# ShoeprintAnalyzr

## *A Shiny app for shoeprints alignment*

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# I. Introduction to Shoeprintanalyzr

- The *Shoeprintanalyzr* is a CSAFE tool to automate the alignment process for two similar shoeprints, providing advantages for both footwear examiners and researchers.

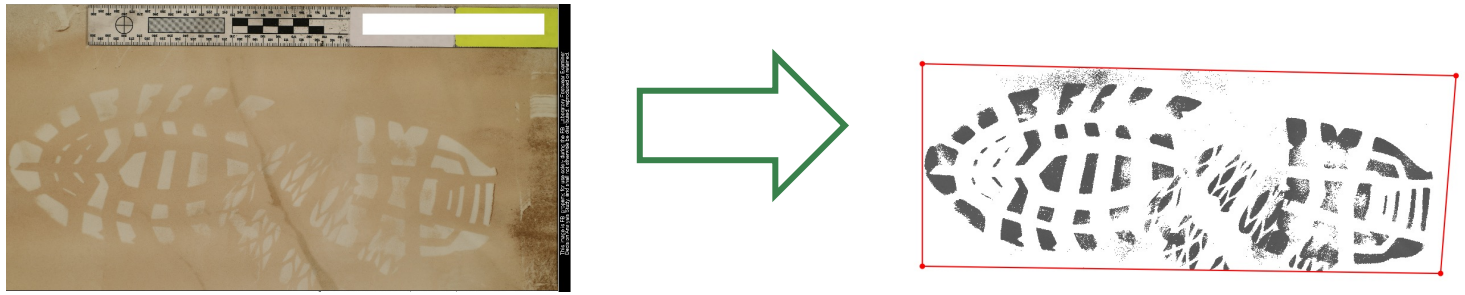
- It streamlines the alignment process, decreasing manual labor while enhancing reproducibility.

- The alignment process is an efficient brute-force search method incorporating a downscaling and cross-correlation with Fast Fourier Transformation.

- It provides image processing functionality to ensure effective alignment.

# I. Introduction to Shoeprintanalyzr

1. **Upload shoeprints** for alignment.
2. **Shoeprint segmentation**–darker impression on a white background.

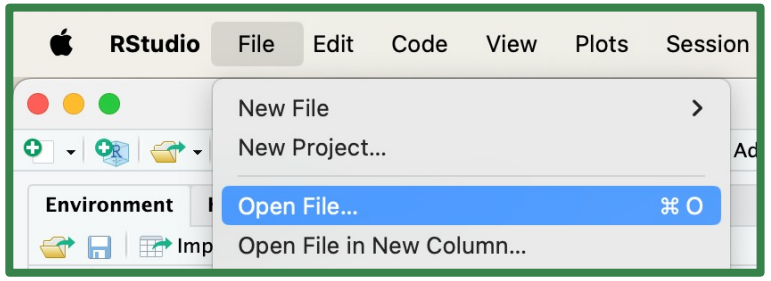


3. **Set parameters** that dictate accuracy and efficiency of alignment.

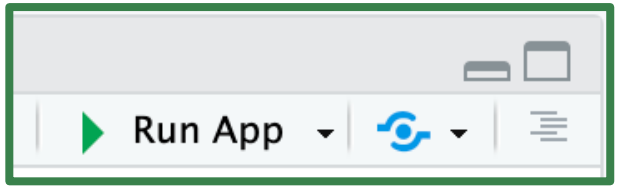
- Alignment results from both processed and original images will be displayed and accessible for download.
- Metadata is provided for reproducibility.

# II. How to launch Shoeprintanalyzr

- Install R and R studio on your computer (see the next slide for details).
- Download “Shoeprintanalyzr_app.R” from https://github.com/hnlee1428/ShoeprintAnalyzr.
- Open the file “Shoeprintanalyzr_app.R” in R studio.




- Click “Run App” in the upper right corner of R Script window.



# II. How to launch Shoeprintanalyzr

## To install R and R studio:

- For Windows: https://teacherscollege.screenstepslive.com/a/1108074-install-r-and-rstudio-for-windows

- For Mac: https://teacherscollege.screenstepslive.com/a/1135059-install-r-and-rstudio-for-mac

# II. How to launch Shoeprintanalyzr

## Errors you may see while running the app in Rstudio:

- In case of error like "`no package called ABC`", you need to install the package by running the following code in Console window:

```
install.packages("ABC")
```

- You can install multiple packages at once; for example, run the following code to install the packages, `ABC`, `DEF`, `GHIJ`:

```
install.packages(c("ABC", "DEF", "GHIJ")
```

# III. Preview of Shoeprintanalyzr

**Questioned impression**

**Upload a shoeprint (png, jpg, tiff)**

Browse... No file selected

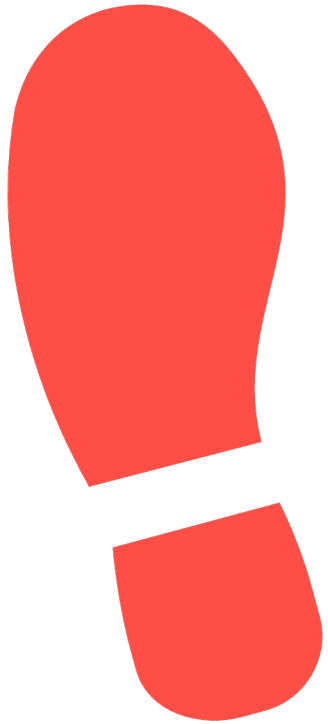
**Optional: processing info (txt)**

Browse... No file selected

**Image Viewing Scale (%)**

25

Note: Viweing scale should be set prior to cropping. If you need to change the scale while/after cropping, update the scale, and then reset/redo cropping.



# III. Preview of Shoeprintanalyzr

## Reference impession

**Upload a shoeprint (png, jpg, tiff)**

Browse... No file selected

**Optional: processing info (txt)**

Browse... No file selected

**Image Viewing Scale (%)**

25

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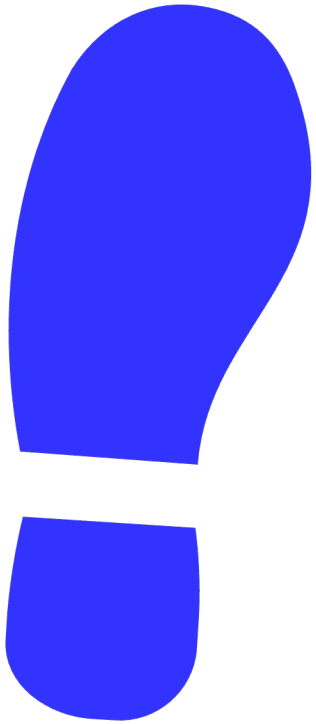


# III. Preview of Shoeprintanalyzr

## Image Processing Tools

**Crop the shoeprint portion**

START ⏸ ⏮ ↺ END

☐ **Grayscale**

☐ **Invert** (before thresholding)

**Threshold**

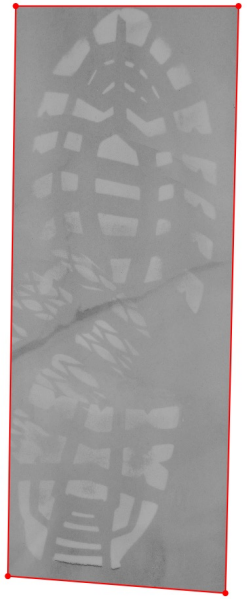
0 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

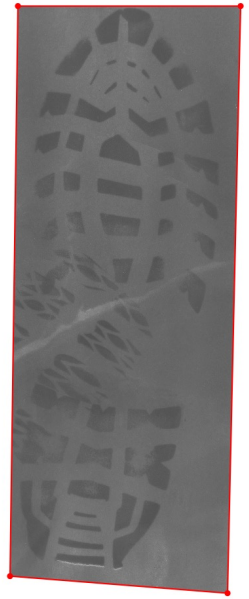
Reset grayscale, inversion, and thresholding

**Threshold Aid Plot**

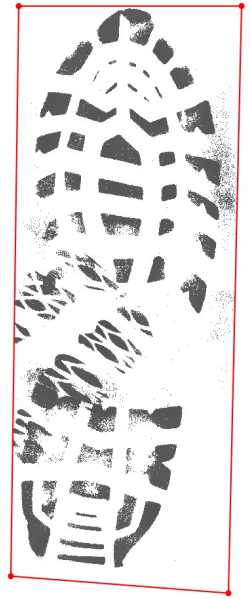
✓ Crop



✓ Grayscale



✓ Invert

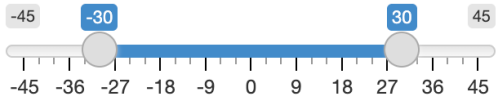


✓ Threshold

# III. Preview of Shoeprintanalyzr

## Parameters for Alignment Computation

**Range of rotation angle to search**




Note: An optimal rotation angle for the questioned image is sought within the selected range. Shortening the range could result in a shorter duration.

**Downscale factor**

1/8

Note: Larger values can improve alignment at the cost of increased processing time, whereas smaller values speed up the process but may compromise alignment.

During alignment, your images will be reduced by 1/8(12.5%).

Process automated alignment!

## Alignment results from processed images

Automated alignment information

Similarity between aligned images

Questioned (aligned)

Reference

Overlay (aligned)

## Download all results

Download

## Original images and their overlay after alignment

Questioned

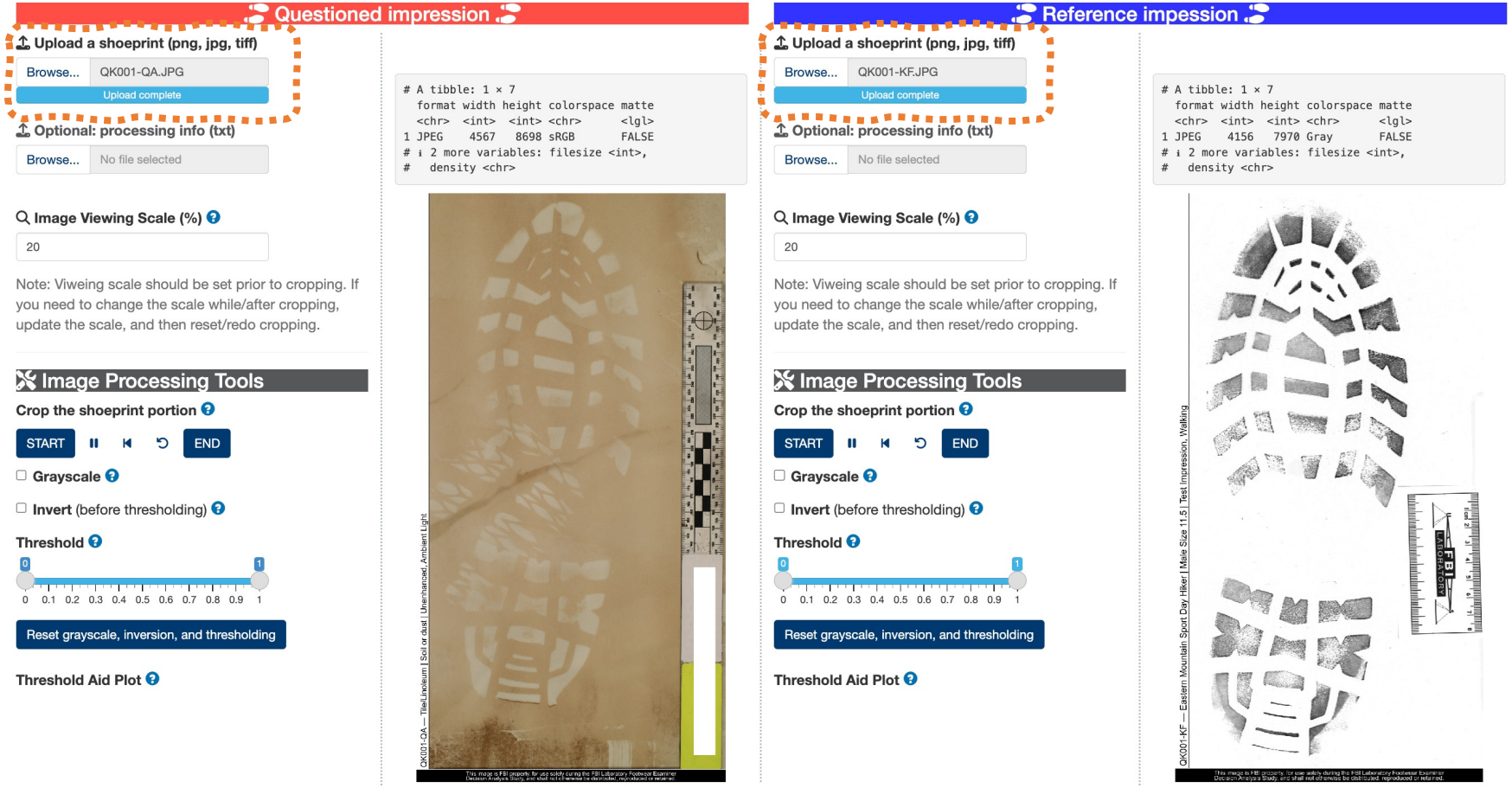
Reference

Overlay (aligned)

# IV. How to use Shoeprintanalyzr

## 1. Upload Shoeprints

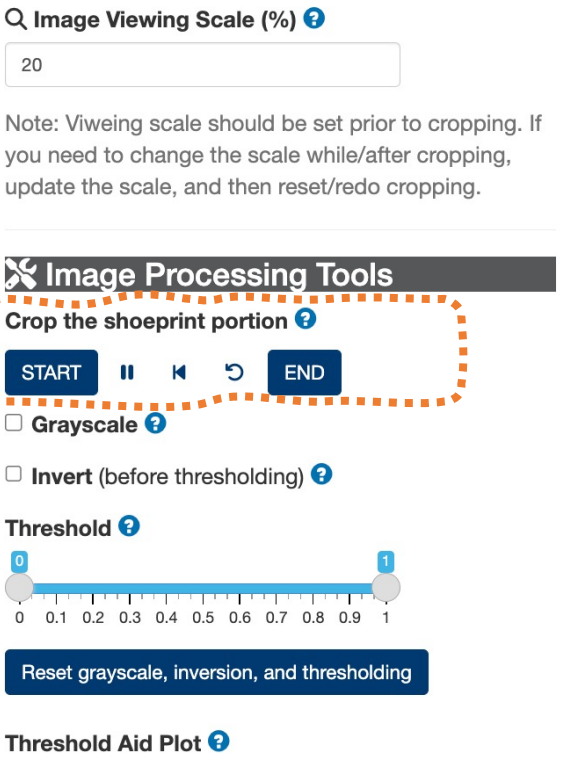
a questioned impression and a reference impression you want to align.

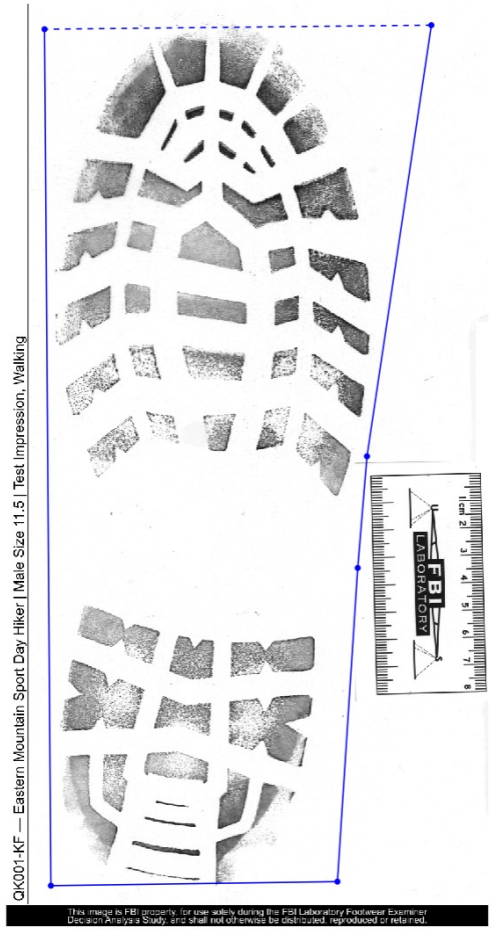


# IV. How to use Shoeprintanalyzr

## 2. Image Processing for Effective Alignment

### a) **Crop out Background**: Select the boundary of the outsole portion.



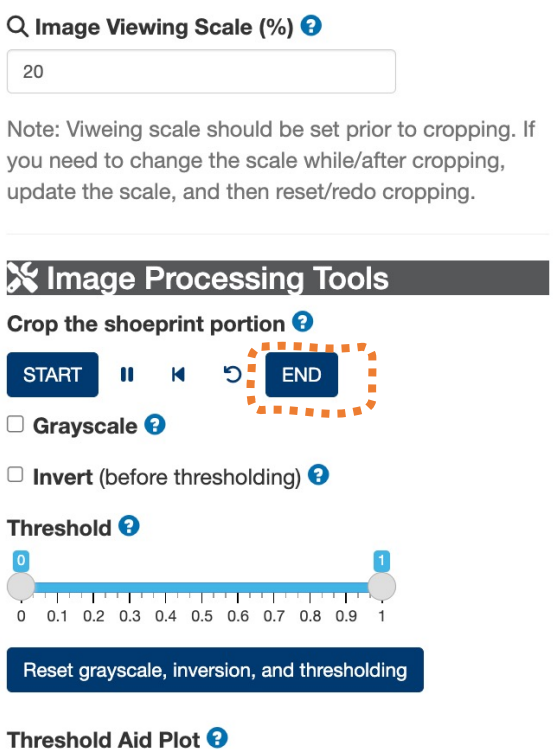



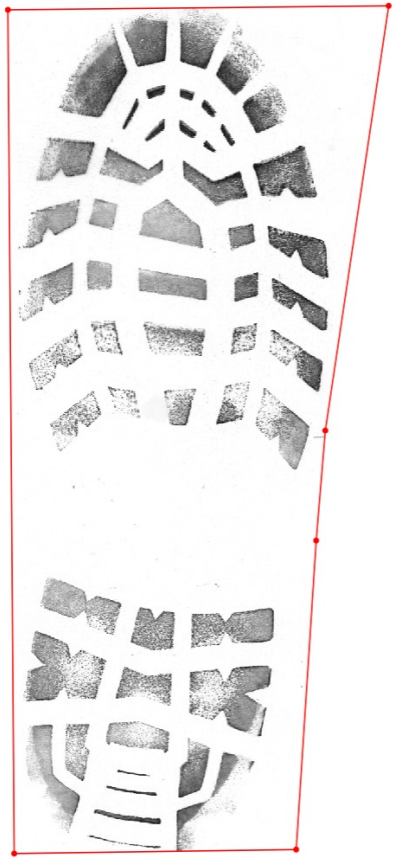

- ✓ Click START
- ✓ Place the boundary points by clicking.
- ✓ Click END once the boundary is set.
- ✓ Note:
  - ⏸ : Pause colleting points.
  - ⏮ : Delete the last point.
  - ↺ : Delete all points

# IV. How to use Shoeprintanalyzr

## 2. Image Processing for Effective Alignment (continued)

### a) Crop out Background: Select the boundary of the outsole portion.



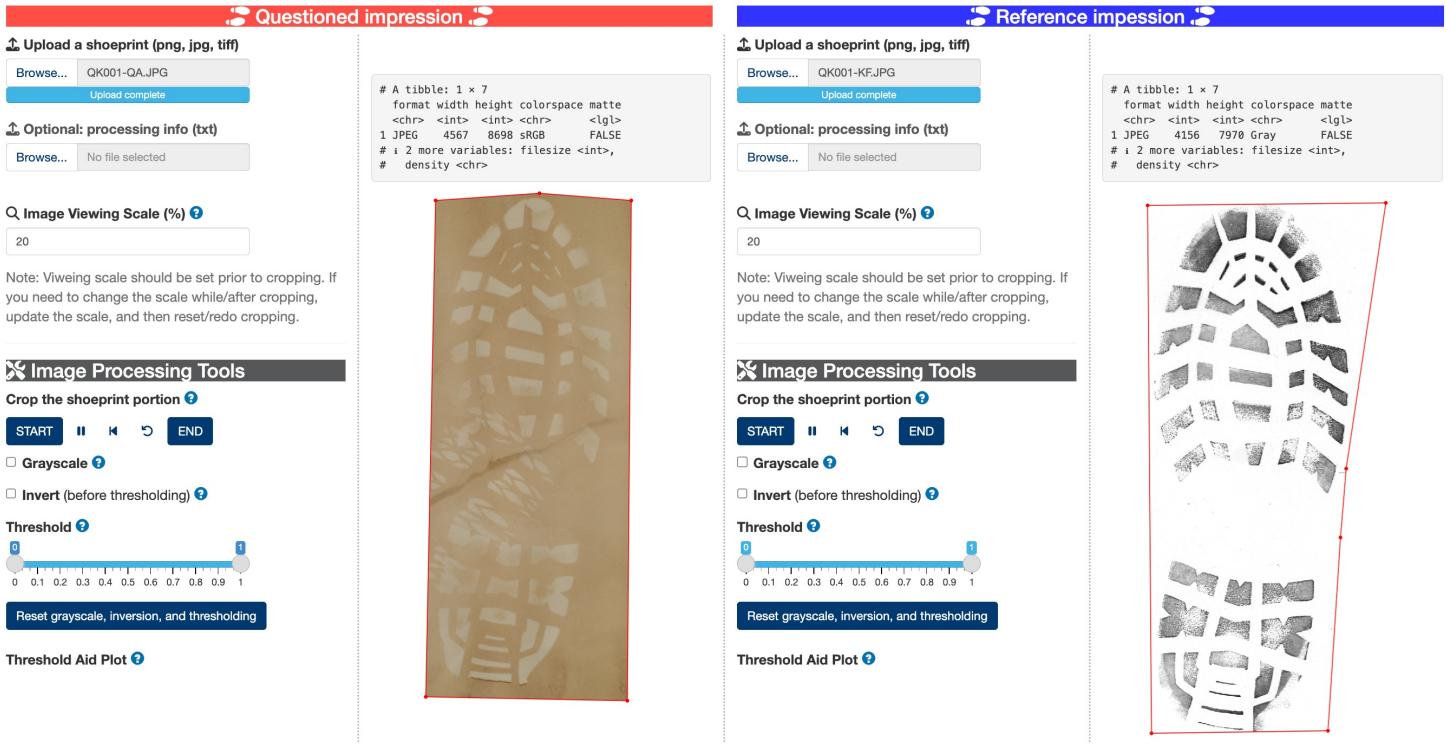



✓ Cropping is complete with a red boundary.

# IV. How to use Shoeprintanalyzr

## 2. Image Processing for Effective Alignment (continued)

### a) **Crop out Background**: Select the boundary of the outsole portion.



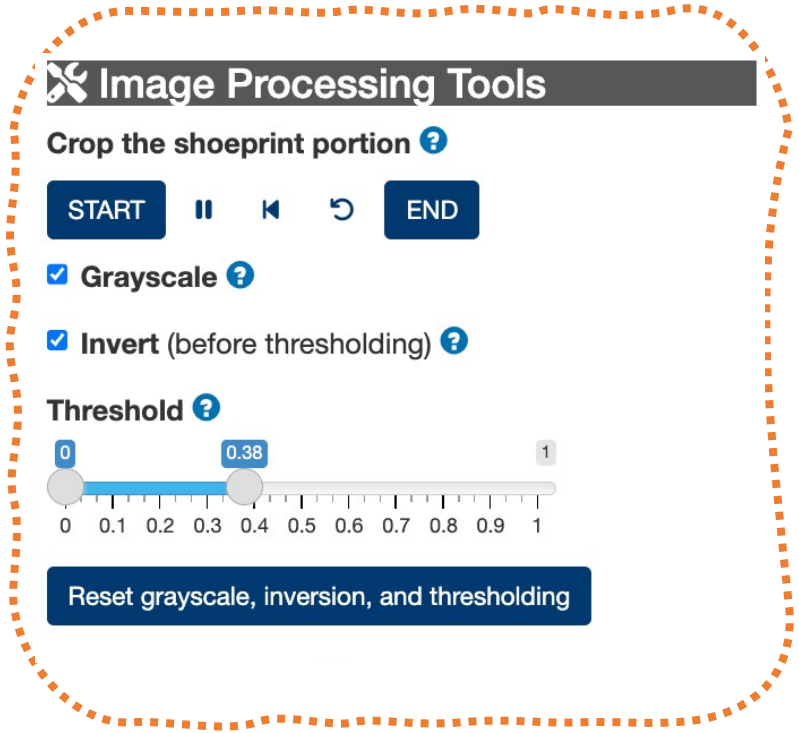

✓ Cropping is complete for both questioned and reference impressions.

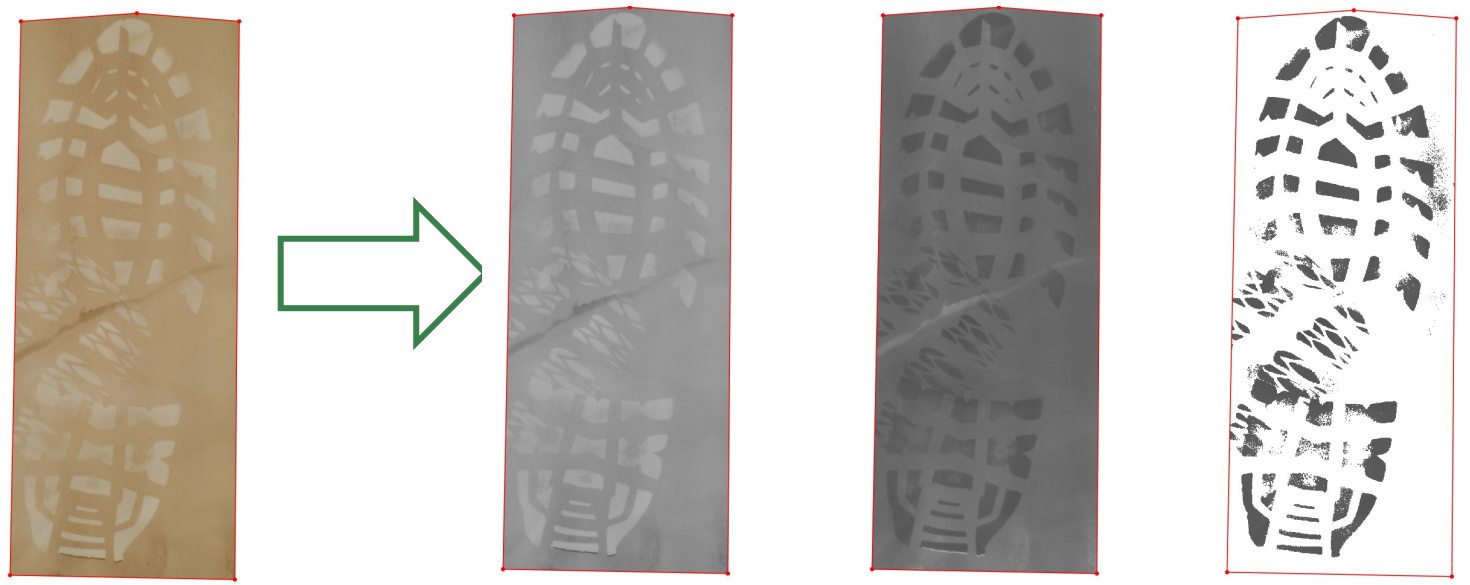
# IV. How to use Shoeprintanalyzr

## 2. Image Processing for Effective Alignment (continued)

### b) Outsole Visible in Grayish with White Background:

Use **grayscaling**, **inverting**, and **thresholding**.



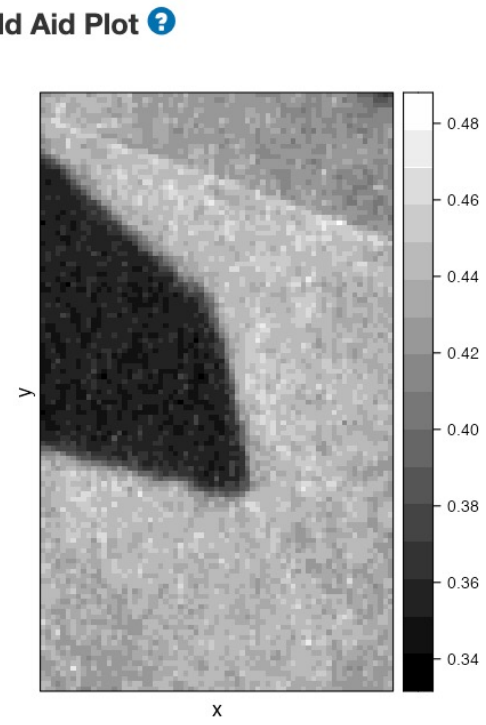



✓ Grayscale ✓ Invert ✓ Threshold

# IV. How to use Shoeprintanalyzr

## 2. Image Processing for Effective Alignment (continued)

**b) Outsole Visible in Grayish with White Background**:
**Threshold Aid Plot** is provided to help thresholding. Select a small part of outsole by dragging. The pixel values in the area will be shown.

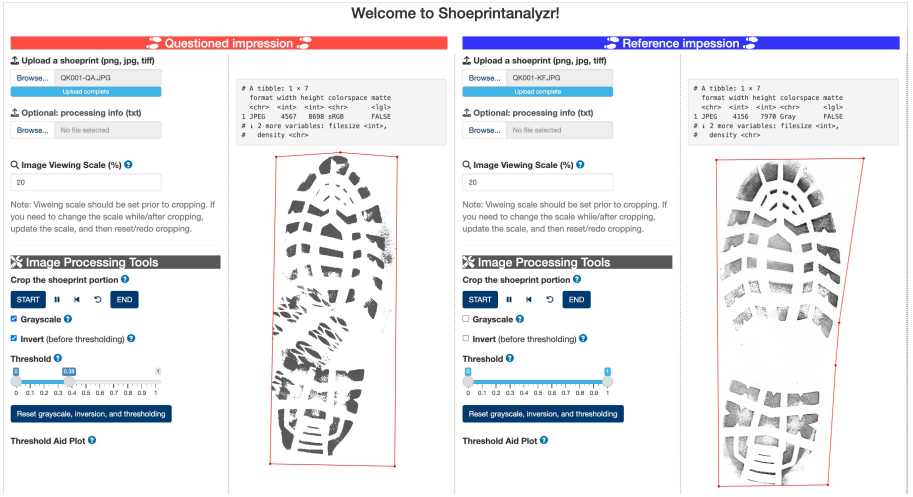


# IV. How to use Shoeprintanalyzr

## 2. Image Processing for Effective Alignment (continued)

### b) Outsole Visible in Grayish with White Background:

Use **grayscaling**, **inverting**, and **thresholding**.

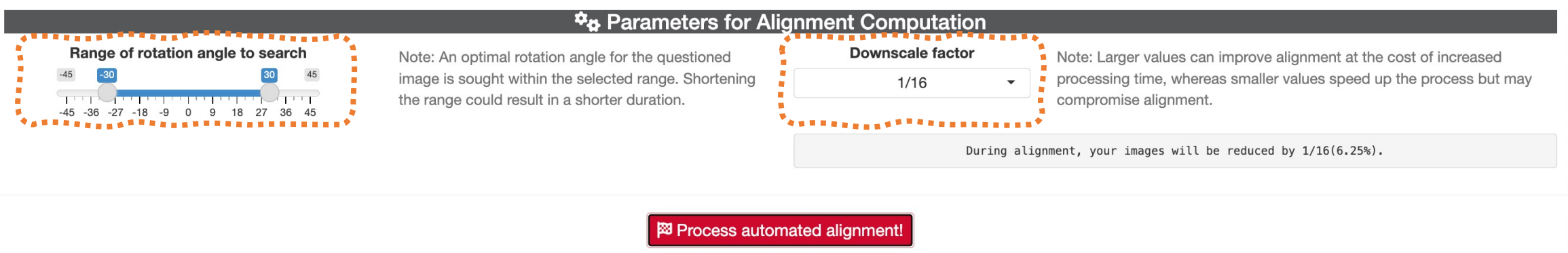



- ✓ Preprocessing is complete.
- ✓ Questioned: cropped, grayscaled, inverted, thresholded at the value set to 0.38.
- ✓ Reference: cropped.

# IV. How to use Shoeprintanalyzr

## 3. Customize Parameters for Alignment

Customize the **range of rotation angles** to search and determine the **downscale factor** used for internal computation.




- ✓ Range of rotation angle is set from -30 to 30 degrees (left).
- ✓ Downscale factor is set to 1/16 (right).
- ✓ Note: An effective downscale factor was 1/16 for images of 4500×8000 pixels and 1/8 for images of 2000×4500 pixels.

# IV. How to use Shoeprintanalyzr

## 4. Proceed with Alignment

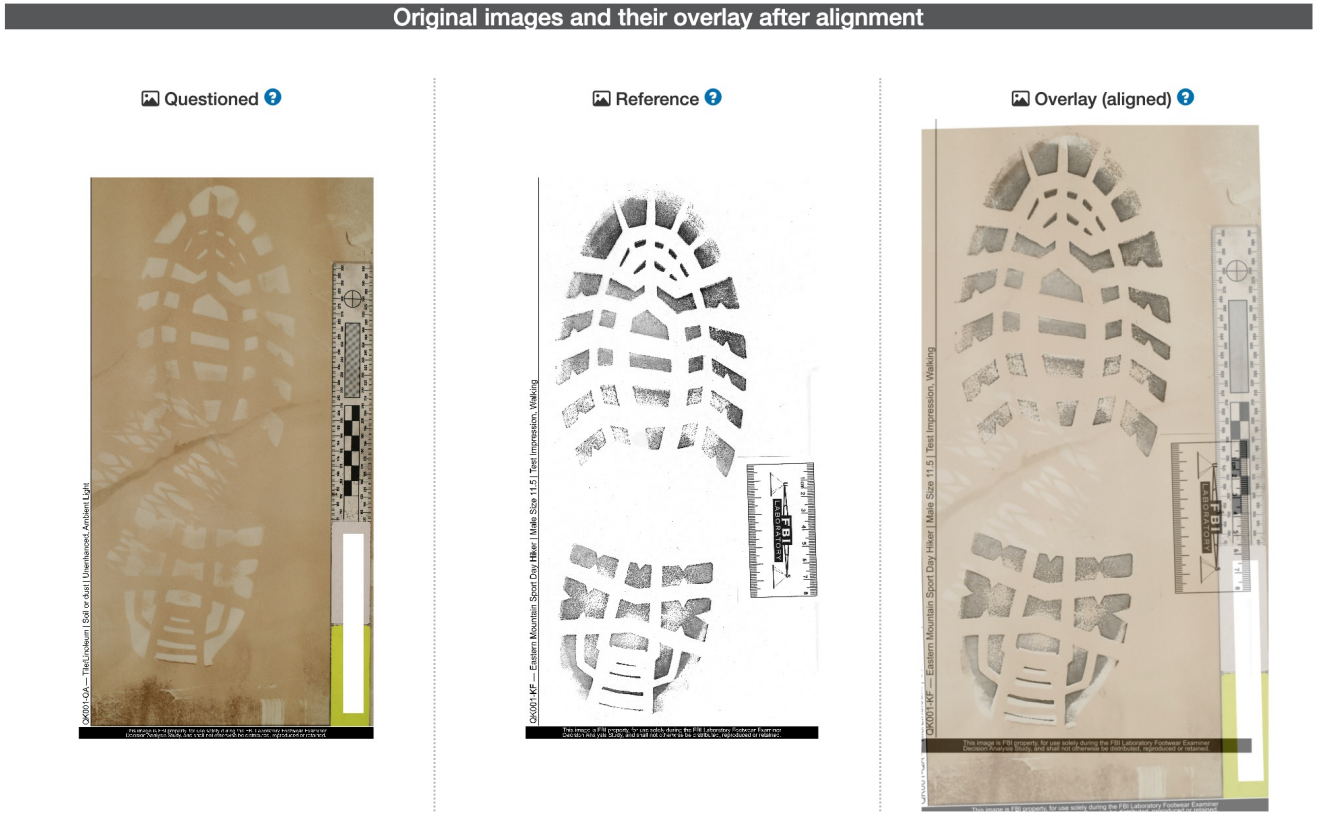
Click 

to start the automated alignment process.


✓ Alignment information (rotation and shifting), similarity score, and the aligned results from processed images are provided.

# IV. How to use Shoeprintanalyzr

## 4. Proceed with Alignment (continued)



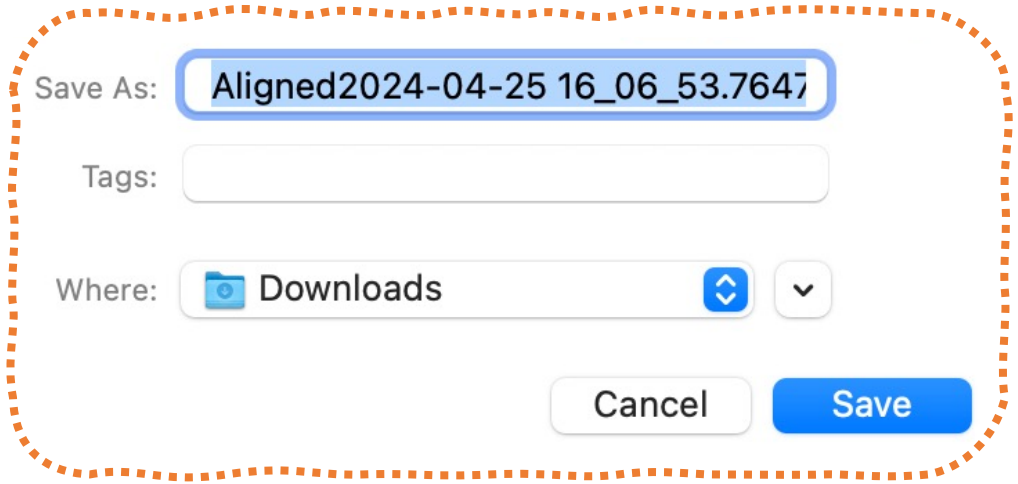

✓ Original images and the overlay of aligned original images are provided.

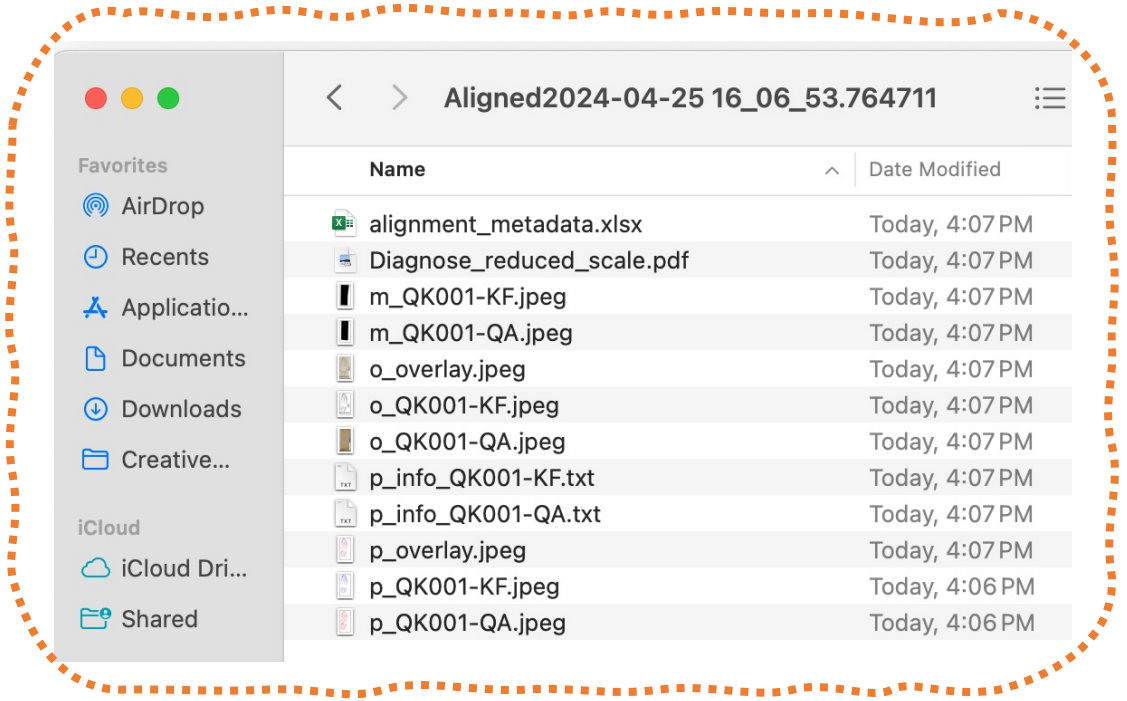
# IV. How to use Shoeprintanalyzr

## 5. Download results

Click 

to download a zip file including the alignment outcomes and metadata pertaining to preprocessing.



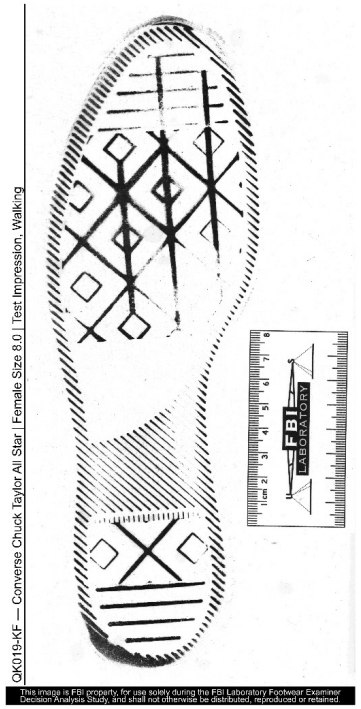

✓ A window pops up to save a zip folder including the results and metadata (left).
✓ The files in the unzipped folder (right).

# V. Performance (matching)

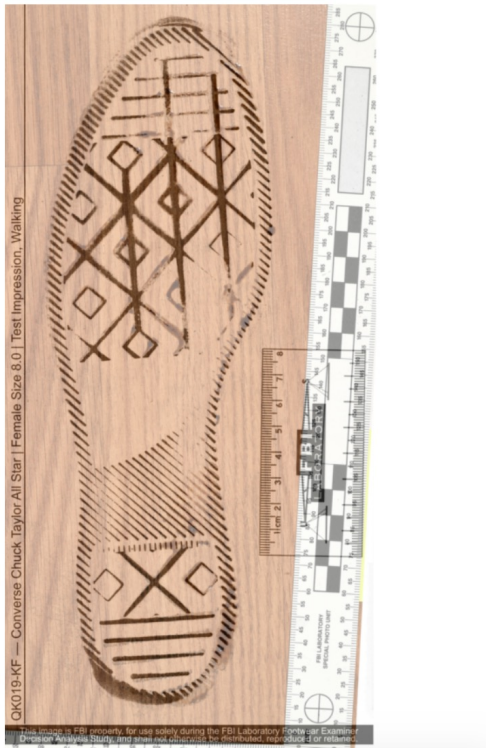
## Original images and their overlay after alignment

Questioned

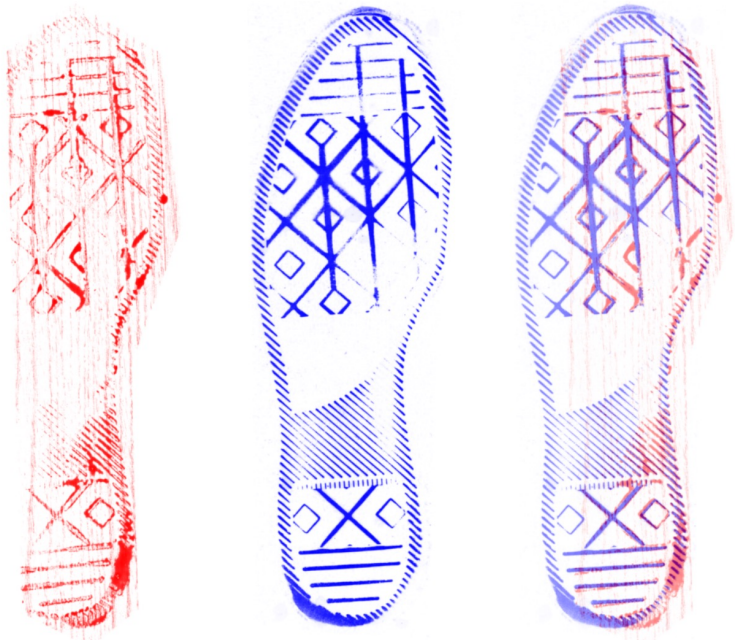

Reference




Overlay (aligned)



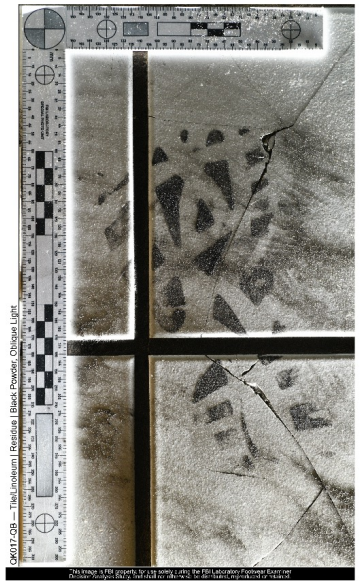

Processed images



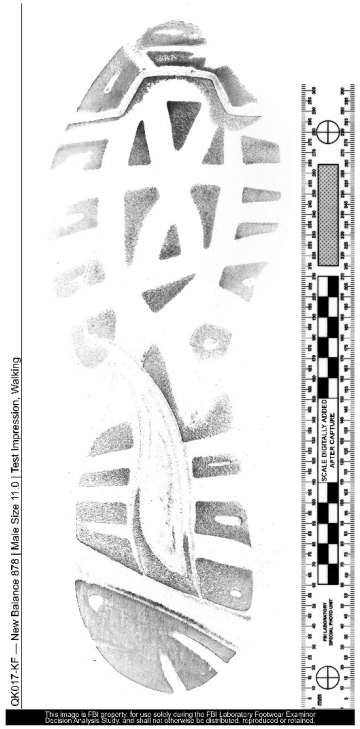
# V. Performance (matching)

## Original images and their overlay after alignment

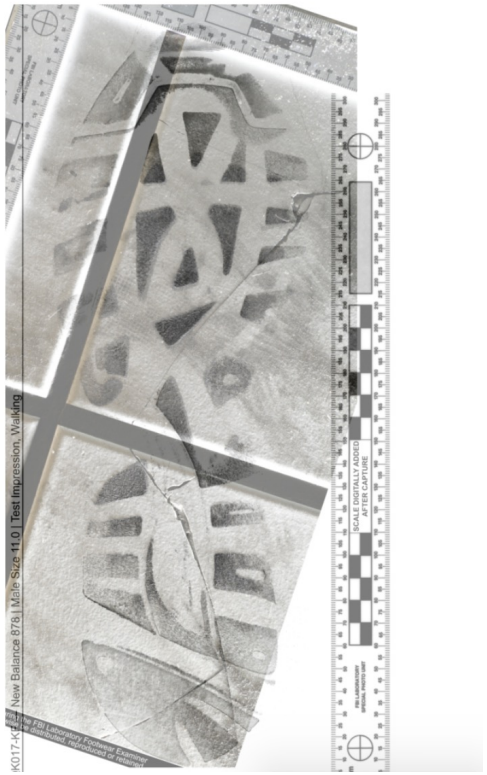
Questioned



Reference



Overlay (aligned)



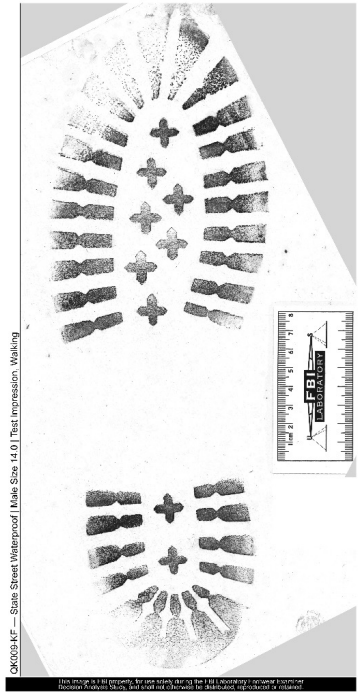
Processed images

# V. Performance (non-matching)

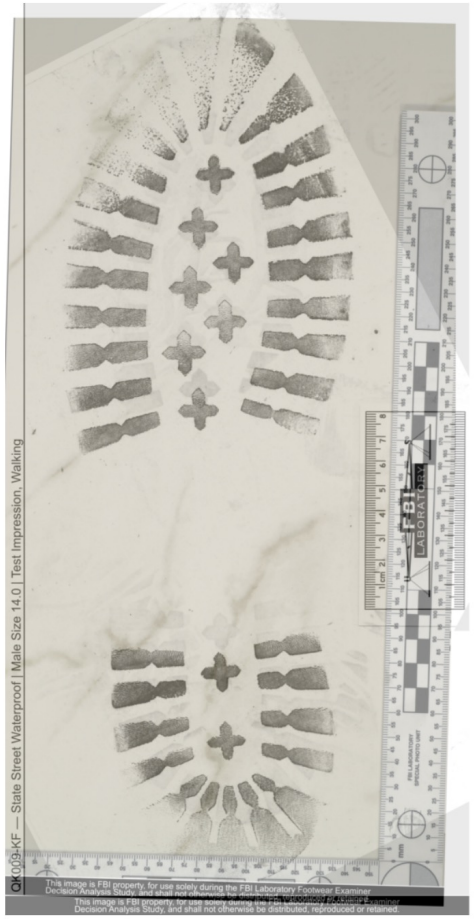
## Original images and their overlay after alignment

Questioned

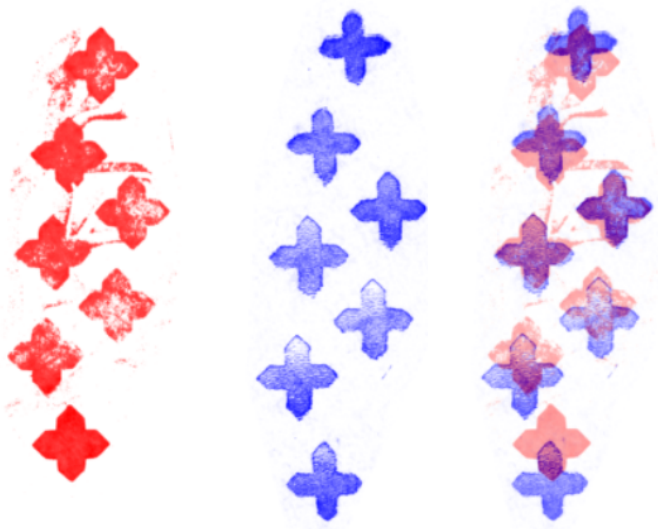
Reference



Overlay (aligned)



Processed images



# VI. Reproducibility and Diagnostics

✓ The downloaded zip file includes shoeprints, binary masks, metadata such as alignment and processing information, and diagnostic plots.