

Circles Application

Description:

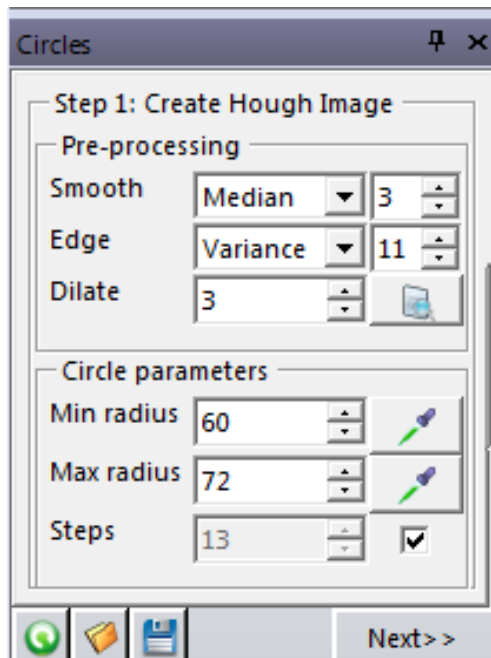
The Circles application is designed to locate and measure round objects (circles) on images. Circles with well defined edges can be measured. Circles can be partially hidden or overlapped. The app is based on the Circular Hough Transform methodology. It is built as a multi-step Wizard of the Find Circles function of Image-Pro Premier.

User Interface:


The app panel contains a multi-step Wizard. Each page is a different step in the process.

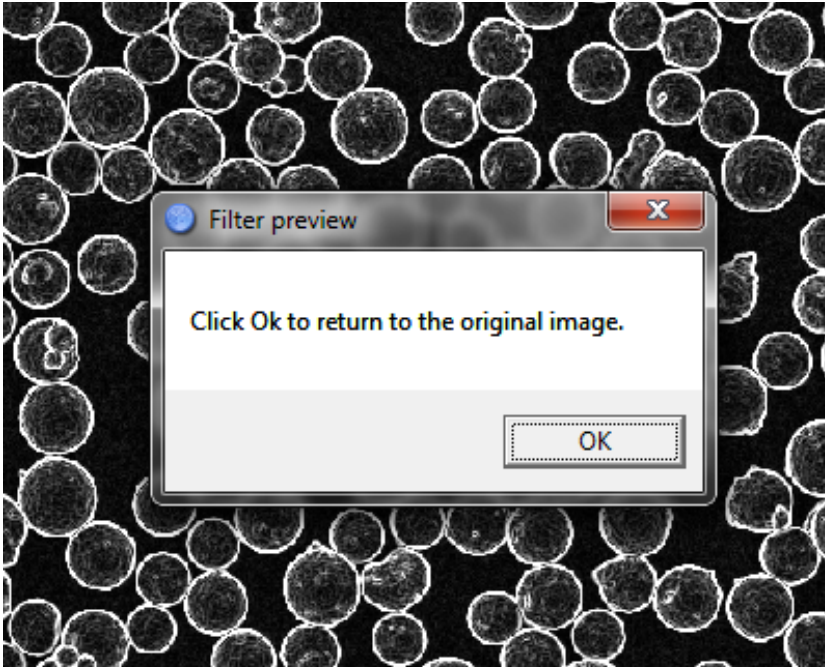
Step 1: Create Hough Image

On the first panel, you can select the desired pre-processing options that extract the edges of the circles.




Pre-Processing:

- **Smooth:** Select the desired smoothing filter (*None, Lopass, Gauss, Median*) and filter strength. The smoothing filters are useful for removing noise from the image.
- **Edge:** Select the desired edge extraction filter (*None, Sobel, Variance, EdgeMinus, EdgePlus*).
- **Dilate:** Enter a value to set the size of post-filter dilation. This increases the thickness of the edge outline in order to make it more pronounced.
-  **Preview:** Use this tool to preview the results of the pre-processing settings for the purposes of edge detection. When you click this button, you will see something like the following:

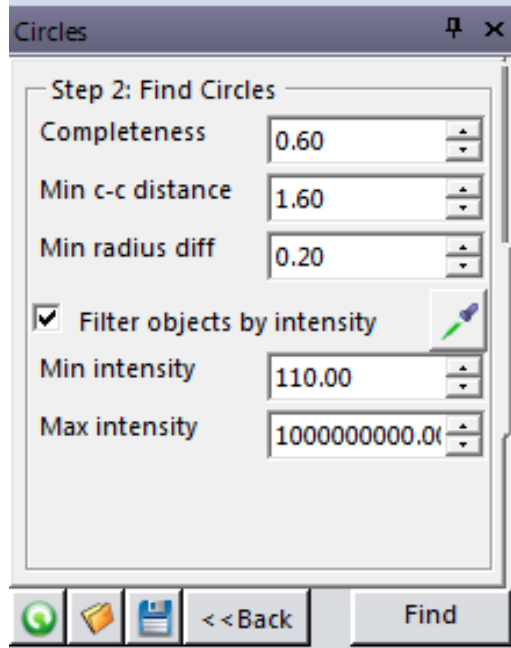


Use **Prefilter** to select the filter to extract circle edges. Use **None**, if the image is already processed and circles are extracted. (Circles must have bright outline on dark background).

Circle Parameters

- **Min radius** and **Max radius**: The values entered in these spin boxes define the minimum and maximum size of the circles to find. Clicking the eye dropper button  allows you to select the radius right from the image.
- **Steps**: The value entered for this option defines the number of Hough images to be created detecting circles from Min to Max radius. This parameter defines the granularity of detected circle radiuses. When the **Auto** checkbox is active, the number of steps in circular Hough transform is calculated based on the range between **Max** and **Min** radii.

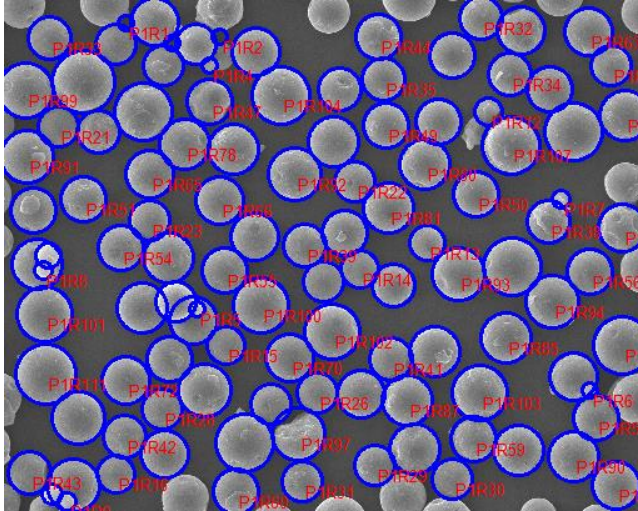
Click the **Next** button to execute Hough transform for all radius steps and show the second page of the dialog:



Step 2: Find Circles

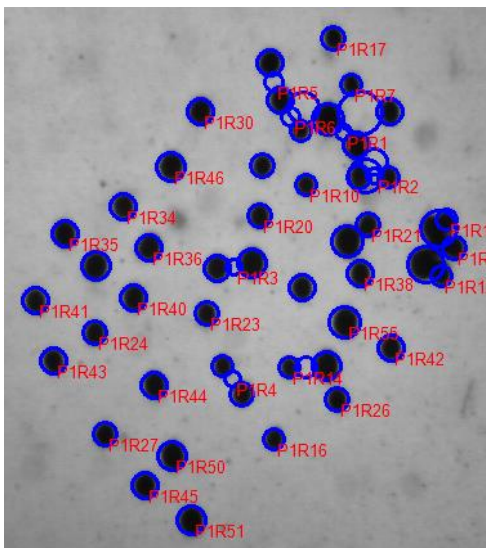
- **Completeness:** The Completeness parameter defines how complete circles should be to be considered circles. Set this value to 1 to locate only complete circles, if the value is set to 0.5 then even half-circles will be located. The values from 0.6 to 0.8 produce the best results. The Completeness value assumes that the circles on the original image or after edge preprocessing have maximum intensity corresponded to the image class (e.g. 255 for Gray8). If the circles have lower intensities, the value has to be increased proportionally.
- **Min c-c distance:** The minimum center-to-center distance option defines how close circles of the same radius can be. This parameter is in minimal radiuses. The default value is 1.0, which means that the circles of the same size cannot be closer than minimum radius (Min Radius). If the objects on your image cannot be overlapped the parameter should be set to a bigger value (e.g. 1.8).
- **Min radius diff:** This option defines the minimum difference in circle diameters when circles have the same center point. The value is relative to the Radius range (Max Radius-Min Radius). The default value is 0.3, which means that the circles can be located separately if their diameters are different for more than 30 percent of the range. If there are no circle overlaps on the image, the parameter should be set to 1.


Click the **Find** button to execute the Find Circles operation. Image-Pro Premier will auto-locate the circles on image based on your settings:



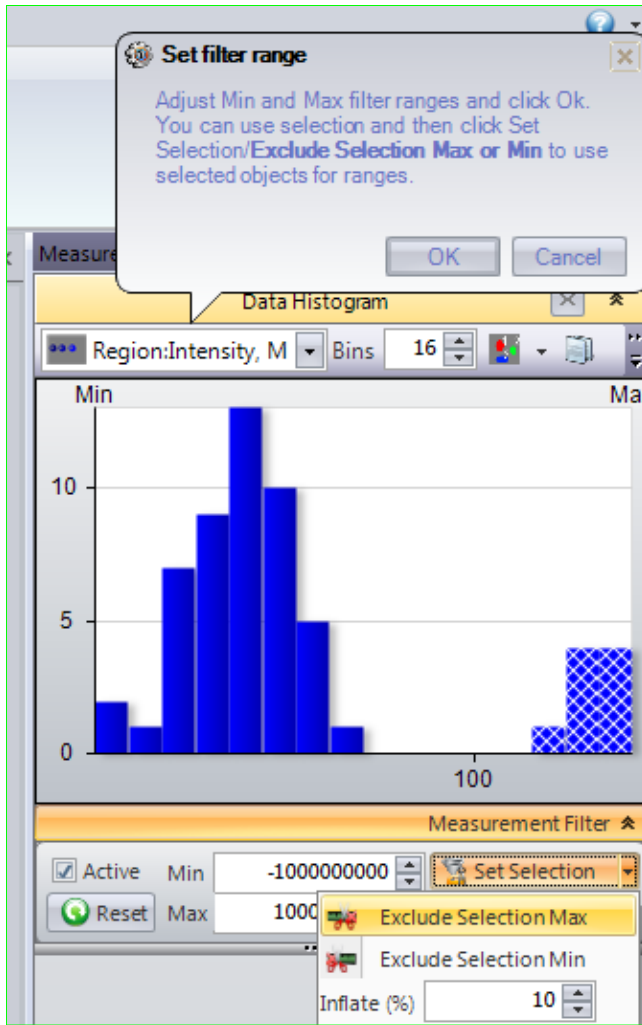
If the results aren't ideal, you can return to the various parameters on the first and second pages of the wizard and adjust them to try and improve the results. Then click the Find button again.

The option **Filter Objects by Intensity** can be used to remove unwanted objects created in between real objects (as shown, for example, in the image shown below).



The Filter Objects by Intensity option can be used when the internal intensity of circles is different from the background intensity. You can use the **Select Intensity Range**  button to set ranges on the data histogram to define the range of intensities that represent the real objects of interest. When you click the Select Intensity Range tool, you will be prompted to do the following:

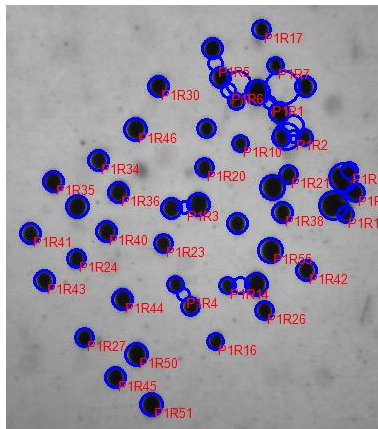
1. Select unwanted objects by clicking on them in the image. (Optionally, you can define the range through the Data Histogram dialog.)



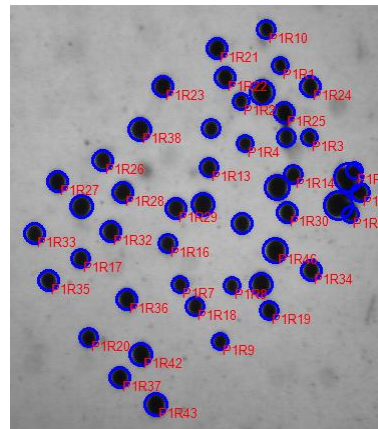
2. Use the **Exclude Selection Max** or **Min** to calculate range excluding values from the selection.

3. Click Ok to set the ranges for the Circle finding options.




The example below shows the results without and with the filtration (range 0-80):



Without Filtration



With Filtration

The options can be saved to a file () , load from a file () or reset to defaults () .

Demo files:

Demo image can be opened from

<Image-Pro Premier Demo Images>\Count and Size\Shapes\CirclesDemo.tif

Code:

The code can be used as an example to command-driven app with multi-page wizard. Some commands use Interaction mode.

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