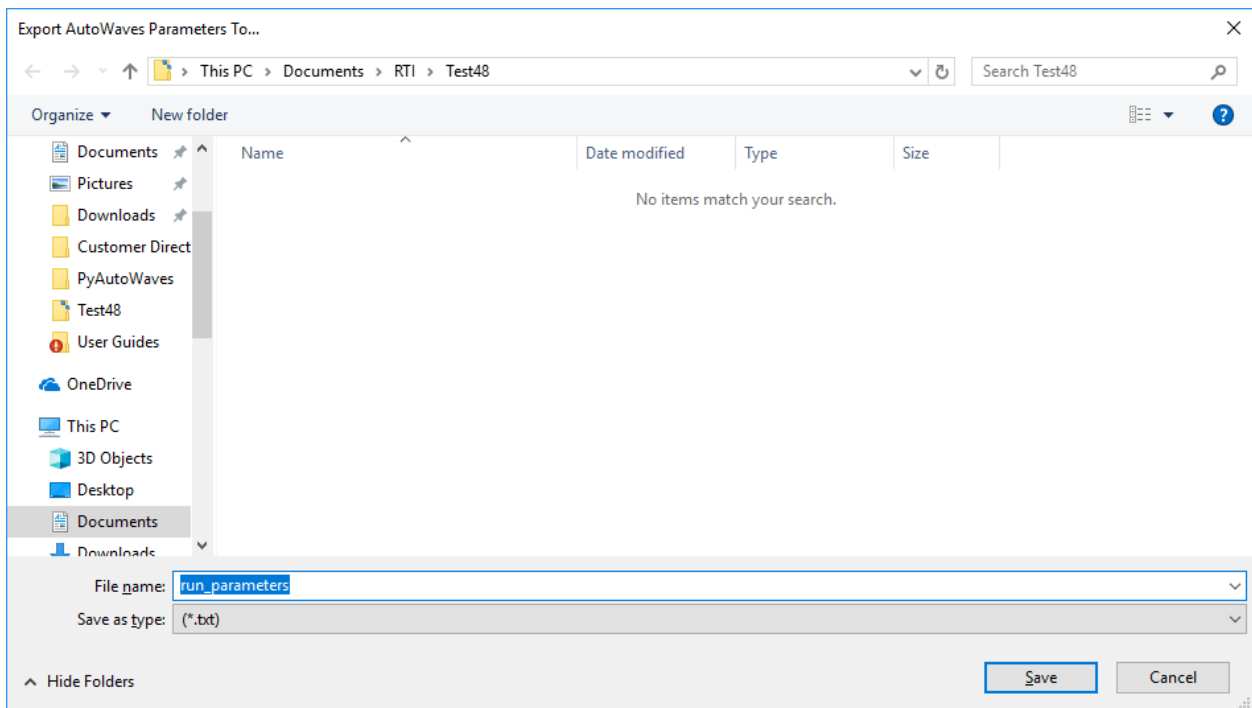


EXPORT

#### PARAMETER FILE NAME



A window will pop up and ask for a parameter file name. You can use the default name. Click OK then Save.



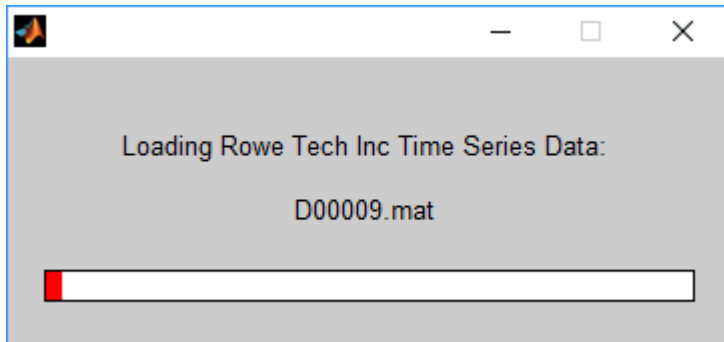
#### RUN

Rev. D



After all the settings have been modified, click the RUN button to begin monitoring for changes in the files in the output directory.

#### DATA PROCESSING



Data processing will then begin and display a progress bar. When all the initial files have completed processing, the waves report and plots will be generated in the folder. Then the folder will be monitored for any additional files added to the folder.

## CONFIG FILE

### PLOT OPTIONS

These are the options related to the live plotting of data to the web browsers.

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#### IP

IP Address to display the live plot. You can set this to “localhost” to view only on your computer. When the application first starts, if this value is not present, it will populate the value with the IP address of your computer.

DEFAULT = localhost

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#### PORT

TCP Port to display the live plots in the web browser. You will need give permissions when the application is first run to this allow this application to use the port.

DEFAULT = 5001

---

#### LIVE

Turn on or off live plotting. If you are averaging a small amount data, 100 or less, then you should turn off live plotting. It takes at most about 20 seconds to update the plot. So a small amount of data averaged will mean the live plot will be updated to often. If set false, the web browser will not be opened.

DEFAULT = TRUE

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#### RATE

Set the number of milliseconds, how often the live plot should be updated. If you set the time to a large number, the live plot will not be updated as often.

DEFAULT = 250 milliseconds

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#### **BUFF\_SIZE**

When doing live plotting, this will include the maximum plots that are included in the plot. There needs to be a limit to how many points the live plot can hold to prevent a memory leak.

DEFAULT = 1000