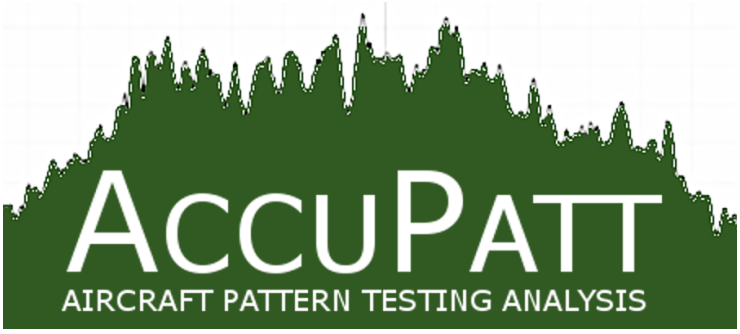
AccuPatt Software User Guide

For Operation S.A.F.E. Fly-Ins

Version 1.06



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1 Introduction

This manual serves as documentation for the software application "AccuPatt," an implementation of various tools to aid in the processing and interpretation of data collected through aircraft spray pattern testing. The program's outputs serve solely as quantitative guidance for analysts in assisting aerial applicators with spray system calibration, and should not be treated as actual deposition measurements unless otherwise noted.

2 Compatible Hardware

AccuPatt may be used to characterize aircraft spray patterns in two ways. Fluorescent dye deposition on string may be measured relatively through the use of a compatible string drive and spectrometer setup. A flatbed scanner may be used as an additional tool to measure droplet stains on water sensitive paper.

2.1 String Analysis Hardware

A suitable hardware setup to perform string analysis must include both a serially controlled stepper motor for for advancing the string as well as an Ocean Optics USB2000+ spectrometer or suitable substitute. The stepper motor drive system must also include a method for maintaining constant speed of the advancing string. For the spectrometer, an excitation light source of appropriate wavelength must also be incorporated for fluorescence analysis of the deposited dye on the string. WRK of Oklahoma produces the only commercial unit which meets these specifications and which has been tested to meet performance expectations.

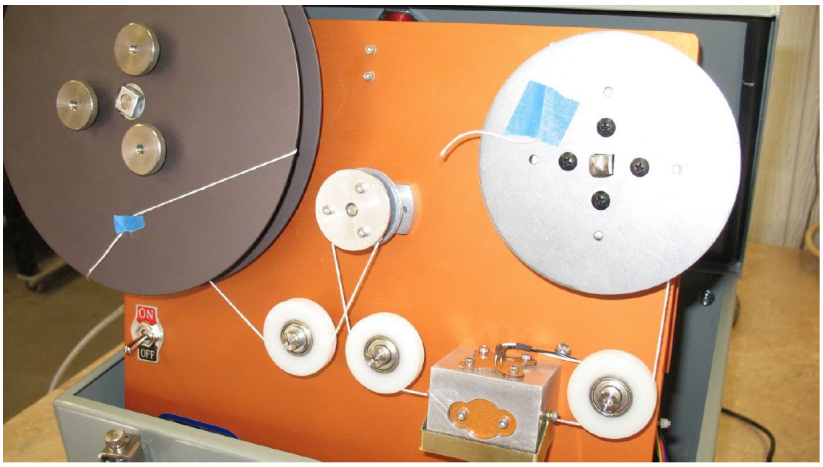


Figure 1: WRK String Spectrometer

2.2 Droplet Analysis Hardware

Scanning of water sensitive cards requires the use of a commercially available flatbed scanner. While any scanner with at least 600dpi resolution should work, only one model has currently been tested for full compatibility: the Epson Perfection V500 Photo scanner.

3 Install

Requirements for running this program are limited to the successful completion of the steps below. While this program is designed to run cross-platform, this guide is geared toward Microsoft Windows users. A version for OS X is available upon request, but is limited to opening and viewing previously generated data files. A fully functioning version for OS X would require the purchase of the Mac compatible spectrometer driver software from Ocean Optics.

3.1 Install Application

Double-click the provided install file and follow the prompts to complete installation. This will automatically place the necessary files onto your C-drive under either *Program Files* or *Program Files (x86)* for 64-bit machines. The install process will place the application in the Start menu applications list, but a desktop shortcut can also be created for ease of access.

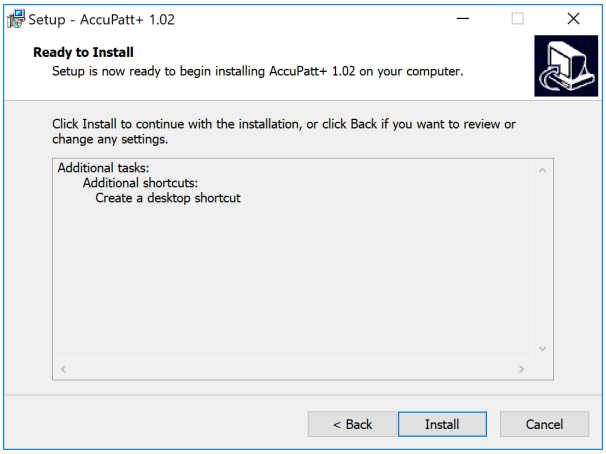
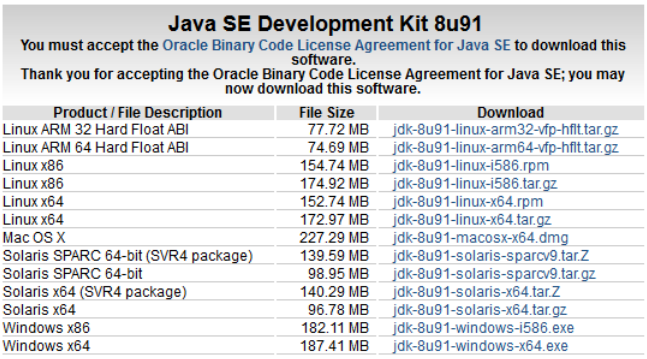


Figure 2: Install Application

3.2 Install JDK

The JDK (Java Developers Kit) is required to run the program and unilize the associated packages. Open a web browser and navigate to the following url:

http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html
Accept the license agreement and download the JDK (Java Developers Kit) for your system. *Note: Select the "Windows x64" link for 64-bit machines or "Windows x86" link for 32-bit machines.* (Figure 3) Run the installer and follow the wizard.



Java SE Development Kit 8u91

You must accept the Oracle Binary Code License Agreement for Java SE to download this software.
Thank you for accepting the Oracle Binary Code License Agreement for Java SE; you may now download this software.

Product / File Description	File Size	Download
Linux ARM 32 Hard Float ABI	77.72 MB	jdk-8u91-linux-arm32-vfp-hflt.tar.gz
Linux ARM 64 Hard Float ABI	74.69 MB	jdk-8u91-linux-arm64-vfp-hflt.tar.gz
Linux x86	154.74 MB	jdk-8u91-linux-i586.rpm
Linux x86	174.92 MB	jdk-8u91-linux-i586.tar.gz
Linux x64	152.74 MB	jdk-8u91-linux-x64.rpm
Linux x64	172.97 MB	jdk-8u91-linux-x64.tar.gz
Mac OS X	227.29 MB	jdk-8u91-macosx-x64.dmg
Solaris SPARC 64-bit (SVR4 package)	139.59 MB	jdk-8u91-solaris-sparcv9.tar.Z
Solaris SPARC 64-bit	98.95 MB	jdk-8u91-solaris-sparcv9.tar.gz
Solaris x64 (SVR4 package)	140.29 MB	jdk-8u91-solaris-x64.tar.Z
Solaris x64	96.78 MB	jdk-8u91-solaris-x64.tar.gz
Windows x86	182.11 MB	jdk-8u91-windows-i586.exe
Windows x64	187.41 MB	jdk-8u91-windows-x64.exe

Figure 3: Install JDK

3.3 Install OmniDriver

OmniDriver is the Spectrometer communication software required by the program. Open a web browser and navigate to the following url:
http://oceanoptics.com/support/software-downloads/#omnidriver
Download the applicable OmniDriver software for your system and follow the wizard. (Figure 4)

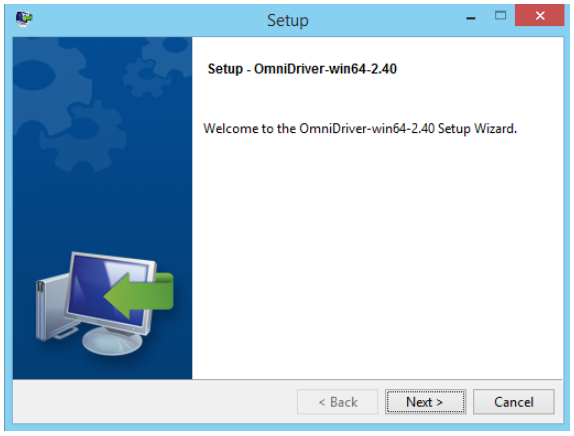


Figure 4: Install OmniDriver

4 Settings

The first thing to familiarize yourself with should be the various parameters which may be set and adjusted to fit your particular use of the software. Navigate through the menu bar to *Settings* → *Settings*. The Settings window (Figure 5) has several distinct sections listed below. Default values are provided for most options which represent typical use of the system, and can be set by clicking the *Restore Defaults* button at the bottom of the window.

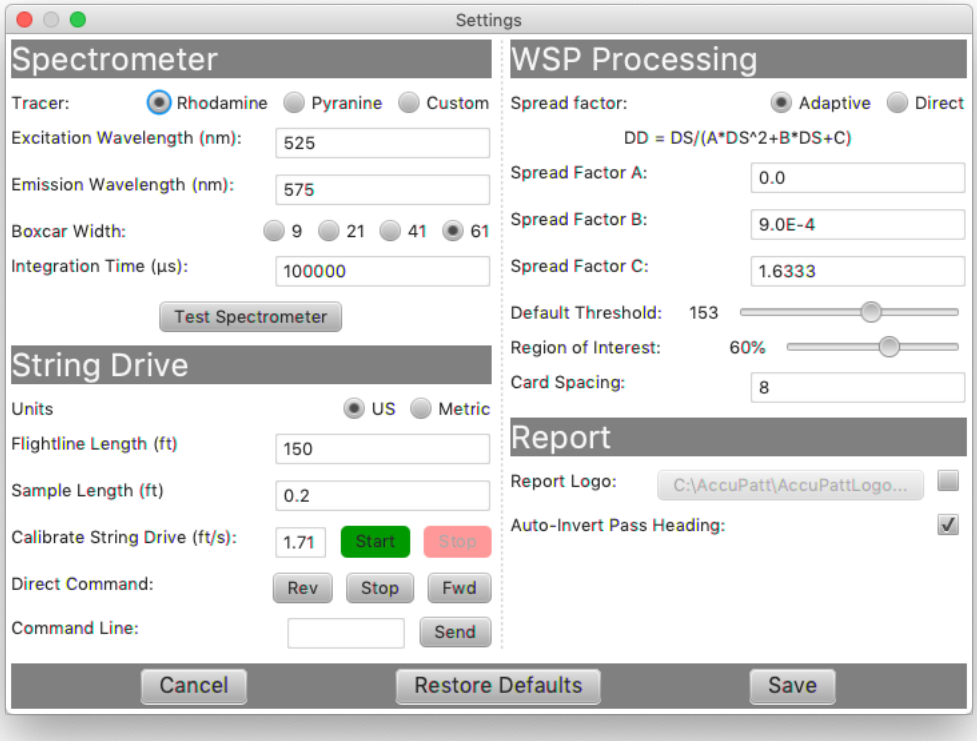


Figure 5: Settings

4.1 Spectrometer Settings

Note: Special care must be taken when adjusting spectrometer attributes. Unintended results such as false readings or program unresponsiveness may occur.

1. Tracer: Sets the excitation and emission wavelengths to correspond with chosen tracer.

2. Excitation Wavelength: Desired sample excitation wavelength in nanometers. This will be based on the LED and Band-Pass filter used in your system.

3. Emission Wavelength: Desired sample emission wavelength in nanometers. Selection of *Custom* will allow modification of all other spectrometer settings.

4. Boxcar Width: Size of averaging window (in number of pixels) around the target wavelength. A larger number corresponds to increased spectral scanning width.

5. Integration Time: Period of integration used for each sample point in microseconds. Should not be less than 85 percent of the time required for one sample length to pass through the mirror block. A larger number corresponds to increased sensitivity.

6. Test Spectrometer: Opens a new window with an animated plot of light intensity by wavelength. This can be used to ensure your spectrometer is operating as desired.

4.2 String Drive Settings

1. Units: US units correspond with length in feet, wind velocity in miles per hour, pressure in pounds per square inch, temperature in Fahrenheit, flow rate in gallons per minute and application rate in gallons per acre. Metric units correspond with length in meters, wind velocity in kilometers per hour, pressure in pounds per square inch, temperature in Centigrade, flow rate in liters per minute and application rate in liters per hectare.

2. Flightline Length: Length (ft,m) of string to be analyzed.

3. Sample Length: Length (ft,m) of desired sample section. An error will occur if (*Flightline Length*)/(*Sample Length*) is not an integer, as this will be the total number of sample points per analysis.

4. Calibrate String Drive: Velocity (ft/s,m/s) of string through mirror block during analysis. To perform a calibration, first ensure that the proper flightline length is entered corresponding to the section of string you are using. Next, align the green mark just past the light block, click START. Monitor the string passing through, then click STOP once the red mark

passes through the light block. The velocity is then calculated based on flightline length and elapsed time. Once a velocity has been established, any flightline length may be used without re-calibration.

5. Direct Command: Manually control the string drive system using the Reverse, Stop and Forward Buttons.

6. Command Line: Send custom commands to the stepper motor drivers using the Send button and text field. See "String Drive Customization" for commands. Upon manually changing any attribute of the stepper motors, perform a string calibration to ensure velocity is accurate.

4.3 WSP Processing

Note: The Water Sensitive Paper (WSP) scanning and processing feature is only enabled on AccuPatt+ versions.

1. Spread Factor: Select either the *Adaptive* or *Direct* calculation of droplet diameters. These use the diameter of the stain (DS) to compute the diameter of the droplet (DD) which created the stain. The equation chosen will appear on generated reports using the coefficients listed (Spread Factors A, B and C).

2. Threshold: Select an 8-bit value (0-255) to establish a maximum threshold for distinguishing between droplet stains and unstained WSP area. During processing, a threshold is automatically established for each card scanned, but this setting establishes the upper limit of that auto-threshold. In other words, a value will be automatically chosen for each region of interest, but if that value is greater than this setting value, then this settings value will be used instead.

3. Region of Interest (ROI): Range of 1%-100%. This sets the percentage of the total area of an individual piece of WSP that is desired for processing. A larger number (closer to 100) corresponds to a larger sample area. The user can always modify the area during processing, but this setting establishes the initial automatic sizing.

4. Card Spacing: Must be a positive integer. Simply the distance between WSP collectors.

4.4 Report Settings

1. Report Logo: Enable to include a custom image on generated reports. Click the button with the current logo file name to navigate and select a new custom logo.

2. Auto Invert Pass Heading: Enable to automatically rotate the entered pass headings by 180 degrees. This is to account for traditional flightline collection protocol. If unsure, leave enabled.

5 Running a Series

5.1 New Series

Once your settings are chosen, load a string onto the system. (Note: If string length calibration has not been performed for the current hardware/software combination, refer to the "Settings" section to complete calibration.)
If the string is from an aircraft that has not already been analyzed, navigate to *New Series* → *New Aircraft*. (Figure 6)

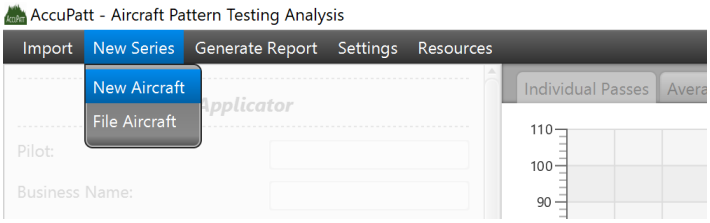


Figure 6: New Series - New Aircraft

5.2 Import Aircraft

If the string to be analyzed is from an aircraft which has previously been run; the Applicator, Aircraft and Nozzle information can be imported for convenience. Navigate to *New Series* → *File Aircraft*. (Figure 7) A file browser window will open. Double-Click the desired file to import the contained information.

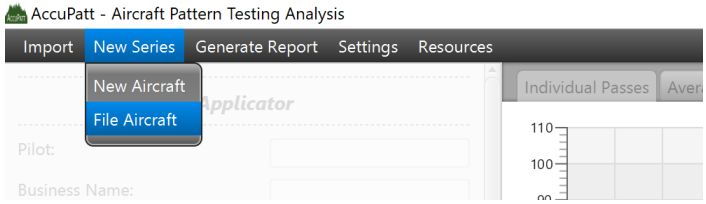


Figure 7: New Series - Existing Aircraft

5.3 Input Aircraft/Series Information

5.3.1 Applicator Info

Alphanumeric text entered in this section is saved into the data file for reporting and will not otherwise be used by the program. It is acceptable to leave these fields blank. (Figure 8)

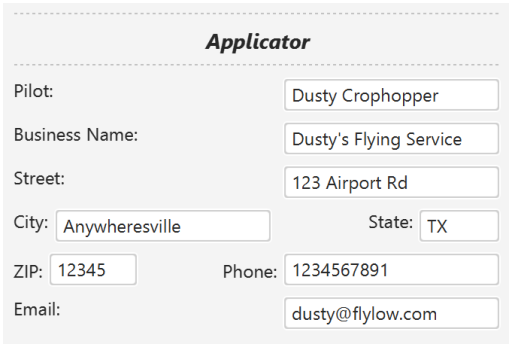


Figure 8: Applicator Info

5.3.2 Aircraft Info

The registration and series number fields are required. Registration number can be any combination of numbers and/or letters. The series number field requires a numeric value. Aircraft Make/Model drop-down boxes contain data from the Excel Workbook *AgAircraftData.xlsx*. Custom Make/Model information may be typed into the drop-down boxes. (Figure 9)

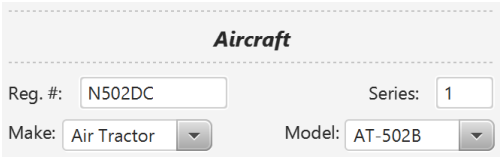


Figure 9: Aircraft Info

5.3.3 Nozzle Info

Use the drop-down box to select the nozzle type first. Available size and deflection angle values for the chosen nozzle will then populate the respective drop-down boxes. Nozzle information is stored in the Excel Workbook *NozzleModels.xlsx*. Custom Nozzle type, size and deflection may be typed into the drop-down boxes. (Figure 10)

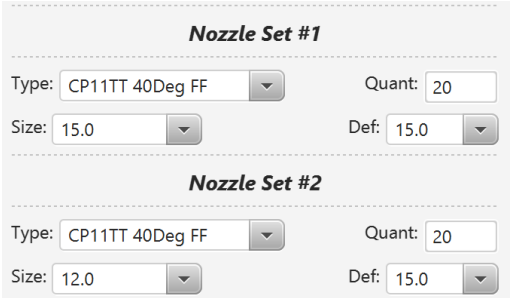


Figure 10: Nozzle Info

Nozzle choices will affect resultant model calculations for VMD, % less than 100, etc. which appear on the generated report.

5.3.4 Output Info

Data entered here must be numeric. Boom pressure is used in the USDA Atomization models. Target Rate is saved into the data file for reporting and will not otherwise be used by the program. Target Swath is used to construct the overlap plots and %CV calculations. (Figure 11)

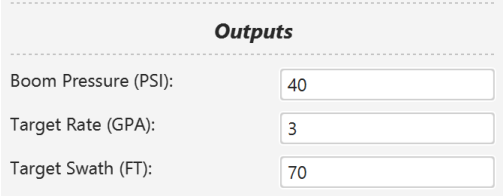


Figure 11: Output Info

5.3.5 Series Data

Data entered here must be numeric. Data may only be entered in checked columns. Un-checking a pass will exclude it from analysis. Airspeed and Cross-Wind Velocity are calculated from this data and are used in conjunction with other entered series data to run the USDA atomization models. (Figure 12)

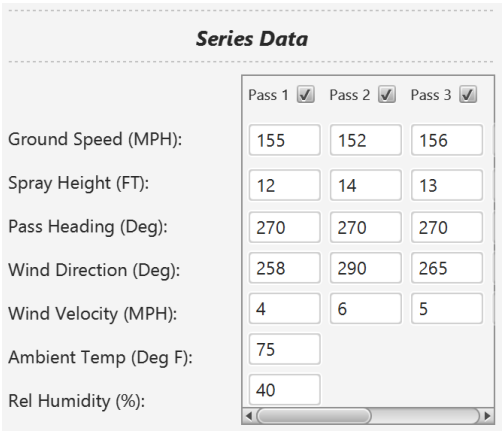


Figure 12: Series Data

5.3.6 Extra Info

Alphanumeric text entered here is saved into the data file for reporting and will not otherwise be used by the program. It is acceptable to leave these fields blank. (Figure 13)

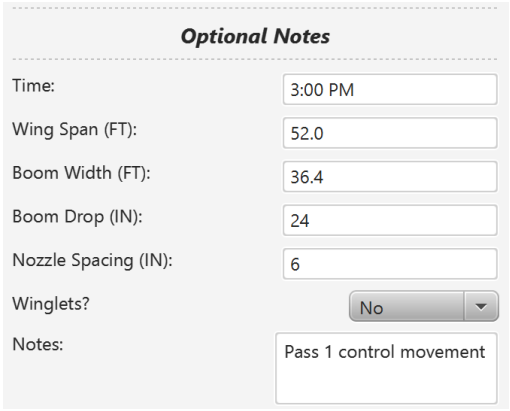


Figure 13: Extra Info

5.3.7 Create Data File

Once all relevant series information is entered, click the green *Save and Proceed* button at the bottom of the data entry window. (Figure 14) A save window will appear asking where you would like to save the data file. Choose a location and rename the file if desired, then click Save. The file just created contains all entered series data and is also where pattern data is saved after each pass is

analyzed.

Figure 14: Click to create Data File

5.4 Reading the String

Once the analysis screen is active, the program is ready to run a string. The "Pass Number" Choice Box at the bottom of the *Individual Passes* tab represents the section of string which will be run. Use the arrows to toggle which pass to analyze next. Only passes which were checked in the previous step will be available (Figure 15). With the string threaded through the light block and attached to the take-up spool, click the Green START button to begin advancing the string. (Figure 15)

Figure 15: Select Pass to Run

The same button will then read MARK. Once the green mark passes through the light block, click MARK. (Figure 16)

Figure 16: Starting the analysis

The upper plot will begin to populate fluorescence data, and will stop when the calibrated length of string has been analyzed.
To abort the analysis and stop the string drive system click the red STOP button. This will dump all current pass data from memory. The pass may be restarted as normal using the previously mentioned procedure. While the string is not being read, manual advancing and reversing of string can be accomplished with the appropriately labeled buttons at the bottom left of the *Individual Passes* tab.

5.5 Individual Pass Plots

Following the completion of each pass analysis, the pattern is "re-zeroed" based on the lowest acquired point, filtered for smoothness and replotted below the

original. The ends of the plot may be trimmed (generally to remove from analysis sections of string contaminated by red/green marker residue) by using the "Horizontal Trim" selector at the bottom of the screen (Figure 17). The filtered plot will rescale to exclude the chosen number of points on each side of the plot.

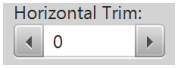


Figure 17: Trimming the Ends of a Pass

The individual pass pattern may also be vertically "trimmed" to remove perceived background noise using the vertical slider on the right side of the lower plot window. Dragging the slide upward will show a black box on the plot (Figure 18) which represents the undesired portion of the pattern. The new "zero" line will be the top of the black box.

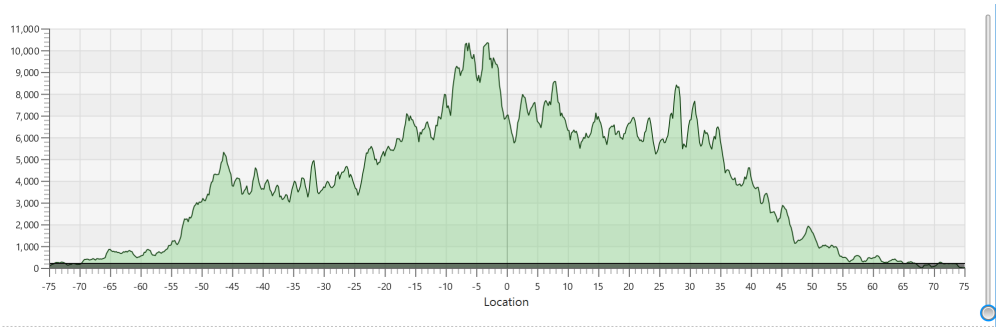


Figure 18: Vertical trimming of a pass

5.6 Overlay and Average Plots

The *Average* tab has two plots on it (Figure 19). The upper plot is an overlay of all the selected passes. The lower plot is a point by point arithmetic average of the overlay plot. The dashed vertical lines on the average plot correspond to the desired swath width, while the dashed horizontal line represents the half average value of all data points within the desired swath width.

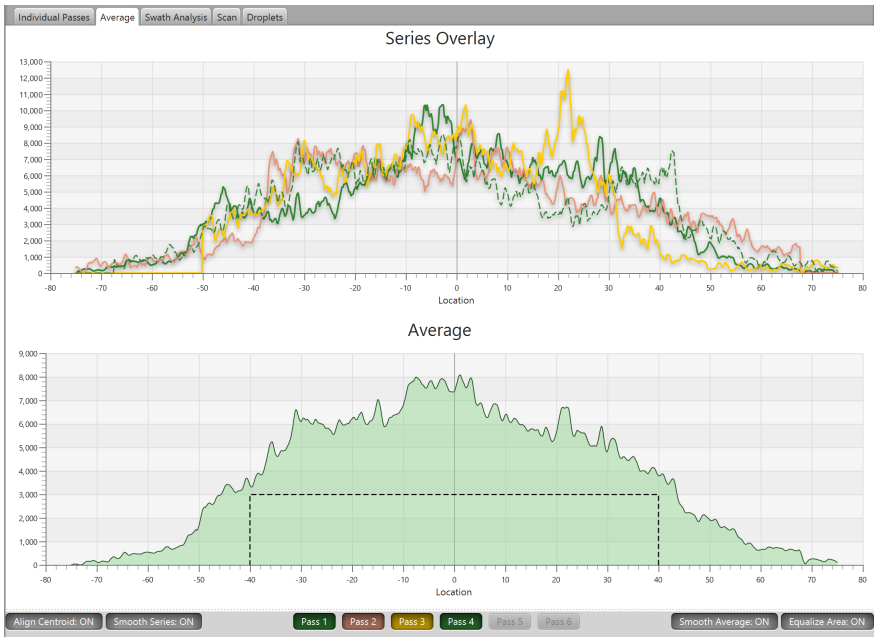


Figure 19: Average Tab

The controls at the bottom of the page operate as follows:

1. Pass Buttons: Turn on/off individual pass contributions to the average.
2. Align Centroid: Finds the center of mass of each individual pass and shifts the pattern horizontally such that the centroid is located at the zero mark.
3. Smooth Passes: Turn on/off a smoothing filter (4th Order, 50 point, Savitsky-Golay) applied to each individual pass to improve interpretability. The smoothed passes will be used to compute the average pattern.
4. Smooth Average: Turn on/off an additional smoothing filter applied to the average pattern.
5. Equalize Area: Turn on/off scaling of passes for proper weight in average pattern. Takes pass with the highest sum of data points and scales other passes point by point so that their integrated areas are equal.

5.7 Swath Analysis

The *Swath Analysis* tab contains two plots (Figure 20). Both plots simulate overlapping the measured pattern at intervals of the desired swath width. The upper plot simulates use of a racetrack pattern and the lower plot simulates use of a back and forth pattern. To simulate the back and forth pattern, adjacent

passes are horizontally inverted about the center point of the pattern in an alternating fashion. The simulation can be done with no overlapping passes (leaving all buttons at the bottom of the tab unchecked), 3 overlapping passes (L1/R1 checked) or 5 overlapping passes (L1/R1 and L2/R2 checked). The plotted area shows the additive contribution of all selected overlapping passes to the central swath width of the central pattern. The summation of all overlapped passes represents theoretical uniformity in the field and is used to compute the Coefficient of Variation (CV). The dashed horizontal line represents the average relative deposition about which standard deviations are computed for the CV calculations. In other words, the further each additive overlap point is from the average, the more it contributes to the overall CV.

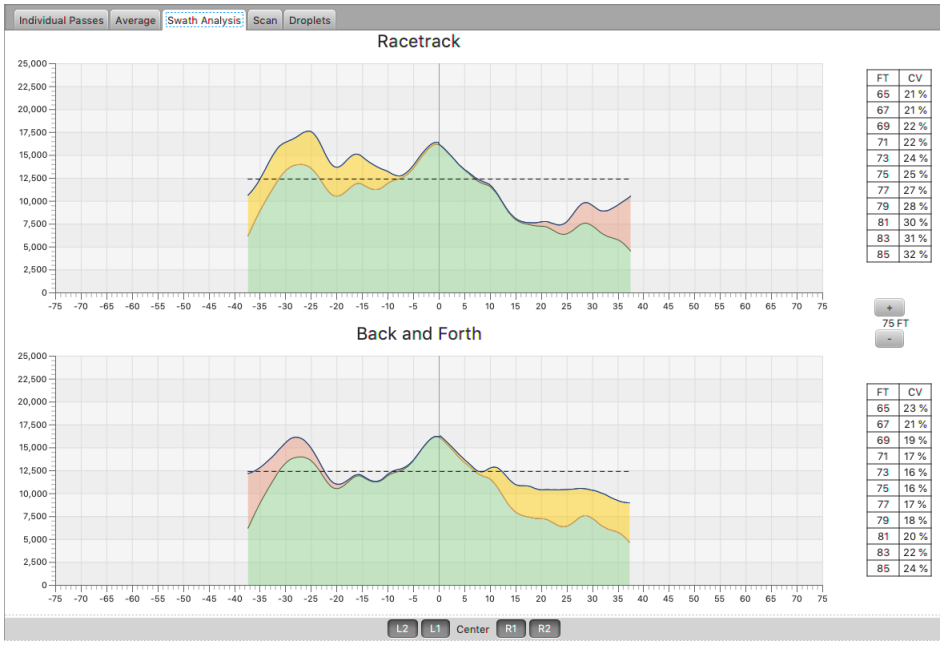


Figure 20: Swath Analysis Tab

The *Swath Analysis* tab also has controls on the right hand side which may be used to Increase/Decrease the desired swath width (and thereby resultant plots).

5.8 Scanning WSP Cards

The *Scan* tab contains controls for initiating WSP (card) scanning and stain processing (Figure 23). Up to 9 cards may be used. To initiate a scan, follow the steps outlined below.

1. Place the cards face down on the scanner and arrange them such that the leftmost card is at the highest position and the rightmost card is at the

lowest position. For example, if 7 cards are to be used with 8-foot spacing, L-24 (the 3rd card left of center) will be at the highest point and R-24 (the 3rd card right of center) will be at the lowest point. This is typically accomplished via a "stair-step" method as shown in (Figure 21).

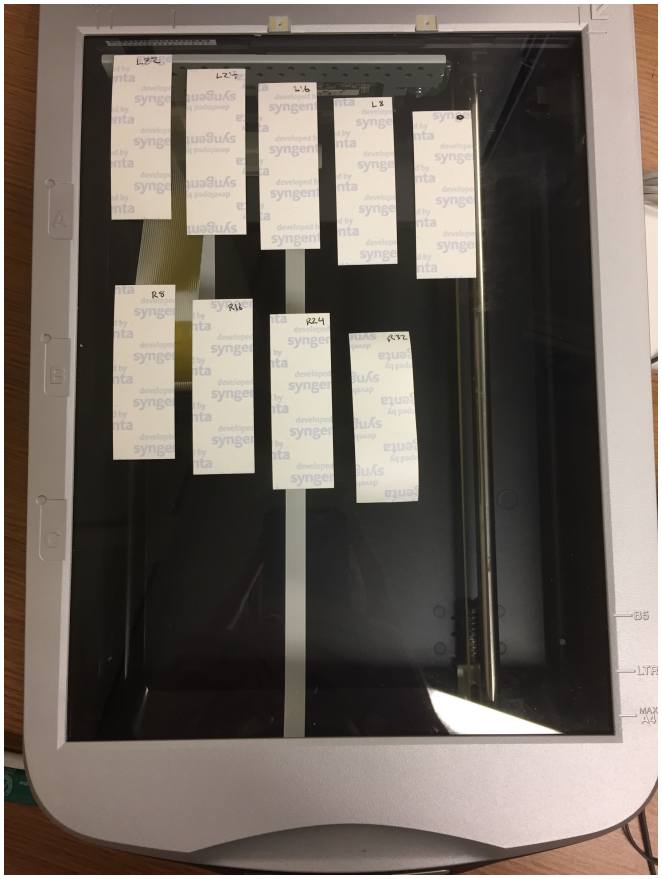


Figure 21: "Stair-Stepping" cards for vertical acquisition

2. Next, click the *Preview Scan* button in the lower left corner. This will first check to see if a scanner is connected and prompt you to do so if one is not. A low resolution scan will then be done to locate cards and preview the areas which are to be used for analysis (Figure 22). The black box outlines represent boundaries for processing, outside which no data will be used. These boxes may be dragged for repositioning (i.e. to avoid defects such as fingerprints) and they may be resized by dragging corners or edges. See the *Settings* section for how to change automatic sizing of regions of interest (ROIs).

3. Once ROIs have been established, leave the preview window open and

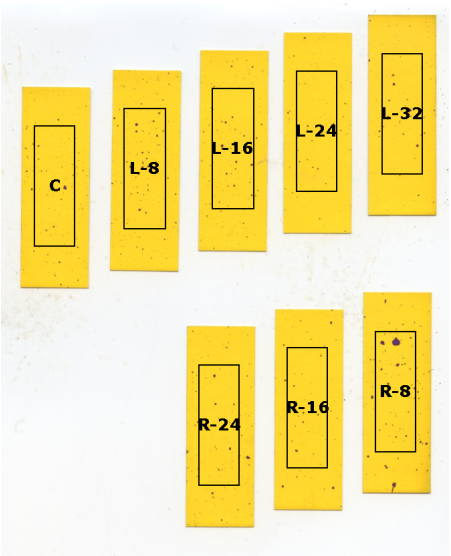


Figure 22: Result from Preview Scan

navigate back to the *Scan* tab and click *Full Scan*. This will initiate a high resolution scan and subsequently crop out the ROIs you selected and process them individually. If the number of cards detected is not equal to the number of cards you have selected to include in analysis (Bottom right of *Scan* tab) a warning will pop up asking you to remedy the situation before moving forward.

4. Upon scan completion, card images and relevant information will appear on-screen (Figure 23). The location of each card is displayed above each image.

5. This is a good point to do some quality control. Underneath the normal image of the card is a thresholded binary image showing in blue what the software interprets to be droplet stains (Figure 24). Above that image is an indicator of what threshold is used. The thresholded images can be useful in identifying if your threshold needs adjustment or if the cards you are attempting to process may be overly moisture contaminated. You may choose to adjust the threshold at this point using the [-] or [+] buttons. The composite calculations are based on all cards included in analysis. Any card may be excluded from the composite calculations by clicking its respective green button in the bottom right of the tab. For example, in (Figure 23) the card "L-8" has been taken out of the composite calculations.

6. The software does some further processing automatically. Droplets which are touching the edge of the ROI (stains in red) are treated specially.

Their stain area is counted toward the percent coverage calculation, but they do not get included in any droplet spectrum calculations (e.g. VMD, RS, etc.). This is because we cannot know the full stain size. Another piece of processing involves a "Watershedding" algorithm which attempts to separate adjoining stains to provide more accurate droplet spectrum information. The culmination of this processing can be seen if you click on the thresholded image for a card. A new image window will pop up with a mask on the original scanned image (Figure 25). The mask shows outlines traced around each droplet which will be used for droplet spectrum analysis.

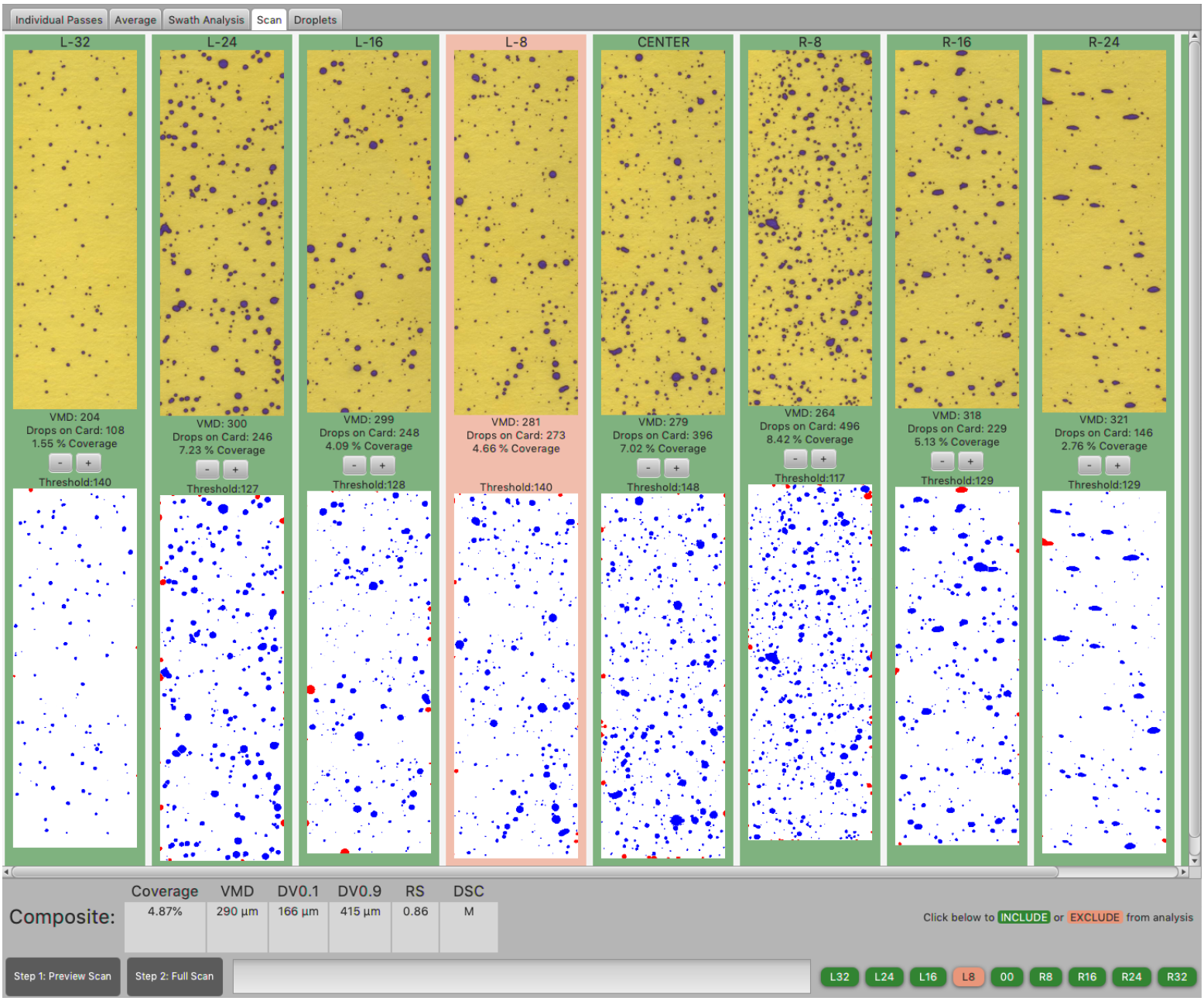


Figure 23: Results from Full Scan

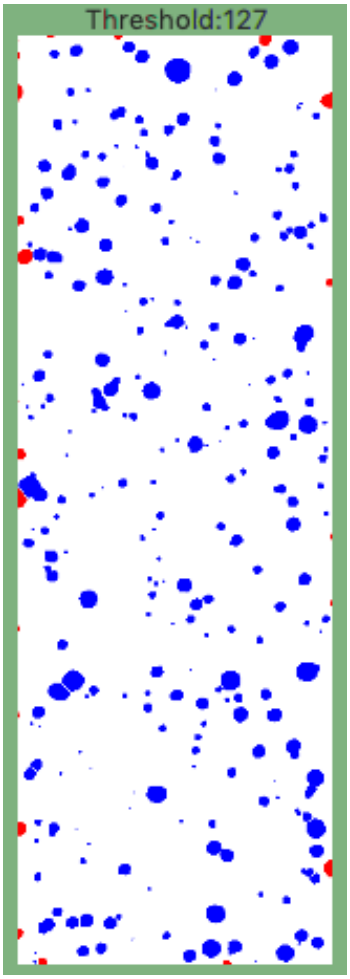


Figure 24: Thresholded Image

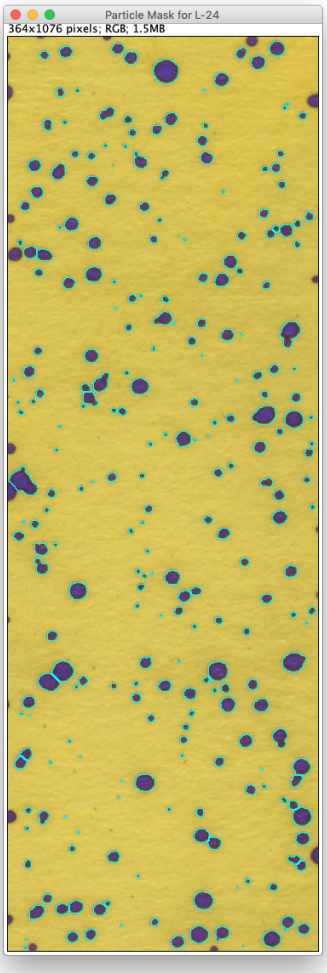


Figure 25: Particle Mask

6 Opening and Updating AccuPatt Data Files

AccuPatt data are stored in *.xlsx* files capable of alternatively being opened with Microsoft Excel. While Excel is not a requirement to use AccuPatt, it can be used as a tool to view the raw data for needs not addressed by this software package. It is not advised to make direct modifications to these data files, but if this is necessary, it is advised to make a copy of the file first.

6.1 Opening

Navigate to *File* → *Open*. A File Chooser box will appear wherein the desired file may selected. Clicking "Open" will load all data from the file into the program and allow viewing/manipulation of patterns as well as report generation. Any values modified at this point will be reflected on the report, but will not update the data file.

6.2 Updating

With a data file (refer to "Opening" above) the user can make changes to fields such has Applicator Info, Aircraft Info, etc. To permanently change these values in the data file, scroll to the bottom of the data entry pane and click the green *Update Data File* button. (Figure 26) A pop-up window will appear confirming update success.

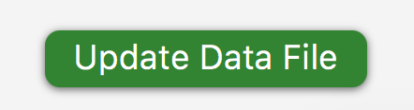


Figure 26: Update AccuPatt Data File

7 Finder

If you store all your fly-in data in a central directory of some sort, you can use the Finder tool by navigating to *File→Finder*. This will bring up a search window (Figure 27).

1. Choose the directory to search within. Finder will locate ALL AccuPatt, WRK-SDAG and USDA-AATRU type data files in the chosen folder (including all sub-folders). At this point you can click *Search* or optionally refine the output using steps 2 and/or 3 below.

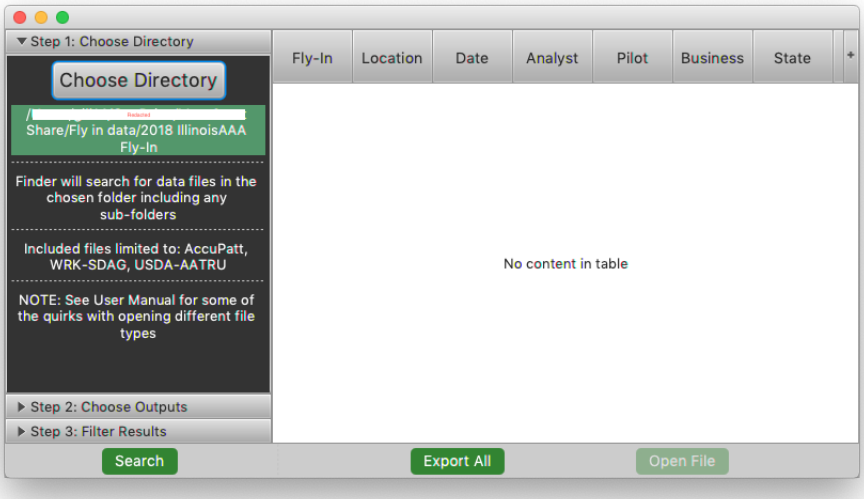


Figure 27: Using the Finder feature - Step 1

2. (OPTIONAL) Choose what information you are interested in displaying. By default, all fields are checked, but you can uncheck any field you do not want to display. For example, in (Figure 28) the "Nozzles" output is turned off, so nozzle data will not be displayed in the output table.

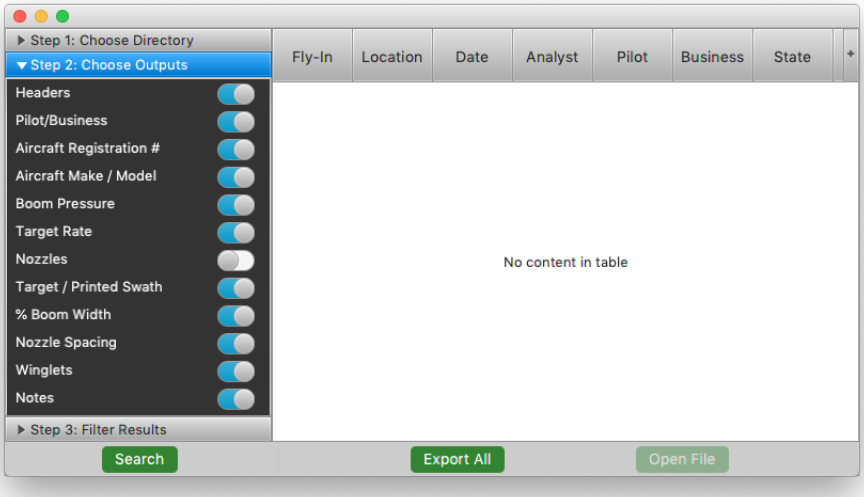


Figure 28: Using the Finder feature - Step 2

3. (OPTIONAL) Choose any filters to apply. The drop-down boxes allow you to choose a data type to filter by (Figure 29). The corresponding text fields are for the text to filter by. Finder will search the selected field in each data file to see if it contains the filter you applied. For example, if the filter "Aircraft Make/Model" is selected and you type in "AT" you would get results containing multiple Air Tractor models as well as Ag Cat and Weatherly since "AT" is found somewhere in the make/model name. Once you have completed the listed steps, click *Search*.

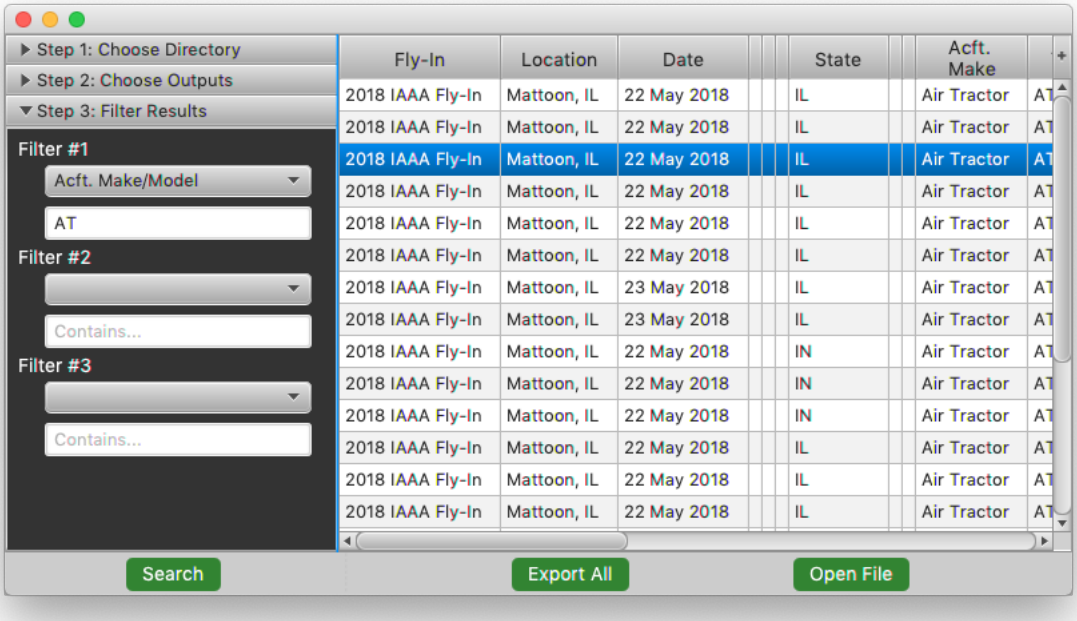


Figure 29: Using the Finder feature - Step 3

The results will be displayed in a sortable table (Figure 29) with columns for all the parameters selected in Step 2 above. Additionally, only results matching the filters you applied in Step 3 above will appear. The columns operate in a similar way to Microsoft Excel and can be resized as desired. Clicking *Open File* will open the selected file in AccuPatt. Clicking *Export All* will allow you to save a date/timestamped Excel file containing the data displayed in the Finder window. This allows you to create custom reports for sharing or archival.

8 Generating a Report

8.1 Initiate Generation

Navigate to the *Generate Report* menu (Figure 30) and check whether a string analysis page and/or a card analysis page is desired. Then click *Generate Report*.

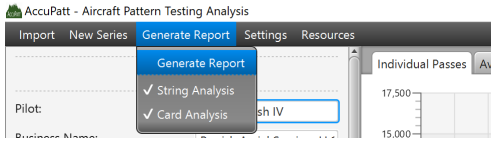


Figure 30: Generating a Report

A pop-up window will appear with proposed headers for the report. (Figure 31)

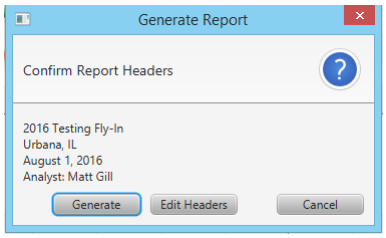


Figure 31: Generating a Report

Headers may be modified by clicking *Edit Headers*. A new pop-up will appear with fillable text boxes which may be left blank if desired. Click *Save* to accept the changes and return to the *Generate Report* window. (Figure 32)

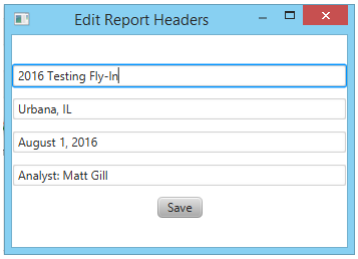


Figure 32: Editing Report Headers

Click *Generate* to create a PDF report which will be saved in the same directory as the data file. The report will appear on screen once it has been created.

8.2 String Analysis Page

The header of the String Analysis page contains a summary of all data entered. If no Card analysis page is included, the String Analysis page will also contain USDA Atomization model data if available. The series overlay and average plots will be shown along with the Racetrack and Back and Forth Overlap plots. The color key for the series overlay plot is indicated by colored markers above each pass in the Series Data block. A range of swath widths (below and above the desired swath width) will also be displayed with their respective Coefficients of Variation (CVs) for Racetrack and Back and Forth simulations. Any notes will be shown immediately below the header.

8.3 Card Analysis Page

Page 2 of the report (if selected) will contain data only relevant to WSP processing. The header will indicate the spread factor used to back-calculate droplet sizes from stain sizes. In the gray shaded box in the header, USDA atomization model predictions are shown for various droplet spectrum characteristics including the Droplet Spectrum Category (DSC). Below the predicted values, a non-shaded box of corresponding composite (measured) data is shown for the WSP scanned. Images for each ROI are shown along with localized droplet spectrum data. ROIs that are excluded from analysis will cause a blank space on the report to properly align card images with respective points on the coverage plot below. This plot of percent coverage vs. collector location is found in the center of the page. At the bottom of the page is a histogram of Percent of total volume measured vs. Droplet diameter. For example, the rightmost bar in (Figure 34) shows that roughly 7.5% of the total spray volume is contained in droplets between 650 and 700 microns. Currently, there is no method for altering the X-axis of this histogram.

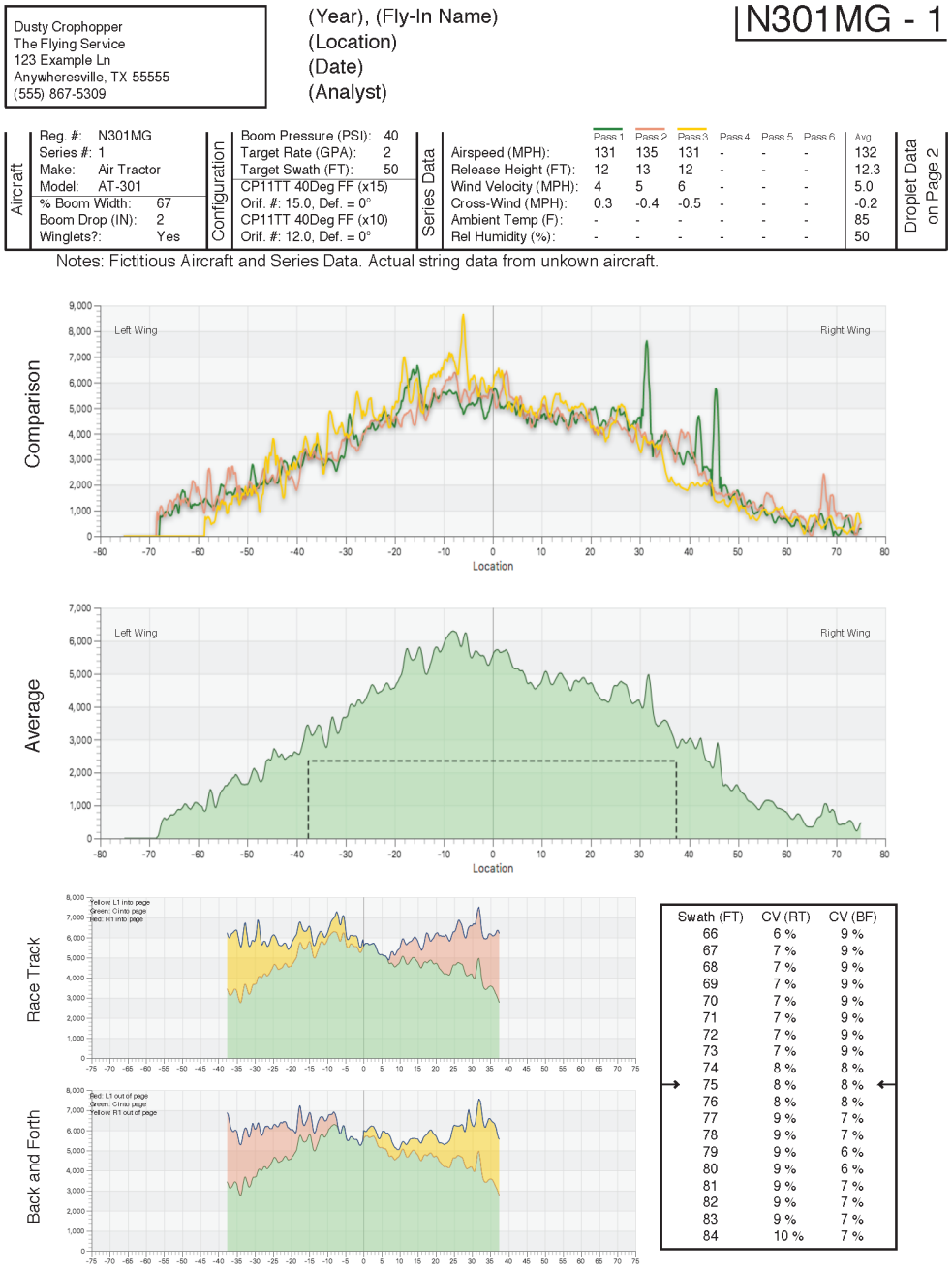


Figure 33: String Analysis Page

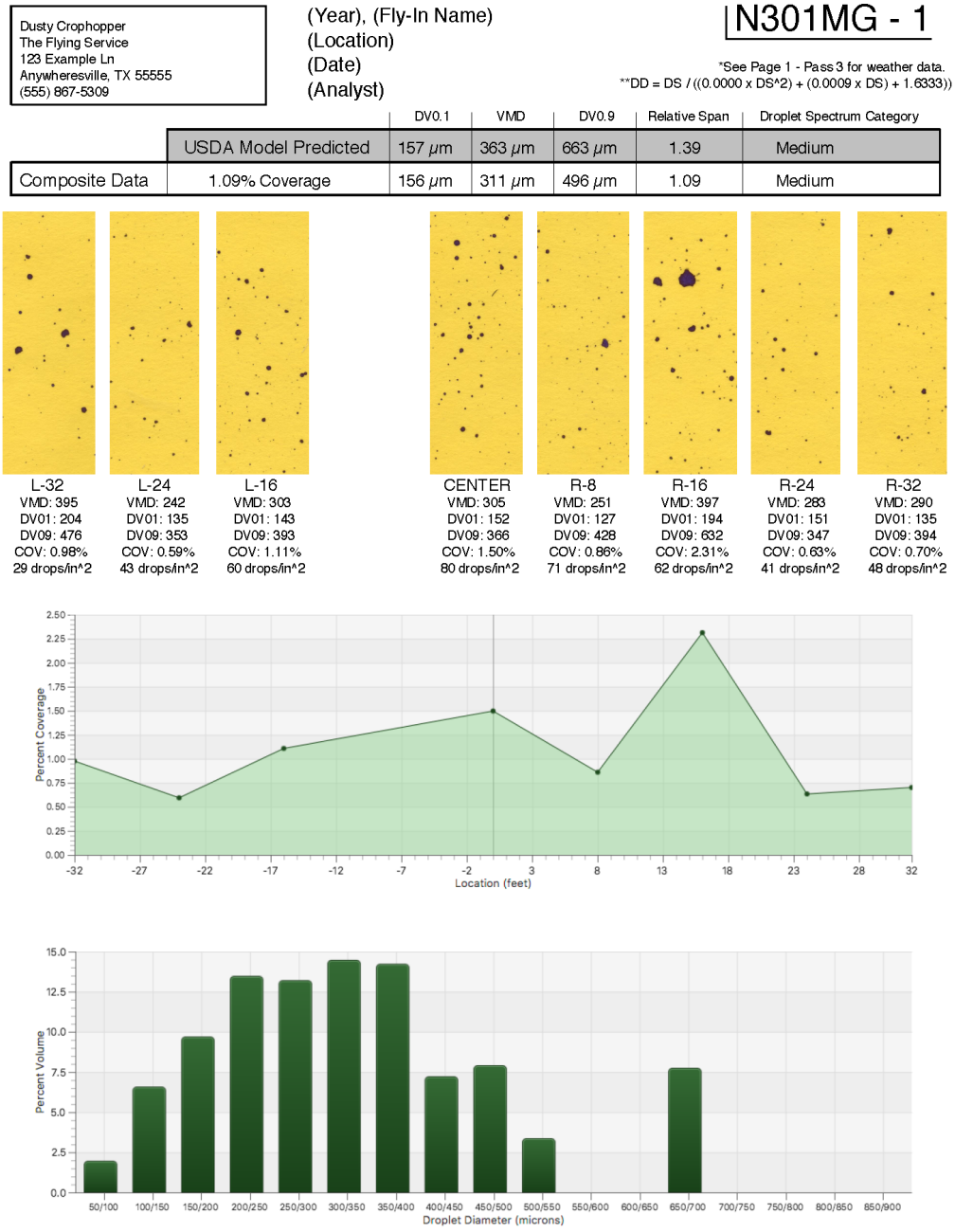


Figure 34: Card Analysis Page

9 Resources

9.1 Calibration Calculator

A simple tool for calculating boom and nozzle flow rate is found by navigating to *Resources* → *Calibration Calculator*. (Figure 35)

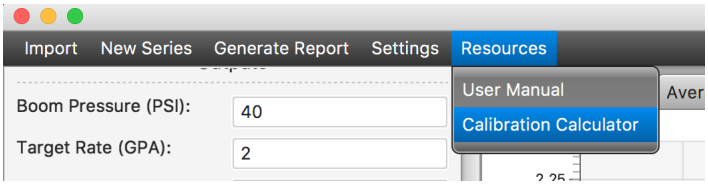


Figure 35: Open Calibration Calculator

The upper and lower sections of the tool (separated by a dashed line) operate independently, but may be used in conjunction with each other to aid in application equipment setup. (Figure 36)

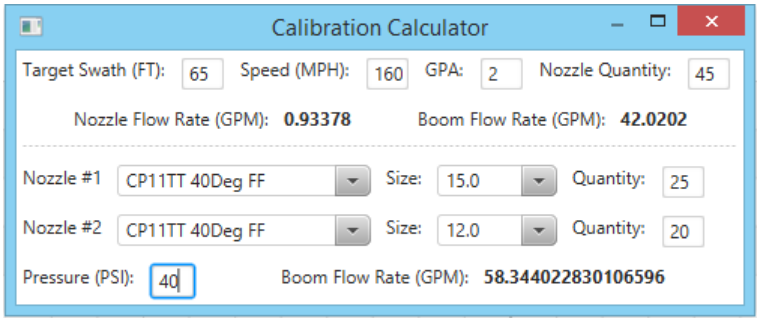


Figure 36: Calibration Calculator

10 Importing WRK-SDAG Data

Data files generated using the WRK-SDAG v34/v35 system can be opened using the normal *File* → *Open* procedure.Corresponding Pass B,C,D,E and F data will automatically be imported if available. Swath width, pattern manipulation and report generation are supported for these files, however, the smoothing algorithms should not be used since the hardware which generated the original data was already providing smoothed data. Additionally, you may notice different CV numbers with AccuPatt versus WRK-SDAG. This is because AccuPatt will centroid each pass individually, whereas WRK-SDAG only centroided the average pattern. The integrated-area scaling in AccuPatt may also cause some deviation from WRK-SDAG

11 Importing USDA-AATRU Data

Data files generated using the USDA Aerial Application Technology Research Unit's "Swath Anaysis" system can be opened using the normal *File* → *Open* procedure. Choose any pass from a desired series and the entire series will be loaded. AccuPatt will search for an associated *.prn file containing metadata such as Pilot Name, Address, etc. and load it as well. Since some of the data fields used by the USDA system do not match AccuPatt, the data from these fields will simply be put into the "Notes" field in AccuPatt. You may notice some variation in CV numbers in AccuPatt compared with the USDA system. This is due to the different orders and number of points used in the smoothing filter.

12 Calculations

12.1 Airspeed

$$Airspeed = GroundSpeed - WindSpeed * \cos(WindDirection - PassHeading)$$

12.2 Cross-Wind

$$CrossWind = WindSpeed * \sin(PassHeading - WindDirection)$$

13 String Drive Customization

The following commands can be sent to the stepper motor driver board to alter the behavior of the stepper motors. When sending a command, the first letter (header) must be either "A" (addressing the take up spool motor) or "B" (addressing the sample spool motor). A relevant listing of subsequent characters and respective commands is found below.

1. *Drive*: [D] Move stepper motor in a continuous rotation in specific direction (dir) at the rate determined by VELOCITY. While rotating, velocity can be modified on the fly. dir= + or - If dir omitted, rotation is halted. (e.g. "BD-" starts turning the sample spool in reverse, rewinding string back onto sample spool.)

2. *Velocity*: [V] Sets the pulses-per-second rate used in Drive. Value = 1 to 200, multiplied by 50 pulses per second. (e.g. "AV20" sets the velocity of the take up spool motor to 1000 pulses per second)

3. *Ramp-Rate*: [R] Sets the ramp rate used in the acceleration and deceleration curves. Value = 1 to 255.

4. *Current*: [C] Sets the drive current which is used at any time the motor is rotating. Value = 1 to 20, multiplied by 0.1 amps.

5. *Idle*: [I] Sets the idle reduction current which is used at any time the motor is at rest. Value = 1 to 10, multiplied by 10 and listed as a percentage of full current set by the Current command.

For a complete command listing and overall guide to stepper motor control: http://www.weedtech.com/wtmcd-m.pdf