DATINF® GMBH – DATENANALYSE & ANGEWANDTE INFORMATIK

Manual

Scientific Counter

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Introduction

When counting a number of significant objects in a picture, a software solution is more than often a better alternative to manual counting. For object detection in more difficult image field areas however, computer programs as human 'counters' are in most cases unsuccessful.

Scientific Counter is a flexible software solution for the counting of cells, colonies, holes in foam or other objects in digital images. The software's diverse range of setting possibilities enables the meeting of the widest possible range of requirements. Through this we hope, that our software can be of significant assistance in dealing with field areas of 'difficult pictures'.

The flexibility of the software makes it necessary to have a sound understanding the effects associated with the various assessable settings. In this guide you will find short descriptions as well as illustrated examples explaining all settings. For the purpose of simplifying the program for a daily use, a few settings examples have been put together as templates, which can be used as a starting point for adapting one's own analysis tasks.

The software works with pictures of various resolutions and formats. With aid from the use of a faster algorithm, the software is also excellent for the analysis of high-resolution images.

Scientific Counter provides a graphical user interface for the easy setting of parameters. The selectable option for displaying the progressive steps of the analysis in a test section of the original image allows a convenient and fast optimization of the most important parameters.

From Picture to Number Count

Finding the optimal program settings for a specific picture type is not always easy. In principle, the objects to be counted should be well recognizable and as consistent as possible. The first adjustment can always be made after the following step sequence. For fine-tuning, it's usually necessary to make variations on one or two of the parameters and compare the results. For adjustment of the parameters, more representative images should be used to cover the widest possible range of occurring situations.

Steps for Adjusting the Settings

The words marked in bold denote the respective category in the Options window.

1. Load Image
2. Open the Options window (click on `Option settings' or under `Options' in the menu bar select `Load options')
3. **Color Selection**
   - Invert the image if the objects are too dark
   - Select a color in which the most relevant objects will be recognized.
4. **Analysis Area**
   - Define the area of analysis (selection of the image area to be examined)
5. **Image**
   - Image preprocessing: Find the brightness trend in the image, set the background median filter to 100. If the trend remains visible, reduce the median filter gradually. If relevant objects disappear, increase the filter likewise.
   - Image preprocessing: Small disturbances in the image? Try setting the mean filter to 3, variating if necessary.
6. **Objects**
   - Indicate the criteria for object selection, e.g. to count all found objects:
     Size: 0-∞
     Brightness: 0-255
     Form: 0-1
7. **Separation**
   - Is a separation of areas desired?
     If so, define selectivity and convexity if needed and enter as exclusion criteria.
8. Start test analysis
9. **Test Result**

- Examine the result of the test analysis: Under the test result some of the parameters of an object will be displayed by moving the mouse over that object; if necessary, adjust the appropriate criteria and repeat the analysis.

If the analysis is carried out successfully, go on to define further criteria and properties:

10. **Parameters**
    - Selection of the object parameters to be displayed. Display with standard deviation or median?
11. **Scale**
    - Indicate a scale if necessary
12. **Histogram**
    - Selection of displayed size in Histogram
13. **Markings**
    - Check the marking color: If the color of the picture is similar to the marking color, the marking color should be changed
14. **Save**
    - Determine in which folder the analysis results should be stored; when you click on 'save' in the main window.
      E.g.: C:\results.txt, C:\result-details.txt.
15. **Print**
    - Choose a format for printing. If the input box is left empty the standard format will be used.

When the detection process has worked well enough and all further settings are made, click on 'Apply' to analyze the whole image. In affiliation, further fine-tuning of parameters can be carried out if necessary. Useful information is provided in the 'Details' window. Move the mouse over an object and diverse parameters for that object can be read under 'Selected object info'.

Object Parameters

Direct Parameters

The following table outlines the Scientific Counter calculated *direct object parameters*. These are required for the defining of the *derived parameters* and are defined through direct measurement in the image.

Parameter	Figure	Description
Minimal FERET-Diameter	F_{min}	Smallest possible projection of the object's dimensions
Maximal FERET-Diameter	F_{max}	Greatest possible projection of the object's dimensions
Area	A	Area of the object
Convexual Hull	A_{conv}	The convexual hull of the object
Perimeter	P	Perimeter of the object
Perimeter of convexual surface area	P_{conv}	Perimeter of convexual surface area of the object
Diameter of area	D_A	Average diameter of a circle whose area is equal to the size of the object
Diameter of perimeter	D_p	Average diameter of a circle whose perimeter is equal to the perimeter of the object
Inner circle radius	R_{in}	Maximum radius of the circle within the object (inner circle)
Outer circle radius	R_{out}	Minimum radius of circle surrounding the object (outer circle)
Inner circle diameter	D_{in}	Maximum diameter of the circle inside the object (inner circle)
Outer circle diameter	D_{out}	Minimum diameter of the circle surrounding the object (outer circle)

Table 1. Direct Parameters

Derived Parameters

The derived object parameters are determined through the above indicated direct parameters and are listed and explained in the following tables:

Parameter	Figure	Description
FERET-ratio	F	Measure of the compression or expansion of an object
Radii ratio	R	Measure of the spatial extent of an object
Form	S	Measure of deviation from circle form
WADELL- circulatiry ratio	S_W	
Deg. of circularity	S_K	
TICKEL-ratio	S_T	
HORTON-compactness	S_H	
PENTLAND-Projection	S_P	
Modification parameter	S_M	
Extent ratio	S_E	
Convexity	C_K	Reciprocal of convexity (s. *convexual hull)*
Deformation	C_R	Measure of the amount of ‘‘cracks’’ and ‘‘indentations’’ on an object
Solidity	C_F	The measure of how strong the surface of an object ‘‘melts’’ in different directions into the surrounding space (s. *convexual hull)*

Table 2. Derived parameters

FERET-Diameter ratio

Measure of the compression or expansion of an object		
Formular	Range values	Circle
$F = \frac{F_{\min}}{F_{\max}}$	$0 < F \leq 1$	1

Circle-radii ratio

Measure of the spatial extent of an object		
Formular	Range values	Circle
$R = \frac{r_{in}}{r_{out}}$	$0 < R \leq 1$	1

Form

Measurements of how much the shape of the object within the circle converges depending on area and perimeter		
Formular	Range values	Circle
$S = \frac{4\pi A}{P^2}$	$0 < S \leq 1$	1

WADELL- Circularity ratio

Measure of how much the form of the object within the circle converges depending on the diameter of the circle, whose area is equal to the surface of the object, and maximum Ferret diameter		
Formular	Range values	Circle
$S_W = \frac{D_A}{F_{\max}}$	$0 < S_W \leq 1$	1

Deg. of circularity

Measure of how much the form of the object within the circle converges depending on area and perimeter (*deg. of circularity = Form$^{1/2}$*)		
Formular	Range values	Circle
$S_K = \frac{2\sqrt{\pi A}}{P}$	$0 < S_K \leq 1$	1

TICKEL-Ratio

Measure of how much the form of the object within the circle converges depending on area and outer circle diameter		
Formular	Range values	Circle
$S_T = \frac{4A}{\pi d_{out}^2}$	$0 < S_T \leq 1$	1

HORTON-Compactness

Measure of how much the form of the object within the circle converges depending on area and perimeter (*HORTON-Compactness = 1/curve degree*)		
Formular	Range values	Circle
$S_H = \frac{P}{2\sqrt{\pi A}} = \frac{1}{S_K}$	$1 \leq S_H <$ INF	1

PENTLAND-Projection

Measure of how much the form of the object within the circle converges depending on area maximum Ferret-diameter		
Formular	Range values	Circle
$S_P = \frac{4A}{\pi F_{\max}^2}$	$0 < S_P \leq 1$	1

Modification parameters

Measure of how much the form of the object within the ellipse converges depending on inner-circle radius and maximum Ferret-diameter		
Formular	Range values	Circle
$S_M = \frac{r_{in}}{F_{\max}}$	$0 < S_M \leq 1$	0,5

Extent ratio

Measure of how the surface area of the object behaves in relation to an imaginary rectangle with sides of lengths $F_{\min}$ and $F_{\max}$		
Formular	Range values	Circle
$S_E = \frac{A}{A(F_{\min} \cdot F_{\max})}$	$0 < S_E \leq 1$	0,785

Convexity

Reciprocal of convexity (s. *convexual hull)*		
Formular	Range values	Circle
$C_K = \frac{P_{conv}}{P}$	$0 < C_K \leq 1$	1

Deformation

Measure of the amount of "cracks" and "indentations" on an object (*Deformation = 1/convexity*) (s. *convexual hull)*		
Formular	Range values	Circle
$C_R = \frac{P}{P_{conv}} = \frac{1}{C_K}$	$1 \leq C_R < \text{INF}$	1

Solidity

The measure of how strong the surface of an object "melts" in different directions into the surrounding space (s. *convexual hull)*		
Formular	Range values	Circle
$C_F = \frac{A}{A_{conv}}$	$0 < C_F \leq 1$	1

Comparative table of some geometric objects

	Circle	Ellipse 2:1	Square	Rectangle 2:1	Spicule 10:1	Double circle	Half ring 2:1
FERRET ratio ***F***	1.00	0.50	0.71	0.45	0.10	0.50	0.50
Form ***S***	1.00	0.85	0.79	0.70	0.26	0.50	0.28
Radii ratio ***R***	1.00	0.50	0.71	0.45	0.10	0.50	0.50
WADELL S_W	1.00	0.71	0.80	0.71	0.11	0.71	0.51
Deg. of circularity S_K	1.00	0.92	0.89	0.84	0.51	0.71	0.53
HORTON S_H	1.00	1.10	1.12	1.19	1.98	1.41	1.90
TICKEL S_T	1.00	0.50	0.64	0.50	1.12	0.50	0.26
PENTLAND S_F	1.00	0.50	0.64	0.50	0.12	0.50	0.26
Modification S_M	0.50	0.25	0.35	0.22	0.05	0.25	0.09
Extent S_E	0.79	0.79	0.71	0.89	1.00	0.79	0.41
Convexity C_K	1.00	1.00	1.00	1.00	1.00	0.82	0.90
Deformation C_R	1.00	1.00	1.00	1.00	1.00	1.22	1.11
Solidity C_F	1.00	1.00	1.00	1.00	1.00	0.88	0.51

Table 3. Theoretical values for object parameters

The Convexual Hull

Through the determination of the convexual hull of an object, conclusions can be made about deformation through cracks and depressions. With an increasing deformation of an image object, i.e. declining convexity, the probability increases that it has to do with the overlapping of several *real objects,* which are separate from one another and in detail. The following example demonstrates the concept of the convexual hull:

Fig. 1: Convexual hull

- Left: Object before analysis
- Middle: Hull, whose curvature in respect to the object is always convex, no longer possessing indentations
- Right: Enclosed areas of the convexual hull are filled in

Comparing the old and new area or the old and new perimeter enables conclusions to be made about how strong the surface of an object ‘‘melts’’ in different directions into the surrounding space or if an object is deformed through cracks and indentations.

For enclosed objects such as Ellipses and rectangles, the convexual hull of the derived parameters CR, CK and CF are always 1.
The *convexity* C_K can be used as a selection criterion for the separation of the objects involved. E.g. If many enclosed objects are found in an image which can be identified individually with the naked eye, they can be excluded by configuring the option of *Convexity-exclusion-criterion* before object separation in an image analysis, in order to save counting time. See the chapter on "Description of options".

Program Controls

Following a successful analysis the main window looks like the example in Fig.2. The diagram portrays the size distribution of the detected objects. In the example (Fig. 2) 75 objects with a size of 0,7 mm^2 are found.

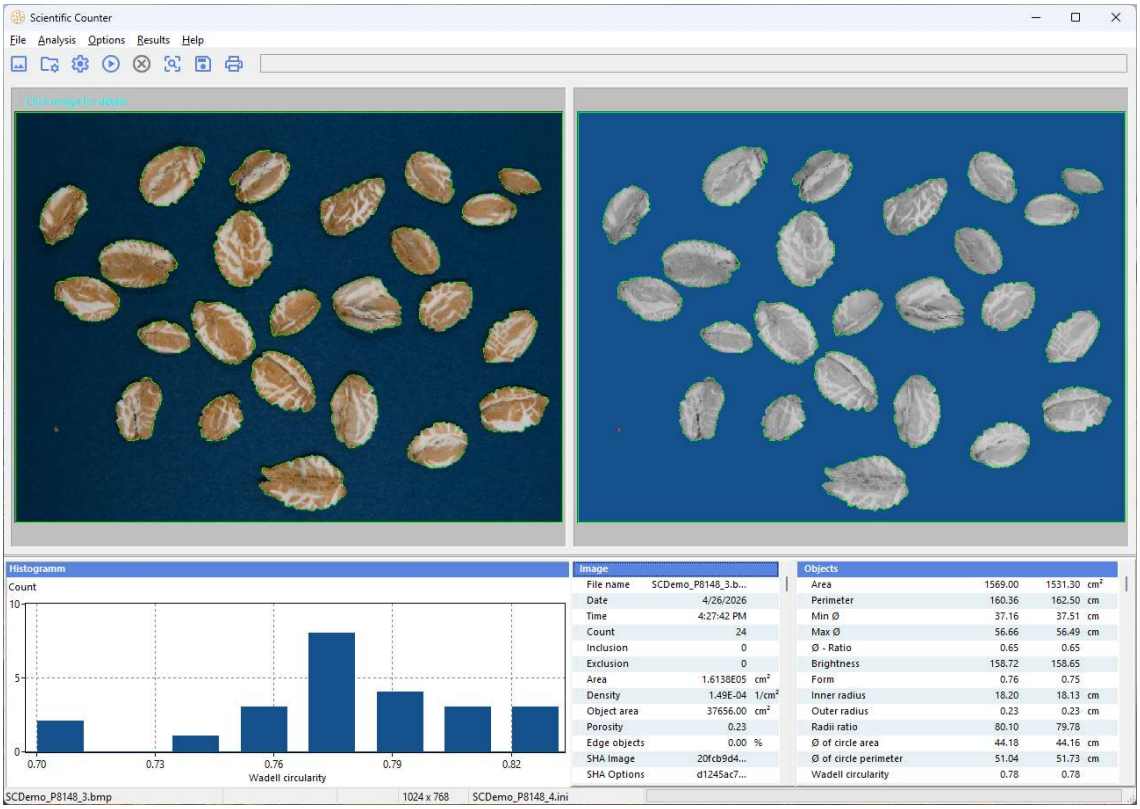

Fig. 2: Screenshot after analysis

Standard Settings

Upon starting the program, the file DISCdefault.ini from the program directory will be loaded. This file is responsible for options used for image analysis. When you are satisfied with the suitable options, you can save these options as the new standard options (DISCdefault.ini) under Menu, Options -> 'Save options as standard'. These settings will then be loaded automatically upon program startup.

Using the example templates

The program provides some sample pictures (SampleImage1.jpg, ..., SampleImage4.jpg) and matching configuration files (SampleOptions1.ini, ..., SampleOptions4.ini). These configuration files can be used as a starting point for the adjustment of parameters in one's own images. For this the configuration of the images most similar to one's own image should be selected.

Setting program options

The 'Options' window allows for a comfortable adjustment of the program settings. Settings for the selection a section of an image for analysis and for the giving of results can be adjusted.

Fig. 3: Screenshot of Options window

Like all important windows of the program, this window is freely scalable. With a bigger image display, a more precise observation of the steps of analysis is possible, in which details are easier to recognize.

The meanings of the individual parameters are explained in the section entitled "Description of parameters" in this manual. In addition, in the program

a brief description of the importance of setting possibilities can be found as a small supporting aid.
It won't always be possible to find the right settings on the first attempt. The software is therefore designed so it's possible to test and try out various settings. When the suitable settings are found, these can be saved and easily used for the analysis of other images.

Description of Options

General

Under Options, a number of possibilities are available that can be configured for the adaptation of the software for the task of analysis. The settings are briefly explained in the program. A more detailed explanation of the settings is provided in the upcoming sections of this Manuel.
In order to find the most suitable settings faster, it is possible to carry out a test analysis. During the test analysis only a small cut and freely definable image is to be observed.

Test analysis

With bigger images it is helpful (as described below) to be able to initially apply the image options on a smaller image screen area in order to test their effectiveness as quickly as possible.
To do this, select a test field as described in the section, 'Analysis area' and click the button 'Start test analysis'. You can select 'Stop test analysis' at any time for the test analysis to be terminated.
The progressive display of the analysis is an important help for the testing and checking of the options. If the option 'stepwise test analysis' is selected, the test analysis will pause after every relevant intermediate step.
Whether or not suitable settings have been selected is reviewed based on the preliminary analysis of the results.

Color Selection

Invert Image

The software is designed to recognize brighter objects. If darker areas need to be analyzed, the image can be inverted so that these areas appear bright and are therefore detectable by the software.

Blue-channel original Blue-channel inverted

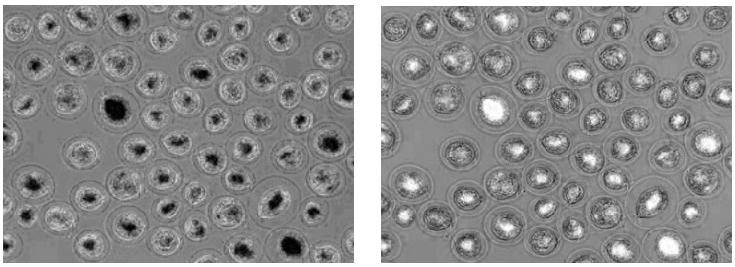

Fig. 4: Example of the effect of image inversion

Color

Chose a color, in which the objects of interest will be recognized best. After changing the Color channel, the analysis image will be updated in the top left-hand side of the options window.

Background: Colored images are assembled from red, green and blue parts. By omitting unnecessary color information, the objects of interest can be more clearly recognized. The brightness information is used for the purpose of generating a grey image.

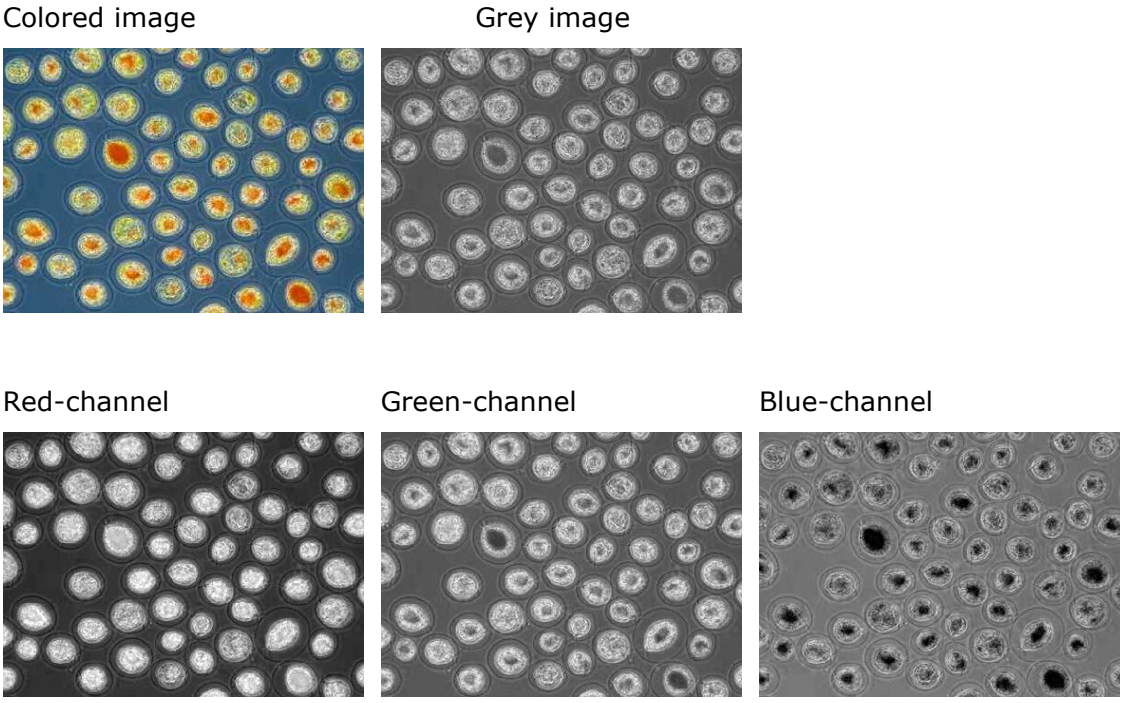

Fig. 5: Example of the effect of different color channels

Absolute Image Difference

For the analysis of crystalline structures the option, 'Absolute image difference' can be selected. This will result in bright and dark areas of the image to be considered, which distinguish themselves from the background of the image.

Analysis area

Various settings for the placement of the image cutting to be analyzed can be found and adjusted under Analysis area. It is often the case that on the edge of the image a Petri dish or holder can be seen.
So that only really relevant areas of the image are analyzed, you can choose to exclude parts of the image.
For the selection of the area of analysis, click on 'Define analysis area' to activate area selection (Fig. 6):

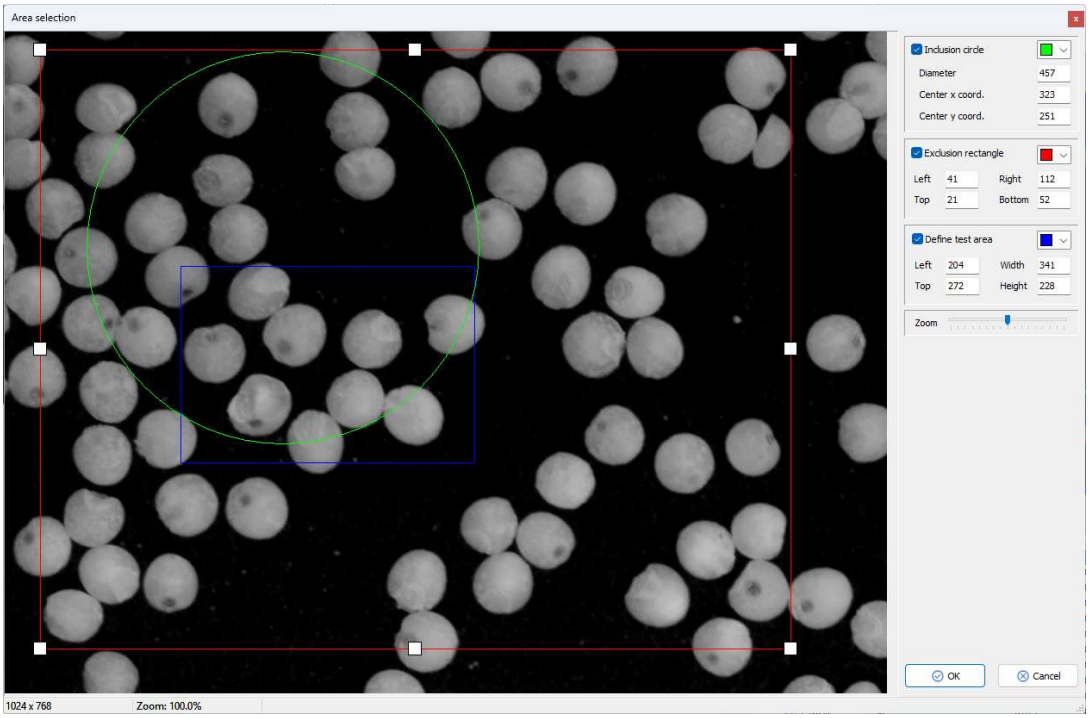

Fig. 6: Area selection

There are three selection frames available, which can be activated or deactivated at any time.

Inclusion Circle

The options under 'Use inclusion' aid in defining and selecting a round area to be used for analysis. The circle diameter can also be made bigger than the image in order to cut off only the corners of an image.

Exclusion Border

The parameters under 'Use exclusion' allow the border of each side of the image to be excluded. A rectangular image area remains, which will be used in analysis.

Defining Test Area

The four area parameters determine the section of the image to be used in the test analysis. The selection boxes under 'Areas' allow you to determine which section of the image is to be used. The selected image section will be shown enlarged in the right-hand window.

The area inside the circle or rectangle will be analyzed. If both sections used are overlapping, the cut surface area is selected as analysis area.

To alter the selection frame, you can either enter digits directly (top right-hand side) or position the mouse (left-click and hold over a border) or expand and contract (click on a corner, hold and drag). The origin of the coordinates is found in the top left corner of the image.

Image

The first step of analysis prepares the image for the counting operation. For instance, a brightness trend (gradient) can be subtracted from the image and noise can be suppressed.

Background Filter

The background filter is used to remove gradients (trends of brightness) or other large scale disturbances in the image. Warning! If the filter is set at a value which is too low, other relevant objects may also disappear from the image. A higher setting should therefore always be tested first, to see if the desired effect can be achieved. A gradual reduction of the filter allows the effect to be easily observed.

If the entire image appears grey after applying the filter, it has been set at a value which is too low. If the background filter is set at zero, it will not be used.

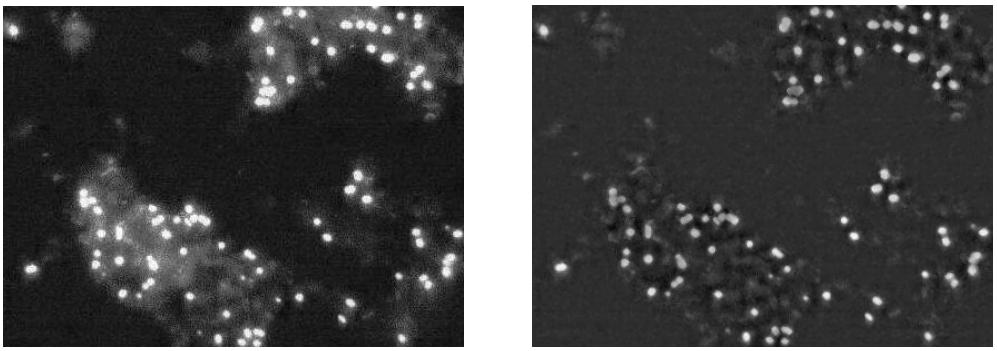

Fig. 7: Example of the subtraction of the background through the application of 'Background filter: 20'

Median Filter

The median filter is used to remove small disturbances from the image. With this, the surrounding points of each individual image element are examined. The mean value of these examined points is considered the new value. After applying the median filter option the image appears 'softer'. The higher the value of the median filter, the less focused the analysis image will appear.

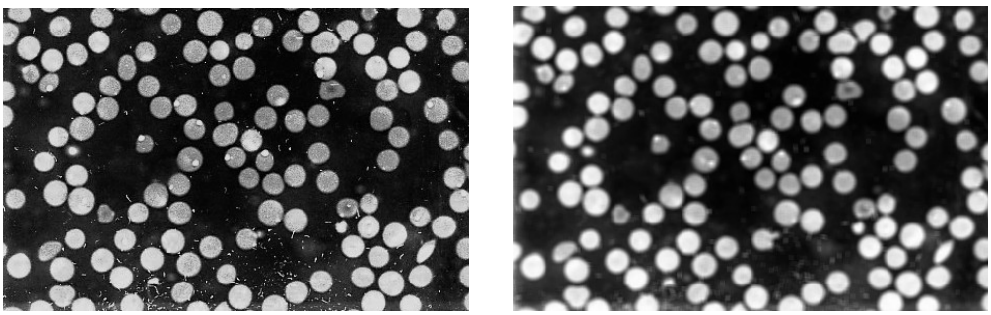

Fig. 8: Example of the use of the Median filter: small image disturbances in the lower area of the picture are almost entirely removed.

Threshold Objects

This parameter allows a threshold to be set, until the image area is accepted as brighter than the object. A large threshold is synonymous with a smaller number of counted objects, while a small threshold results in a larger number of counted objects.

Explanation

The brightness values can be set between 0 and 255. The automatic threshold determination looks for a limit that will be most effective in separating light

and dark areas. Object recognition during a test run functions therefore even with varying background brightness.
Automatic threshold determination can be deferred through the specifications in this parameter.
There are four different threshold types:
SIS ('Simple Image Statistic'*)*
The threshold average will be determined from the amount of the weighted gradient gray values.
Bimodal
A bimodal distribution, whose border is the used threshold, is adapted to the histogram of the grey values.
Bimodal log
Same as Bimodal but with an additional logarithm.
Fixed
This setting prevents an automatic threshold from being determined by the program. The threshold can then be freely chosen.

If too many dark areas are recognized as objects, an appropriate value for the 'Object threshold factor' can be raised. In the shown example (Fig. 9) the automatic threshold value of 120 was multiplied with the factor of 0.8, resulting in the selection of a large amount of unwanted areas. Adjusting the factor to 1.4 resulted in a threshold value of 144 and the desired result.

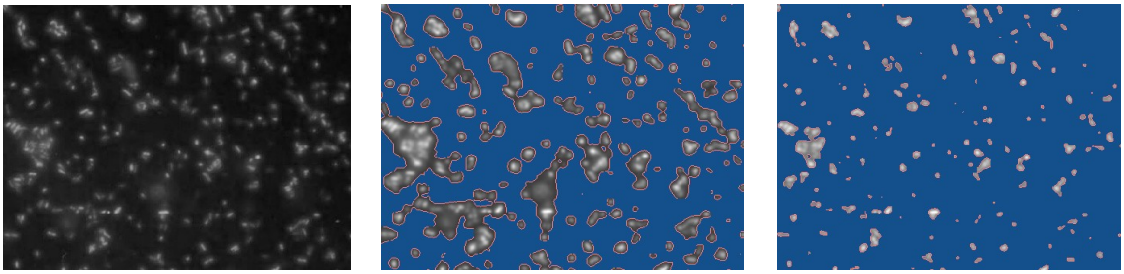

Fig. 9:Threshold: Original image (left), image with threshold factor 0.8 (middle) and 1.4 (right)

Artifact Correction

Artifact correction is calculated in image preprocessing by selecting and activating the 'Artifact correction' box.

Threshold Artifacts

For the recognizing of image artifacts, a threshold value can be given. With this value it can be determined, how bright an object has to appear for it to be recognized as an artifact (e.g. an air bubble). This parameter is closely related to the form factor limit.

Form Factor Limit

Artifacts are differentiated from counted objects mainly by their very uneven form. This factor is used for the recognizing of these artifacts. The form factor exclusion option defines the allowable deviation from the circle form. If the value is less than this allowable deviation, the object is recognized as an artifact and is not counted. By activating 'Exclusion of objects with greater form factor', rounder objects will be excluded and objects with a form factor which is greater than the threshold will be kept for further analysis.

Form factor exclusion is only for objects which are brighter than the 'threshold artifacts' fixed limit.

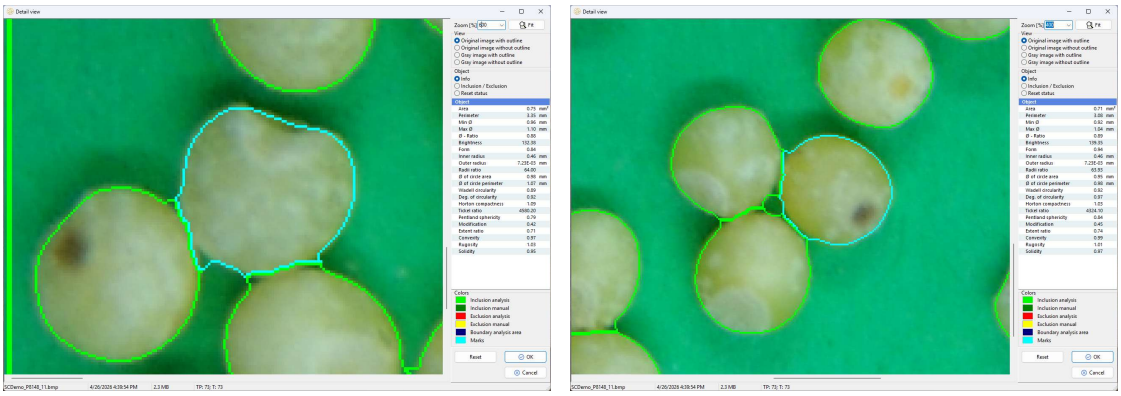

Fig. 10: Object with form factor 0.84 (left) and 0.96 (right)

Objects

In this step of analysis the counting of objects takes place in light of the preparation steps in the 'image' category. Only objects whose size, median brightness and whose form is between the set minimum and maximum are accepted.

Minimum Size

The parameter for the minimum size for an object defines the minimum number of image pixels an object must have for it to be accepted.

Maximum Size

The parameter for the maximum size of an object defines the maximum number of image pixels an object must have for it to be accepted.

Minimum Brightness

This parameter excludes areas which fall below a defined brightness from being recognized as objects.

Maximum Brightness

If particularly bright areas that fill all other criteria of counted objects are excluded, the maximum brightness can fix a threshold for these objects.

Minimum Form

The form factor is the amount of deviation from the circle form. This parameter is used to set the minimum threshold of deviation from the circle form.

Maximum Form

Similarly to the minimum form, the amount of deviation from the circle form is examined. Here, the maximum threshold of deviation from the circle form is set.

Remove Inclusions

With this option, 'holes' in recognized objects can be closed. If, for example, the inner area of an object has the same color as the background, this inner area will then still be counted as part of the object.

Separation

Separate Object Areas

By activating 'Separate areas' it can be set so that an automatic separation of object areas is applied. For this, criteria for separation must be set:

Selectivity

The selectivity indicates the sensitivity with which the object separation is carried out. You can enter values from 0.0 to 1.0, where a greater value will potentially separate overlapping in more object parts.
The selectivity determines of the portion of the object histogram to be used for the separation. Reducing the selectivity prevents areas which geometrically assume the majority of objects from being separated.

In Fig. 11 an area resulting from two light overlapping objects can be seen. The middle image shows the same area after separation with a selectivity of 1.0 where the image appears to deal with four single objects (e.g. Cells). However, the image is actually dealing with duckweed or something similar and a separation of the area into four single objects is therefore not desired. The image on the right was analyzed using a selectivity of 0.9 and provides accurate results.

Fig. 11: Original (left), separation of objects with selectivity 1.0 (middle) and with selectivity 0.9 (right).

Form and Size

Potential objects found in the image that shouldn't be separated can be excluded from the separation process. There are three different criteria to be specified:
All objects whose *convexities are greater than* that of the specified value are excluded.
All objects whose *sizes are smaller than* that of the specified value are excluded.
All objects whose *form factors are greater than* that of the specified value are excluded.

If an object meets *one* of these criteria, it will be excluded from the object separation process.

Test Result

Moving the mouse over the right-hand image after a test analysis allows you to find out each of the various objects' values of size, brightness and form. This will greatly simplify the process of improving the settings.

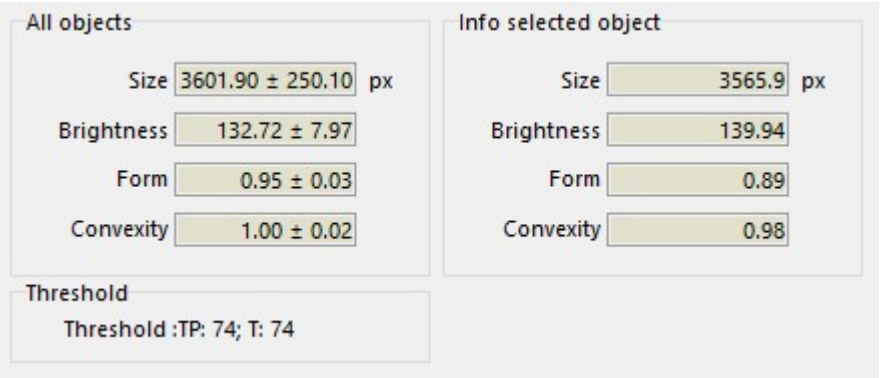

Fig. 12: Overall results of all objects and parameters of the selected object after the test analysis.

Parameter

Under this option you can choose the parameters to be shown after image analysis. The buttons 'Select all' and 'Undo selection' give you easy control of the parameter selection.

Furthermore, under ‘Statistic type’ you can determine whether the standard deviation or the median should appear in the results.
Note: When you save the results, all the parameters are always saved.

Scale

Specifying a scale allows the calibration of the Software on an image scale. Information on the size of objects and areas after calibration will be provided in the selected unit (e.g. millimeters).

Please note that due to changes in the camera settings or with a change in the intake gap the scale is also changed!
If the image scale for a recording system is known, it can be entered directly in the options window as a number, e.g. with a unit pixel/mm.
If the scale is not known, it can be determined using the integrated scale module. For this an image which contains an object of known size is required.
To open the scale module click on ‘Determine scale’:
For the specification of the scale a scale module was integrated. Using this scale module you should choose an object of known size from the image to determine the scale. This scale is then also effective for further images, as long as the recording situation and the camera settings are not changed.

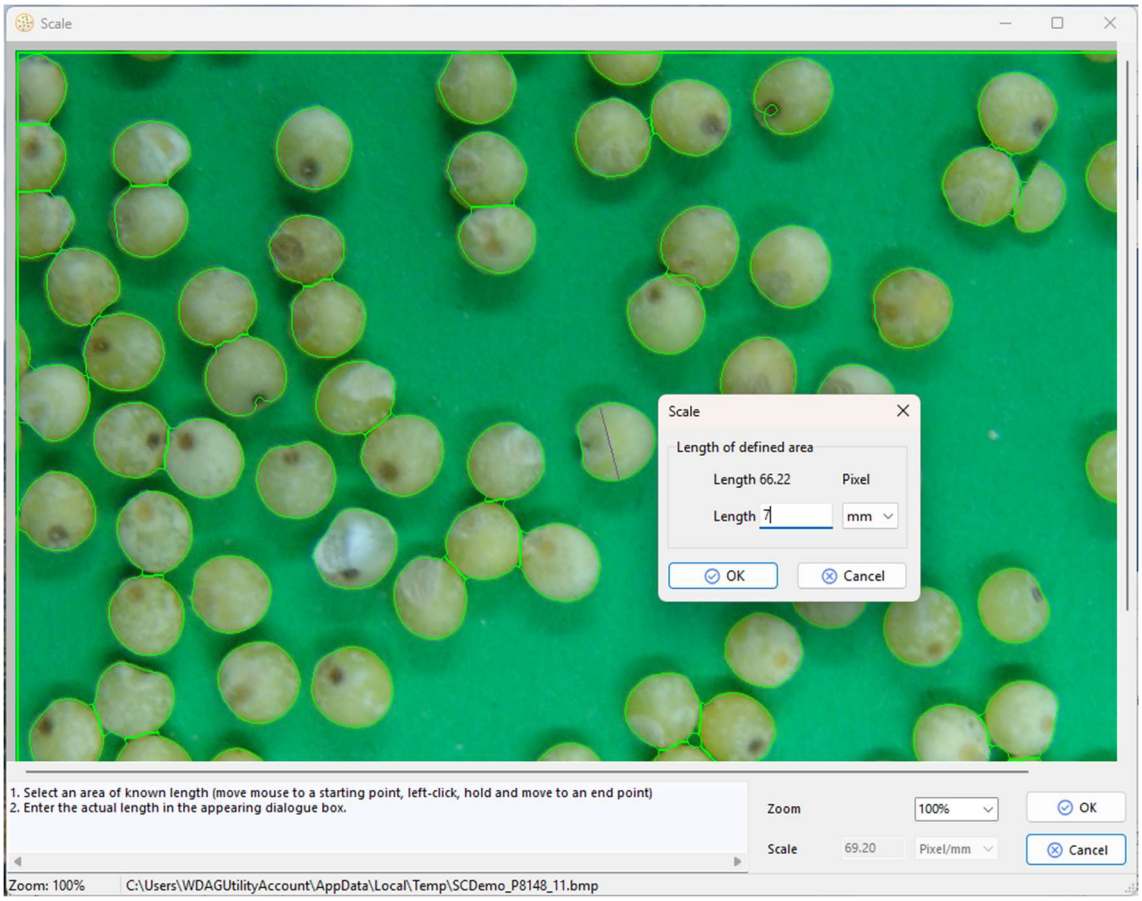

Fig. 13: Setting the scale

In the image a line can be marked using the mouse, of whose length must be known. When this length is entered, the computer calculates the scale. The 'zoom' can be adjusted so that smaller and more detailed objects can be enlarged. Clicking 'OK' will apply the scale settings.

Histogram

Here you can select those image parameters to be shown in the histogram in the main window.

Markings

This section indicates in which color the visual representation of control and manual adjustment should be displayed after image/test analysis. Since this software can be adjusted so flexibly using the different colors, these settings allow for an optimal color display of the markings on an analyzed image. These settings do not affect the results of the image analysis!

Results

The results of the image analysis can be saved into a result file of a given name. Existing results are not overwritten. New results will be added to an existing results file. The data will be saved as a text file. This text file can be read by popular spreadsheet and statistics programs. For most problems it suffices to save the calculated quantity of objects in each image. For problems, where differences in the size or brightness distribution of selected items need to be considered, the analysis results can be given for each individual object. Note: In the mode 'save result details' very large files can easily be formed.

Print

Here, a default printing template can be selected. You can either click on the button to the right of the input box to choose a template, or enter it in the input box directly. Scientific Counter uses its own default template for saving when this input box is left blank.

Detail View

The detailed view allows a comfortable control of the automatic analysis. The results of the automatic analysis can also be modified here when necessary.

Fig. 14: Screen shot of the 'detail view' window.

You can adjust the magnification of the image display using the zoom. The preset gradations can also be overridden using the freely selectable zoom bar. Click on 'Fit' for the image to be automatically zoomed to fit the display window.
Under 'View' you can specify how the image should be displayed and under 'Object' you can select which action to be carried out when you click on an object in the image:

Info allows the colored marking of an object without changing its status.

Inclusion/Exclusion allows you to manually include or exclude an object from the count.
Reset Status restores the original status of the selected object.
The 'Reset' button restores the original status of all objects immediately after the automatic analysis.
Information about a selected object is shown in the object info box on the right-hand side.
For simpler orientation, the marking colors and their respective meanings are also listed. These colors can be changed if needed in the Options window.

Control Mechanism

For the validation of analytical procedures, a checking algorithm based on the SHA256-Encoding (Secure Hash Algorithm) has been integrated in Scientific Counter. With the assistance of the SHA values you can be sure that in a control analysis the *image file,* the *options file* and the *result* coincide with the initial analysis. The program thereby uses a mechanism through which the controllability of the results is guaranteed. The program can be integrated accordingly into processes which need to be validated (e.g. Good Laboratory Practice).

The SHA values are determined for the image file, the options file and the results after each analysis.

You can display these values by clicking on 'Display SHA values' under 'Options' in the menu bar. The values are recorded in the results file and can be given in the protocol.

Printing the Analysis Results

For documentation purposes the analysis results can be printed out. The analyzed image with the marked results and the corresponding figures will be printed.

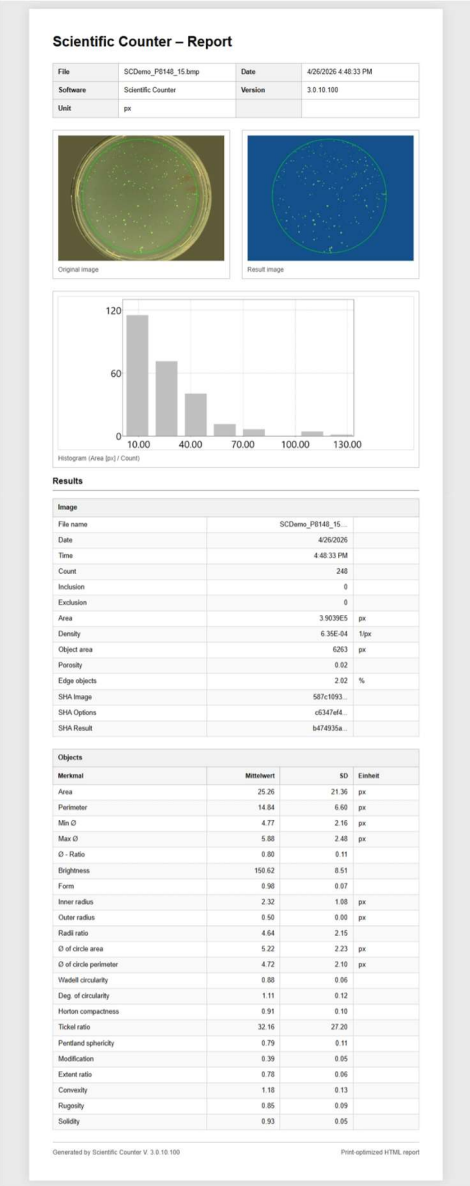

Fig. 15: Print-out example

Report Designer

An HTML file, which can be individually customized, serves as the print template. This requires HTML/CSS knowledge.

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Description of the Result Files

When a valid file name is entered under 'Result files' in the options settings, the results will be saved into this file. The contents and their meaning are listed in the following section:

DateTime	Date and time of the analysis
FileName	Name of file
FilePath	File directory
Unit	Unit of measurement used
Count	Number of objects
anIncl	Manually included objects
ManExcl	Manually excluded objects
Density	Density of objects
Porosity	Porosity of the image
EdgePercent	% of border objects in the total number of objects
SHAFile	SHA value for image file
SHAOptions	SHA value for options file
SHAResult	SHA value for analysis results

The following sizes are each listed with the average value (Mean), standard deviation (SD) and median (Median). (E.g. SizeMean, SizeSD, SizeMedian):

Size	Size of object in Pixels
Perimeter	Perimeter
DiamFeretMin	Minimum FERET-Diameter
DiamFeretMax	Maximum FERET-Diameter
DiamFeretRatio	FERET-Ratio
Bright	Brightness of object
Form	Form of object
RadiusInnerCircle	Radius of inner-circle
RadiusOuterCircle	Radius of outer-circle
RadiiRatio	Radii-ratio
CircleDiameterFromArea	Diameter of area
CircleDiameterFromPerimeter	Diameter of perimeter
WadellCircularityShapeRatio	WADELL-circularity ratio
DegreeOfCircularity	degree of circularity

HortonCompactnessFactor	HORTON-compactness
TickelRatio	Tickel-ratio
PentlandProjectionSphericity	PENTLAND-Projection
ModificationRatio	Modification parameter
ExtentRatio	Ratio of extent
RugosityCoefficient	Deformation
ConvexityRatio	Convexity
Solidity	Solidarity

If in the options settings, 'Save result details' is selected, the data for all individually recognized objects will be written in the second results file. This file contains the following described information for each individually recognized object:

DateTime	Date/Time of analysis
FileName	Name of image file
FilePath	Path of image file
Unit	Unit
Status	Auto: automatically recognized, Manual-Incl: manually included
Size	Size of object in pixels
Perimeter	Perimeter
DiamFeretMin	Minimum FERET-Diameter
DiamFeretMax	Maximum FERET-Diameter
DiamFeretRatio	FERET-Ratio
Bright	Brightness of object
Form	Form of object
RadiusInnerCircle	Inner-circle radius
RadiusOuterCircle	Outer-circle radius
RadiiRatio	Radii Ratio
CircleDiameterFromArea	Diameter of area
CircleDiameterFromPerimeter	Diameter of perimeter
WadellCircularityShapeRatio	WADELL-circularity ratio
DegreeOfCircularity	Degree of circularity
HortonCompactnessFactor	HORTON-Compactness
TickelRatio	Tickel-Ratio
PentlandProjectionSphericity	PENTLAND-Projection
ModificationRatio	Modification parameter
ExtentRatio	Ratio of extent

RugosityCoefficient	Deformation
ConvexityRatio	Convexity
Solidity	Solidarity

The results files can be easily imported into statistic programs or table calculation software for further analysis. Please note that the decimal point will be taken from the system settings.

FAQ – Frequently Asked Questions

What can be counted with Scientific Counter?

Scientific Counter was originally developed for the carrying out of mutagenicy tests (AMES-Test) in which the purpose was to count bacteria colonies. After a number of extensive additions, the program is now flexible enough to be used for the identification of almost all isolated structures with a more or less uniform shape and / or color. Digital pictures are required for the image analysis. The software is not fixed on a specific image resolution, but for the display of images a usual aspect ratio of 4:3 will be assumed.

What are the hardware requirements?

The software runs on standard PCs with current Windows versions starting from Windows 10. A modern computer system with at least 8 GB of RAM is recommended. A fast PC is recommended, especially for large image files. A high screen resolution is advantageous. Adjusting parameters is difficult with less than 1920x1080 pixels. The most important program windows are scalable and support large screen resolutions. High-resolution screens (HighDPI) are also supported.

Are my pictures suitable for analysis?

A requirement for the image analysis is a clear recognisability of the relevant features. Features which cannot be well recognized with the eye will also not be well recognized by the software.
The standardized admission conditions are important. For example, the lighting in a test series is to be kept constant. Images, in which small areas must be found, should not be compressed into JPEG format. Problems have already been encountered with artifact compression in such cases.
If you are unsure about the suitability of an image for DatInf® Scientific Counter, send two or three representative images to DatInf GmbH. You will then be informed about the suitability of the image.

What can I do if I don't find appropriate settings?

Please contact DatInf GmbH! You will be informed about whether an analysis is at all possible. For new customers a once-time adaptation is included in the purchase price – providing that the suitability of the image for the software has been confirmed by DatInf GmbH.
In the case of failure of image suitability for the standard software, DatInf GmbH will be happy to offer an individual solution.

Is the analysis fully automated?

In the case of a large number of images, a fully automated analysis is provided. For this purpose, Robot-Software was developed by DatInf®. For further details, please contact DatInf GmbH.

Which image formats are supported?

The following image formats are supported in the up-to-date version of the program:

- BMP (Windows/OS2 Bitmap)
- JPG, JPEG (Joint Photographic Experts Group)
- PNG (Portable Network Graphic)
- TIF, TIFF (Tagged Image File Format)

Warning! Images in which small areas must be found should not be compressed into JPEG format. Problems have already been encountered with the artifact compression in such cases.

How much does it cost for an individual adjustment?

For new customers, the first adjustment is free from DatInf GmbH - providing that the suitability of the image for the software has been confirmed by DatInf GmbH.
All further adjustments follow according to individual offers.

Will there be updates for this program?

Scientific Counter has its own website:
https:// scientific-counter.com
Online documents and program updates will be made available on this website.