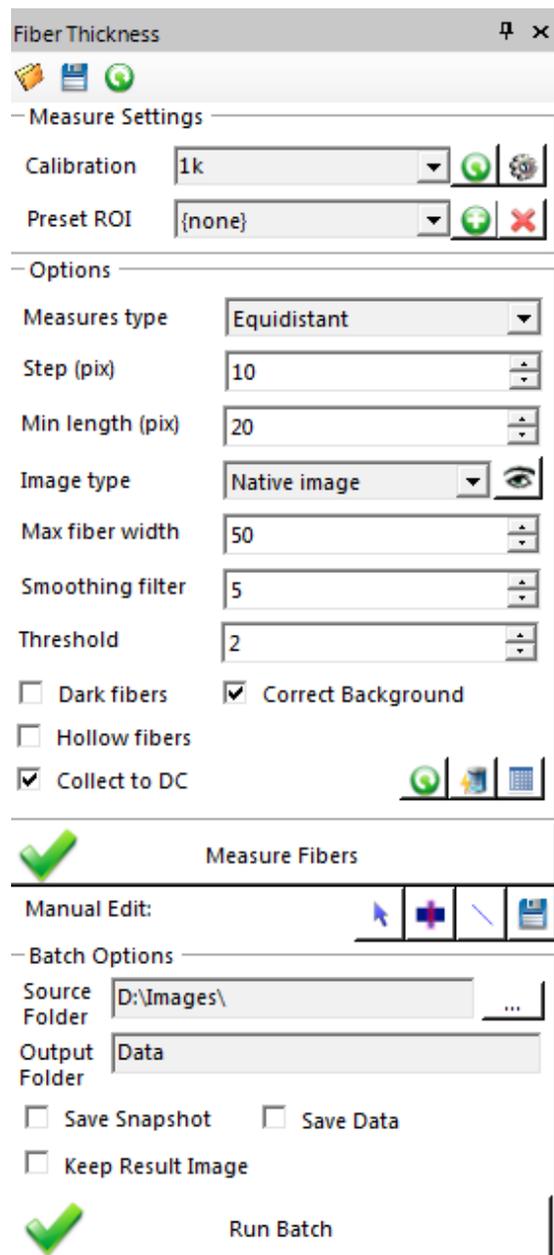# Fiber Thickness App

## Description:

The application is designed to measure thickness and orientation of fibers on images. The app has simple user interface that allows measuring fiber thickness in automatic and manual modes. The app supports batch processing.

## User Interface:

The app dialog:

The *Measure Settings group* contains basic measurement options:

**Calibration** – defines spatial calibration for images. When the option is set to "none" the current image calibration is used. The **Refresh** 🌐 button refreshes the list of calibrations. Clicking the **Create** ⚙️ button will prompt you to create a quick calibration using a reference feature on the image, e.g. Scale Bar.

**Preset ROI** – can be used to define preset Region of Interest, so the grains can be measured only within that region. It can be used for SEM, TEM and other images where part of the image could be covered by a scale bar or other overlay. The active ROI can be added to the Presets using the **Add** ➕ button; you will be prompted to give preset ROI name. The selected preset can be removed using the **Delete** ❌ button.

*Options group*

 The app has 3 options:

***Measures type -*** defines the type of fiber thickness measurements.

- ○ *Equidistant* – thickness is measured on fiber segments with given interval defined by the **Step** parameter (pix). This mode should be used when Average fiber thickness should take into account length of every fiber (longer fibers will have bigger contribution to the Average value). Or variations of the thickness along the fiber should be taken into account.
- ○ *Central Point* – thickness is measured only in the central point of fiber segments. This mode should be used only when one measure per fiber segment is necessary.

Note, that the "fiber segment" refers to the skeletonized version of the fiber image, which is limited by fiber ends or fiber crossings. Examples of different Measure types:
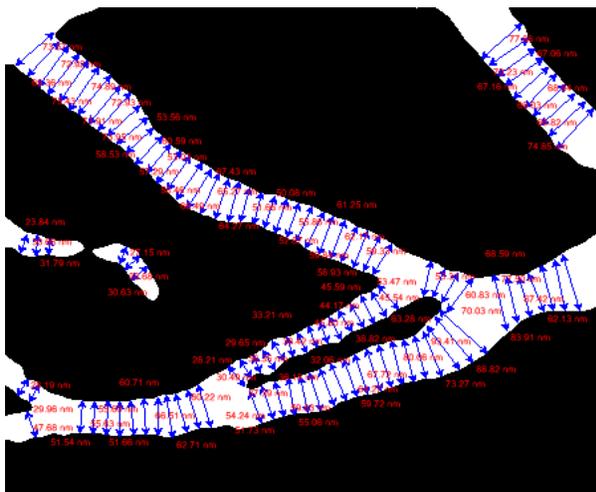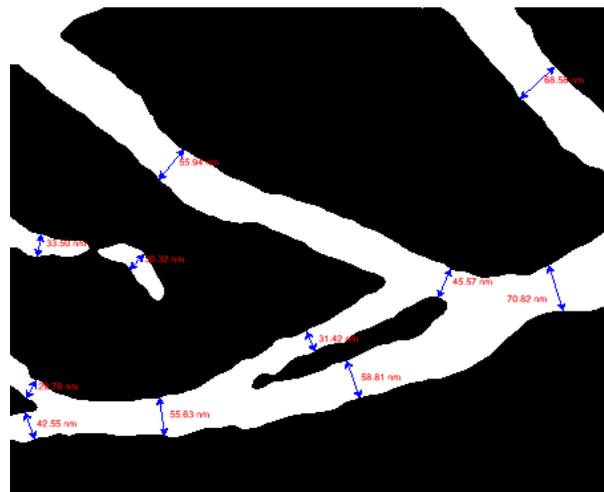


a) Equidistant                                       b) Central Point

*Step (pix)* – defines the interval between thickness measurement lines along the fiber in Equidistant mode.

*Min Length (pix)* – defines the minimum length of fiber segments to be measured in pixels. The parameter is also used to define offset from the crossing points of the skeleton to create thickness measures.

The source **Image type** can be:

> - *Native Image* - typical case, when you have gray-scale or color image.

> - *Binary Image* - if you want to do binarization of your image yourself. It can be used if the image requires custom binarization algorithm.

When **Image type** is set to *Native image* the following parameters define the binarization of the images:

**Max fiber width** (pix) – approximately defines the maximum width of the fiber. The parameter is used in Hight Pass filter separating fibers from background. Larger values can be used on high contrast images, where background intensity is very different from fiber intensity.

**Smoothing filter** (pix) – defines the size of the low pass filter applied to the image before binarization. Larger smoothing values remove more noise, though it can also eliminate very thin fibers, so the parameter should be adjusted based on the image quality and minimum fiber thickness.

**Threshold** – defines segmentation threshold detecting fibers on edge-filtered image. The lower the value, the higher the sensitivity, more weak fibers can be detected. Increase the value to detect only well-defined fibers.

**Dark fibers** should be checked when fibers are darker than the background.

The **Correct background** option should be used when fibers are on uneven background, for example on SEM images. If the images do not have background (pile of fibers on top of each other) this option should be switched off.

The **Hollow Fibers** checkbox should be used when the fibers are hollow inside (the intensity in the middle of the fiber is close to the background intensity), as on the image below.
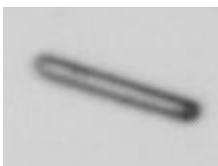


The correctness of segmentation parameters can be checked clicking the **Preview**  button. User may use this button multiple times trying to find parameters for optimal fiber binarization.

Clicking the **Measure Fibers** button will generate fiber thickness measurements as lines and collect te measurements to the Data Collector when the **Collect to DC** option is on. The collected data includes *Image display name* and thickness measurements (Mean/Min/Max/Count) as well as fiber orientation (Mean, StdDev). Orientation is measured in degrees relatively to the horizontal X axis.

Addition buttons can be used to **Reset Data Collector** , **Collect Data** from active image  and **Show Data Collector Table** .

If necessary, the thickness measures can be edited manually using the buttons in **Manual Edit** group:

 - activate measurements selection mode

 - activates Line tool with ***Auto Snap*** to fiber edges. The line should be drawn across the fiber and it will automatically be snapped to fiber edges when the mouse button is up.

 - activates Line tool to draw new thickness measurements manually. In this mode the Local zoom window is automatically activated to help precise positioning of the line.

 - save image with measurements to a file (TIF).


The *Batch Options* group contains controls for batch processing of multiple images in automatic mode.

The **Source Folder** defines the folder with source images (in TIF, JPG, BMP or PNG formats).

The **Output Folder** defines a sub-folder for eventual batch processing data, *Output folder* will be created inside the *Source Folder* and will contain the measurement data. (default Output Folder is ***Data***).

When the **Save Snapshot** control is active the image snapshot with measurement overlay is saved in JPG format to Output Folder (with image name and JPG extension).

When the **Save Data** is active the individual grain size data is saved to Excel file to Output Folder (with image name and XLS extension).

The Output folder will also contain *FiberStats.xls* file with measurement values from all images in the folder as a single table.

The **Keep Result Image** option prevents closing measured images during batch processing.

Clicking the **Run Batch** button processes all images in the source folder.

The options can be saved to a file (), load from a file () or reset to defaults (). The options are saved with FTO extension (Fiber Thickness Options).

## Code:

The code can be used as an example to command-driven app executing image processing, segmentation and measurements.