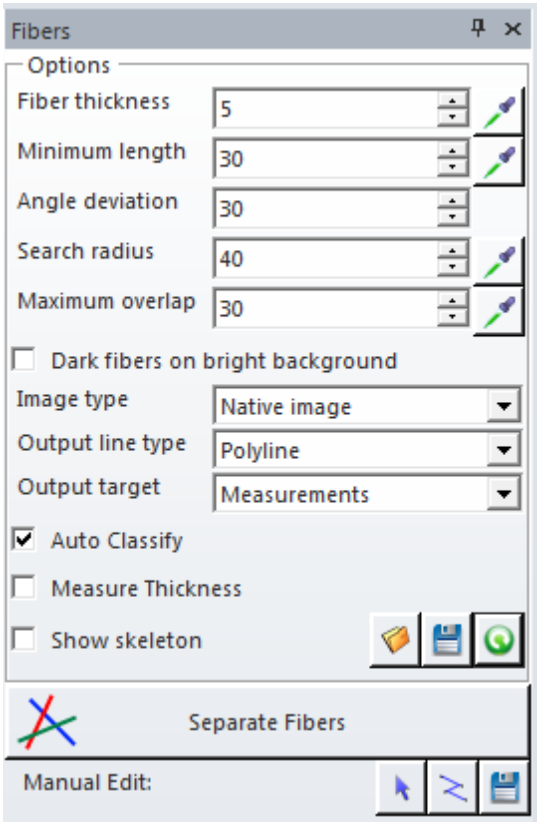
Fiber Separation Application

Description:

The application is designed to separate and measure crossing fibers on images. The fibers on images can be straight and bended. It can be used to measure distribution of thin inclusions or asbestos fibers.

User Interface:

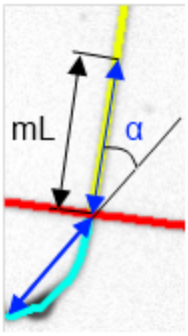


The **Fiber thickness** parameter defines the thickness of fibers in pixels. This parameter is used in pre-processing to extract skeleton of the fibers, the number of pruning iterations depends on this value.

Use the **Measure on Image**  button to measure length on image.

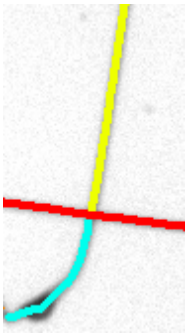
The **Minimum length** defines the minimum fiber length in pixels. Fifers shorter than this limit will be ignored.

The **angle deviation** defines how much the fibers can be bent. If the limit is small, only straight fibers will be detected as separate. This parameter is used connecting branches in the node area. If the orientation of branch vectors differs for more than the given value, the branches will not be connected and considered as separate.

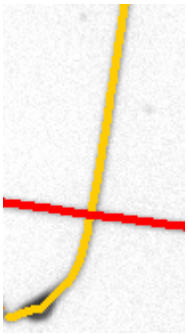


The angle **α** is calculated between vectors at crossing or merge points of vectors. If the length of the vector is less than mL (90 pix default) then the whole vector is used (start to end), if the vector is longer than mL, the only part of length mL on that vector is used. The fibers get linked only if the angle **α** between 2 vectors is less than **angle deviation** . (mL is defined as m_DirectionLength in the code).

Below is the result:



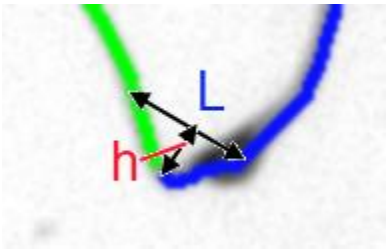
a)



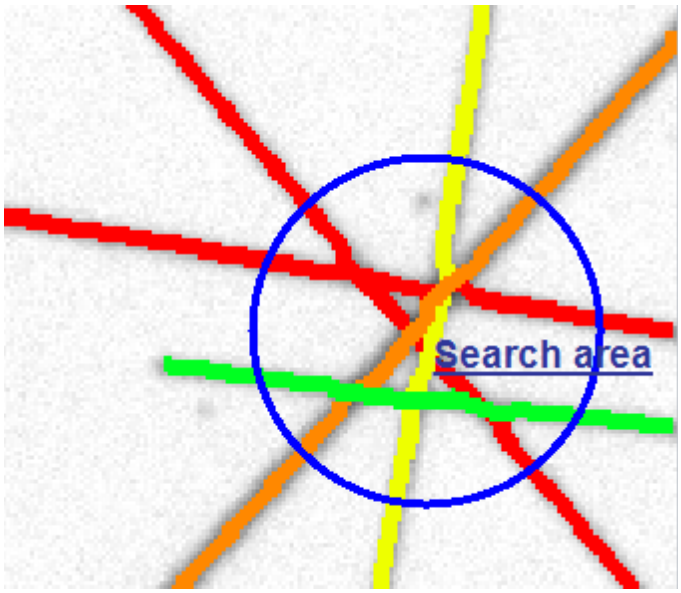
b)

a) Angle = 30, yellow and cyan fibers are considered separate. (b) Angle = 60. The 2 segments are connected.

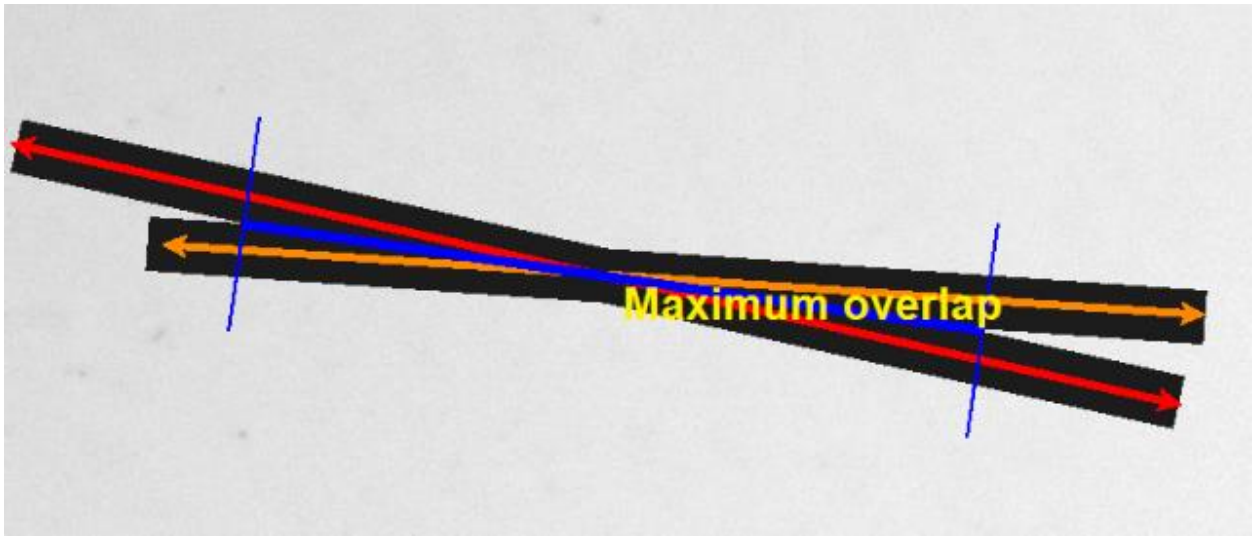
Note, that a single connected fiber can be split into several parts if it bends for more than **h** (5 pixels) from the straight line **L** of length 20 pixels that connects 2 points on the fiber. (L and h limits are defined as m_StraightLineLen and m_StraightLineDeviation in the code).



The **Search Radius** defines the maximum size of the fiber crossing area, which will be analyzed for fiber connections. Below is the example of such crossing area, the **Search Radius** should be bigger than that size.



The **Maximum Overlap** defines the length or the area where two fibers can be overlapped, but still be separated if they have visible exits. The image below illustrates how the maximum overlap can be measured.



The default type of fiber image is bright fibers on dark background. If you have other type, activate the **Dark fibers on bright background** check box.

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.

- *Skeleton* - when user does skeletonization using custom algorithm.

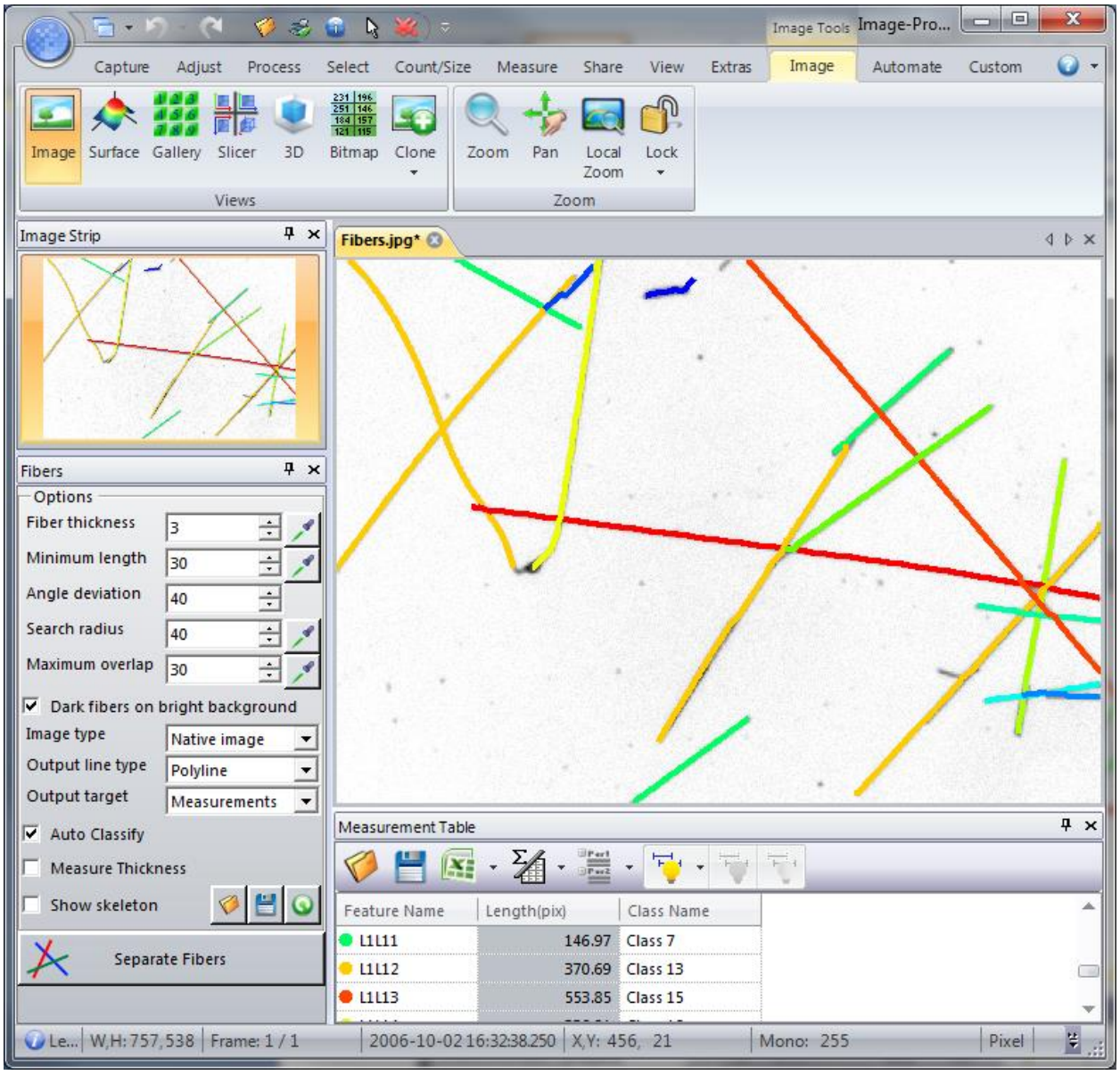
The **output line type** can be *Polyline* or *Start-end line.* With Polyline type the output will be a polygonal line following the skeleton branches. In case of *Start-end line* the output is a straight line connecting the first and the last point of the fiber.

The **output target** can be *Measurements* or *Annotation*. The default output is Measurements. You can use Annotation experimenting with input parameters, where you can also activate **Show skeleton** checkbox to follow the fiber separation algorithm step by step. When output target is set to *Measurements* and the **Auto Classify** option is on, the fibers will be automatically classified by length after separation.

Clicking the **Separate fibers**  button will separate the fibers and show them on active image as *Measurements* or *Annotation* (depending on **Output target**).

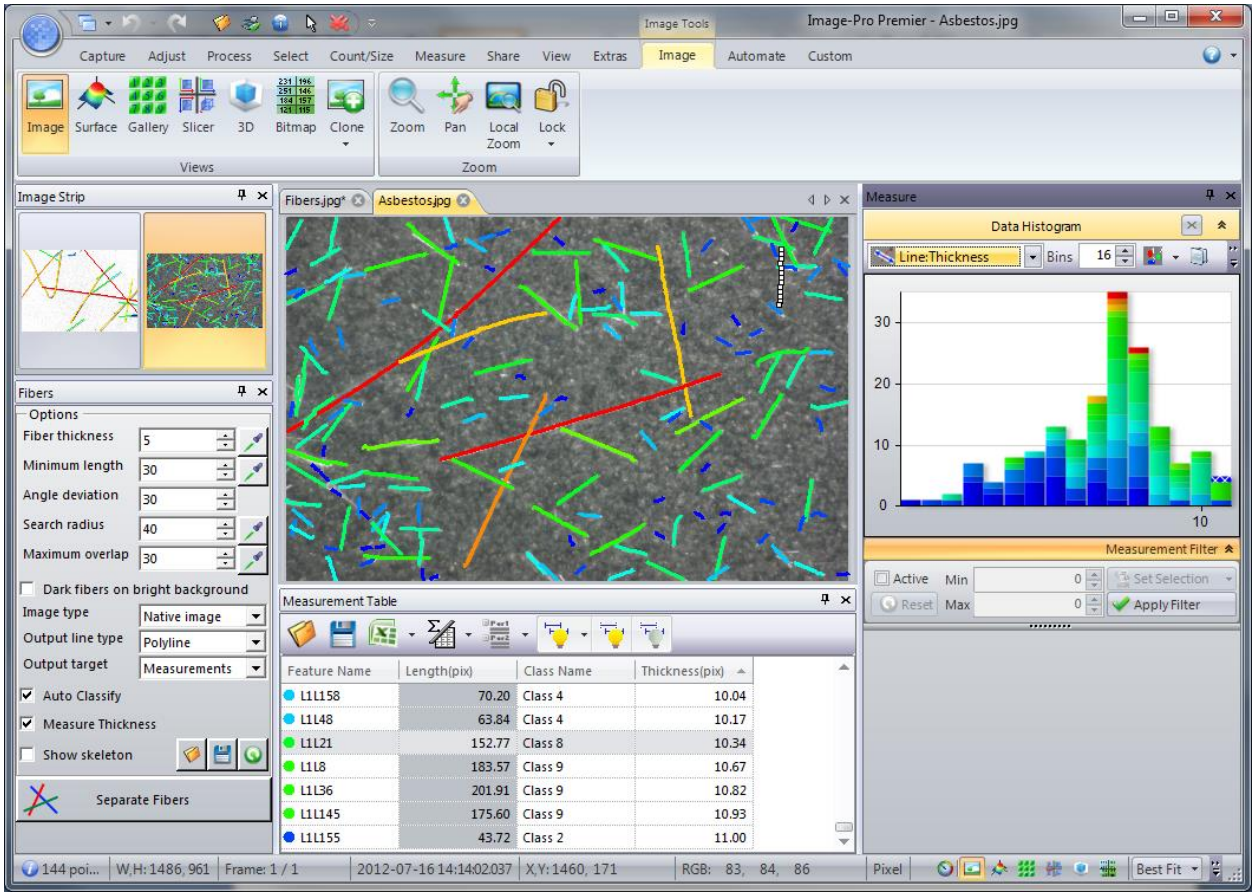
Note, that the app respects the "*Clean Borders*" flags of the measurement options, so fibers touching borders defined by these flags will be ignored.

Below is the example of fiber separation on test image Fibers.jpg:



When the Auto Classify option is active, the fibers are classified by length to show them in different colors.

In some cases you may need to measure fiber thickness. It can be done activating the **Measure Thickness** checkbox. When this option is active the average fiber thickness, based on the thickness of binarized fiber image, is measured. The **Line:Thickness** measurement is automatically added to the selected list of measurements and reported in the data table and other data windows:



Demo files:

Demo image can be downloaded from
ftp://ftp.mediacy.com/uploaded/Premier_Apps/FiberSeparationDemo.zip

Code:

The code can be used as an example to low-level image processing and measurements. The application runs in Compiled mode for better performance.