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TM035 - PAF Fixer WiRE™ 5

This document aims to show the user how to use the PAF fixer to correct anomalous images and data.

The PAF fixer software is in the 'Utilities' folder within the WiRE 5 program files, and can be used to correct maps containing anomalous pixels. By loading maps and selecting the required start and end positions, the pixel values within this area will be replaced with interpolated values.

It is important to remember that when the fix is run, the original file is overwritten. A copy of the original file should be made prior to fixing the data.

Note: due to a bug in the current version of the software (which has been reported), the PAF fixer doesn't currently operate to the method described in this document. Interpolation start and end points can shift, resulting in an over- or under-estimated interpolated area. This document explains the method that should be used when the bug is fixed.

Data Collection

The PAF Fixer interpolates data perpendicular to the direction of data collection. This means that depending on the instrument and data collection method used, the data will be interpolated either horizontally or vertically.

Instrument Used	Data Collection Type	Data Collection Direction	Interpolation Direction
inVia	SL	Vertical	Horizontal
inVia	SHR	Horizontal	Vertical
RA802	SL	Horizontal	Vertical

Table 1: Interpolation directions based on data collection settings

Subsampling

The PAF fixer has a maximum file size, which causes larger files to be subsampled. This means that one pixel in the PAF fixer could represent multiple spectra. For example, a file with 1.4 million spectra (and a 10 µm step size) was subsampled so four spectra are contained in one PAF pixel, while a file with 1 million spectra (and a 1 µm step size) was not subsampled.

Figure 1 shows a file in WiRE (left) and the same file loaded into the PAF fixer (right). The file was subsampled, and so each pixel in the PAF fixer contains four spectra. The red line in Figure 2 shows the original boundary of the white pixels.

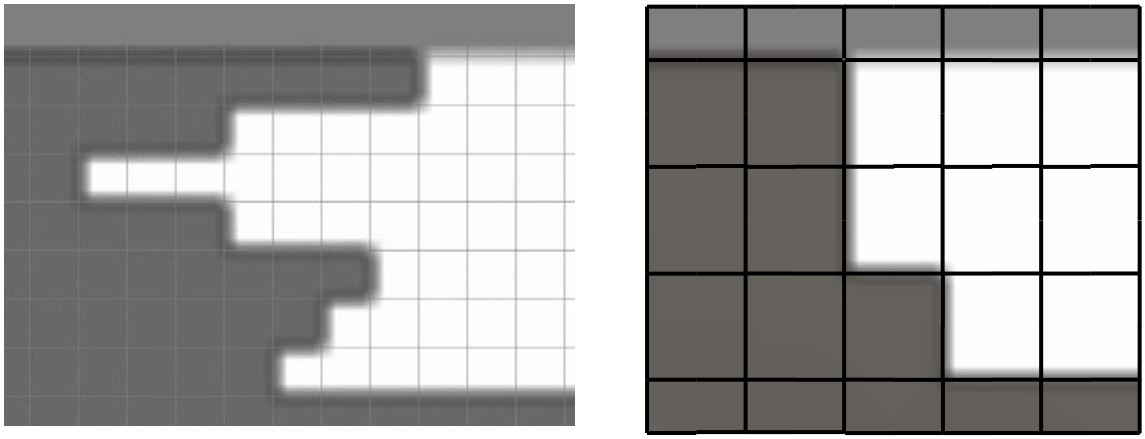


Figure 1: (Left) Image showing the pixels in WiRE and (right) the corresponding pixels in the PAF fixer.

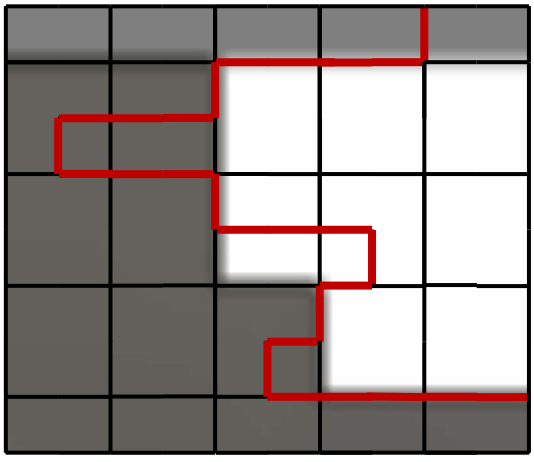


Figure 2: The image displayed in the PAF fixer, with the actual boundary of the white pixels shown by the red line

Note: To view the corresponding subsampled image in WiRE, adjust the settings by selecting 'Properties', 'Map Review Properties' and changing the subsample threshold (which is currently set to 2,000,000), to 1,000,000. In the case of the file with 1.4 million spectra, this will display four spectra as one pixel, as was seen in the PAF fixer software.

When a map has been subsampled in the PAF fixer, it is possible to select a position along the centre line of the pixel. As the subsampled pixel can only display one intensity, selecting a start or end point along the centre of a pixel includes the whole pixel during interpolation.

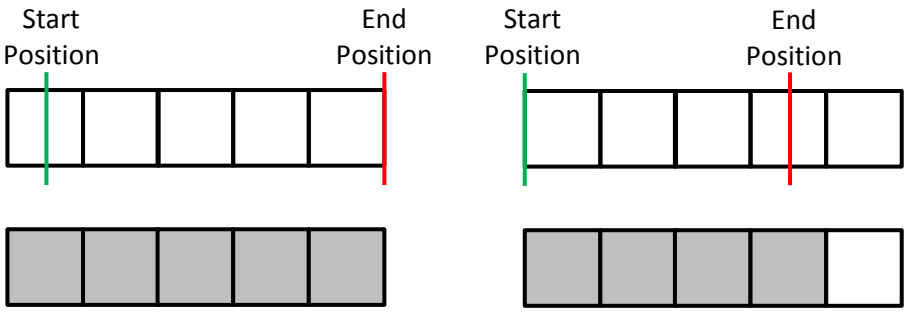


Figure 3: Pixels fixed (shown in grey) when the start position (left) or the end position (right) is along the centre line of a pixel.

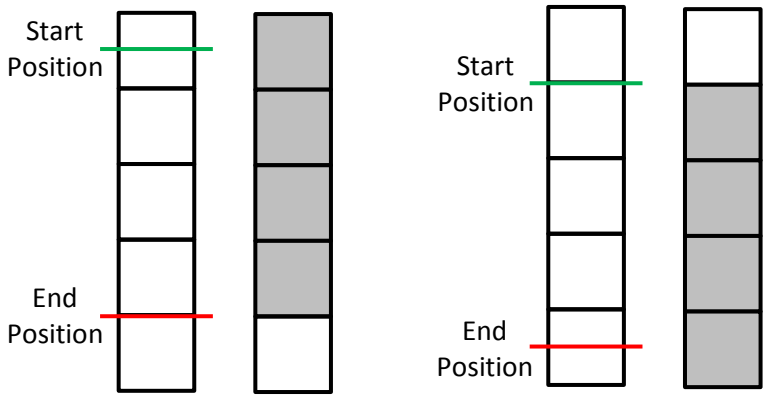


Figure 4: Pixels fixed (shown in grey) when the start position (left) or the end position (right) is along the mid line of a pixel.

When a subsampled file is loaded back into WiRE, the original display of 1 pixel per spectra is shown. However, after interpolation, the four spectra within each PAF pixel all have the same intensity in WiRE.

Note: For clarity and continuity, this documents suggests positioning the start pixel in the top left of the area to be fixed, and the end pixel in the bottom right. However, the start and end positions can be switched without affecting interpolation (i.e. the start position bottom right, and the end position top left).

Horizontal Data Collection

For data that was collected horizontally, interpolation will be performed vertically.

Data will be interpolated down each pixel column within the rectangular area selected by the start and end positions. The pixel at the top of the column will be interpolated to the pixel at the end of the column, without considering the values of pixels between these two points.

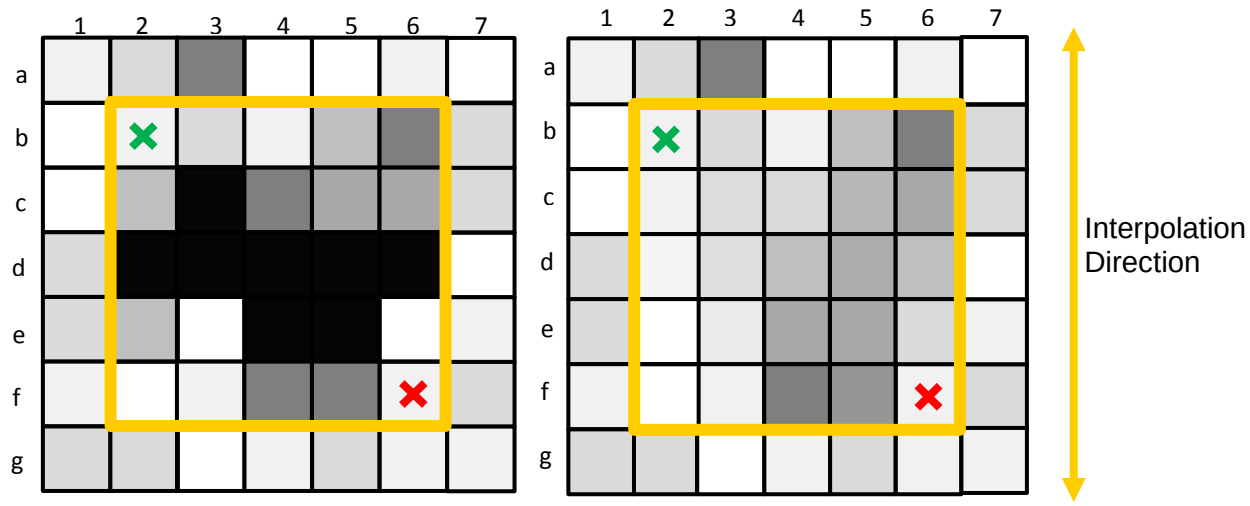


Figure 5: Example pixel interpolation. The start (green) and end (red) points have been selected to correct the area containing black pixels (left), resulting in interpolated pixels replacing the original pixels within the selected area (right).

For example, in Figure 5, start and end positions have been selected to remove the black cells. In the first column selected, pixel b2 is interpolated to pixel f2, with all pixels in between (pixels c2, d2, and e2) ignored from the interpolation and replaced. This results in a column of pixels with a gradient that varies from the intensity of the first pixel (b2) to the intensity of the last pixel (f2).

This process is repeated for each column between the selected start and end pixels. In this case, interpolation is performed on column 2 through to column 7.

Note: Each column is considered independently, and pixels are not affected by the intensity of pixels in a neighbouring column.

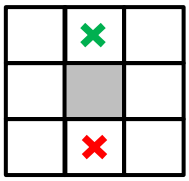
General rule: positon the start point a pixel above the area to be fixed, and the end point a pixel below the area. This will interpolate the 'correct' pixels, replacing the anomalous pixels.

Horizontal Data Collection Examples

To fix a single pixel:

- Position the start point a pixel directly above the pixel being fixed.

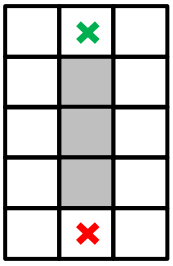
- Position the end point a pixel directly below the pixel being fixed.



To fix a vertical line with a width of a single pixel:

- Position the start point a pixel above the top pixel to be fixed.

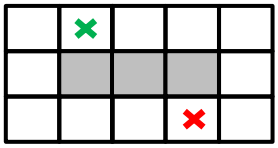
- Position the end point a pixel below the bottom pixel to be fixed.



To fix a horizontal line with a height of a single pixel:

- Position the start point a pixel above the first (left) pixel of the row being fixed.

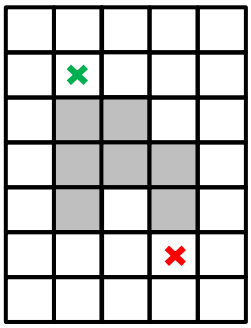
- Position the end point a pixel below the final (right) pixel of the row being fixed.



To fix a larger area:

- Position the start point a pixel above the area to be fixed, and in line with the start of the area.

- Position the end point a pixel below the area to be fixed, and in line with the end of the area.



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Vertical Data Collection

For data that was collected vertically, interpolation will be performed horizontally.

Data will be interpolated along each pixel row within the rectangular area selected by the start and end positions. The pixel on the left of the row will be interpolated to the pixel on the right of the row, without considering the values of pixels between these two points.

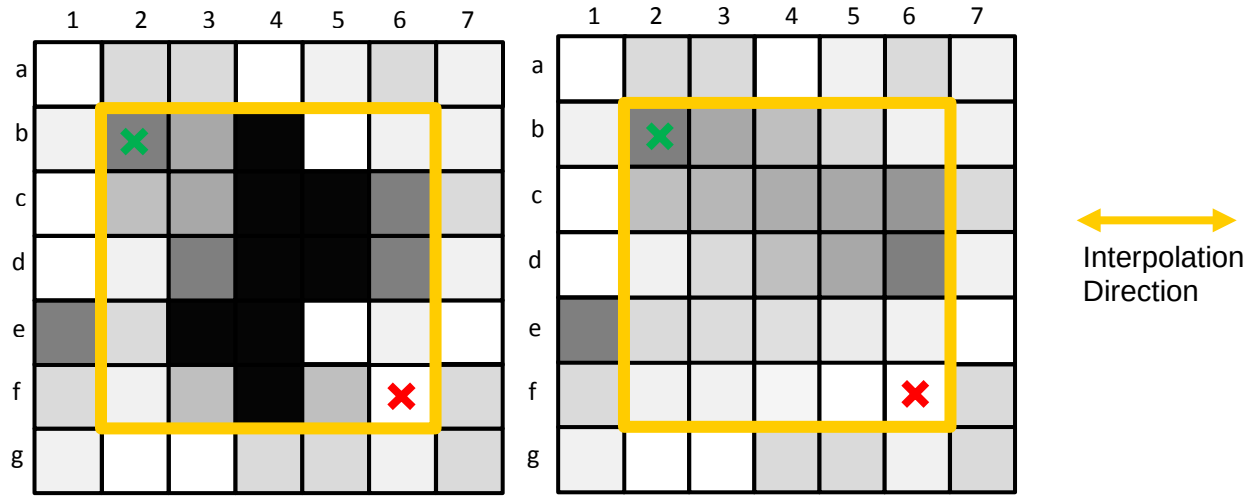


Figure 6: Example pixel interpolation. The start (green) and end (red) points have been selected to correct the area containing black pixels (left), resulting in interpolated pixels replacing the original pixels within the selected area (right).

For example, in Figure 5, start and end positions have been selected to remove the black cells. Pixel b2 is interpolated to pixel b6, with all pixels in between (pixels b3, b4, and b5) ignored from the interpolation and replaced. This results in a row of pixels with a gradient that varies from the intensity of the first pixel (b2) to the intensity of the last pixel (b6).

This process is repeated for each row between the selected start and end pixel. In this example, interpolation is performed on row b through to row f.

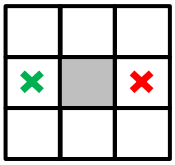
Note: Each row is considered independently, and pixels are not affected by the intensity of pixels in a neighbouring row.

General rule: positon the start point a pixel to the left of the area to be fixed, and the end point a pixel to the right of the area. This will interpolate the 'correct' pixels, replacing the anomalous pixels.

Vertical Data Collection Examples

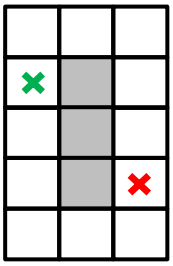
To fix a single pixel:

- Position the start point a pixel to the left of the pixel being fixed.
- Position the end point a pixel to the right of the pixel being fixed.



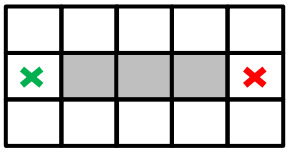
To fix a vertical line with a width of a single pixel:

- Position the start point to the left of the top pixel in the column.
- Position the end point to the right of the bottom pixel in the column.



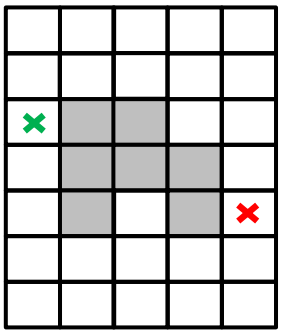
To fix a horizontal line with a height of a single pixel:

- Position the start point to the left of the first pixel in the row.
- Position the end point to the right of the last pixel in the row.



To fix a larger area:

- Position the start point to the left of the area to be fixed, and in line with the start of the area.
- Position the end point to the right of the area to be fixed, and in line with the end of the area.



Warning on interpolating over large areas:

Several iterations with a smaller fixing area may be required to fix a larger area, to ensure that correct data isn't unintentionally interpolated. This is demonstrated in Figure 7, where the edge of the tablet is shown in the bottom left corner and there is anomalous data in the background. The area within the yellow box contains a large amount of the tablet, and after this area has been fixed, the definition of the edge of the tablet is lost.

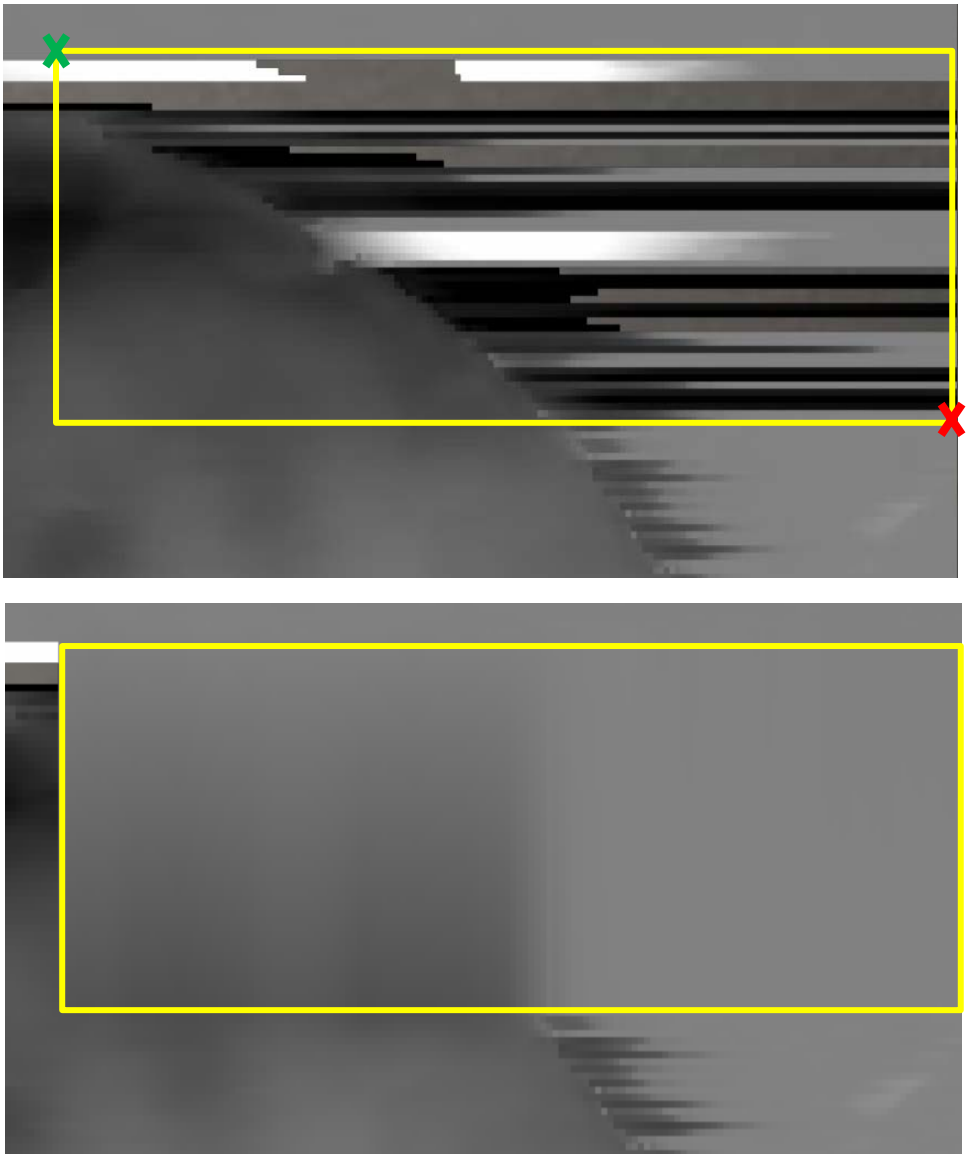


Figure 7: The area selected to be fixed on the original map (top), and the fixed map (bottom). The start position is marked by the green cross, and the end position by the red cross. This generated the area to be fixed, shown in yellow.

To overcome this, multiple smaller areas should be fixed in turn, to avoid altering the data on the tablet. The map thresholding may have to be adjusted in WiRE to alter the contrast and then re-loaded into the PAF fixer, to ensure 'correct' data is not unintentionally interpolated.

Note: it is not possible to fully fix the area shown in Figure 7. This is because a 'correct' row of pixels is required to set as the start and end positions for interpolation. As shown by the bottom image of Figure 7, if a 'correct' row of pixels is not available, the row that has been selected is interpolated – in this case, the data from the tablet is interpolated along the columns, merging it into the background.

Map Fixing Work Flow

1. Threshold the selected map in WiRE to provide the required contrast.

2. **Make a copy of the file prior to using PAF fixer**. When the map is fixed by the PAF fixer, it is automatically saved and the changes can't be undone.

3. Open PAF Fixer by going to: C:\Program Files (x86)\Renishaw\WiRE4\Utilities\PAF Fixer.

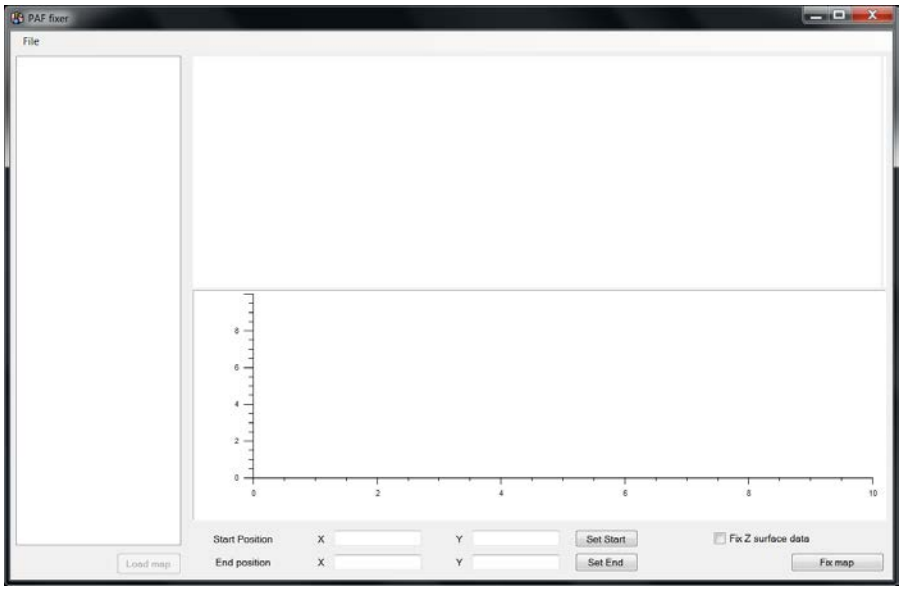


Figure 8: PAF fixer start-up screen

4. Open the file by going to 'File', 'Open' and chose the required file.

5. Select the map from the list of filenames and press 'Load map'.

6. Reposition the map by holding the centre mouse button and dragging, and zoom into the map to show each pixel by using the scroll wheel. Position the map to show the anomalous pixels to be corrected. Left click to position the cross-hair.

7. Set the start and end positions by placing the cross-hair in the required locations and then selecting the corresponding 'set' button.

8. Check the 'Fix Z surface data' option if both the surface and map need to be fixed.

9. Select 'Fix Map', and if you have saved a copy of the file, press 'Ok' to run the fix and update the file.

10. The map will re-load with the fixed map.