Report about "Pictures render tool"

Description of the module and its performance testing

1   INTRODUCTION

Pictures render tool is a part of the *Particles system generator software*. The main objectives of the tool are: (i) Render the pictures with previously generated particle shapes and save the pictures in PNG format; (ii) Provide the functionality of choosing the pictures scale, colors, blur, overlapping and amount of particles per single picture.

2   PICTURES RENDER TOOL INTERFACE

Main window of the pictures render tool with the description of its elements is shown in Figure 1. The interface was developed in python language with the use of PyQt 5.6 library. In the figure, the numbers indicate the following elements:

1. Block with information about generated system of particles – particles type (spherical or non-spherical), number of radius vectors and total amount of previously generated particles. This information is determined from the input txt file;
2. Block which specifies the important render parameters – how many pictures would be generated and how many particles would be present on every particular picture;
3. Block with picture properties which includes picture scale (in µm/pix), picture side size (in pix), calculated real size of the picture (in µm) and picture solidity (in %). The later parameter picture solidity can be used as an indicator of the correct choice of the picture scale parameter. If the picture solidity is close to 100%, it means that the scale (in µm/pix) to low (or on words of microscope the magnification is too high) and almost all space of the picture will be covered by particles without the gap between them. The solidity within the limits of 10-20% is quite normal. ;
4. Block with color settings. It has a button with wrench, which opens a separate window (Figure 4), where it is possible to choose the different colors for the background and particles. There is also a possibility to choose the option for illustrating the scale at the bottom of each particular picture;
5. Block with additional render effects as particles blur and overlapping. The first parameter here, blurred particles (in %), determines the part of all particles to be blurred. The second parameter, blur value (in %), determine the strength of the blur effect. The third parameter, overlapping, determines will particles overlap or not;
6. This block contains two buttons – "Render" and "Stop" – designed for start and stop rendering process correspondingly. There is also a green lamp indicating whether the rendering is currently running;
7. Block with the thumbnail of currently rendering picture. Location of the particles, their shape and colors are the same as in the enlarged picture;
8. Block with basic information about the render process. It contains the fields with information about started rendering time, elapsed generation time so far, approximate time to finish the rendering and the number of the already rendered pictures and particles;
9. Indicator showing the percentage of completion of the pictures rendering process.

Main menu of the pictures render tool and the features it provides is described in Table 1.

Table 1. Description of the pictures render tool menu.

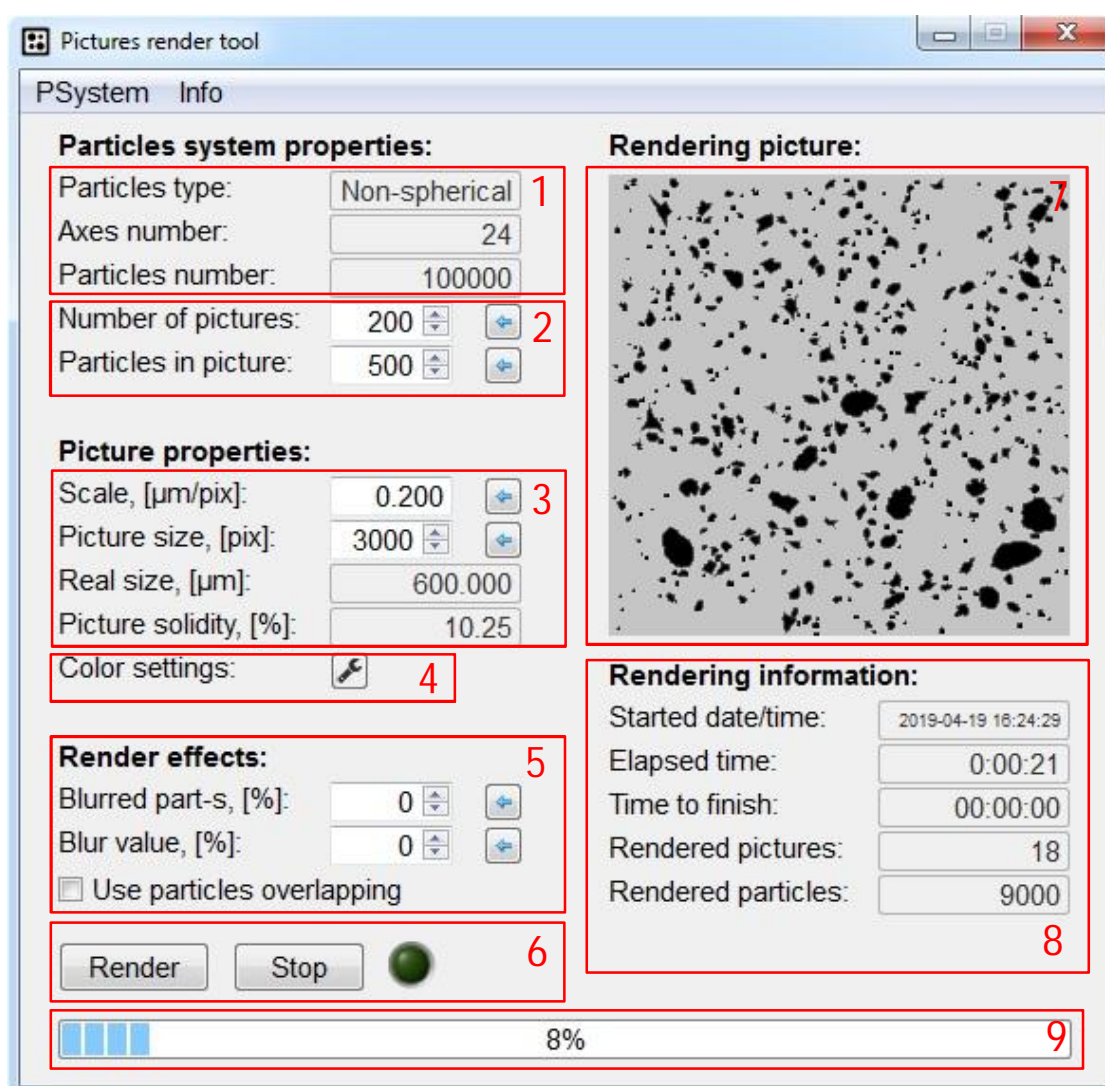| Menu item	Icon	Shortcut	Description
PSystem menu			
Open file…	📂	Ctrl + O	Open the dialog window for choosing the txt file and then loading the generated particles data.
Info menu			
Help	⊕	Ctrl + H	Open a .pdf file with help information about the tool.
About	i	Ctrl + A	Open window with some important information about the tool version and its developer.

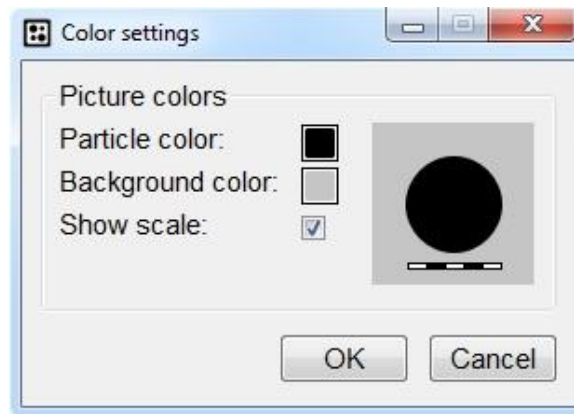**Figure 1.** Main window of the pictures render tool.

Figure 2. Window with color settings of rendering pictures. Also, contain an option to show the scale with some other parameters on every rendered picture.

3   TOOL RENDER CAPABILITIES

During the development of the particles system generator software, a separation in functionality was made between the particles generation and it's rendering so that already generated particle data (generation of particles may take considerable time especially when a huge number of particles are generated) can be used in multiple renders of such pictures that are needed at the current moment. Rendering of pictures takes significantly less time than generation a particles system.

Using the render settings described in the previous chapter the pictures render tool has many opportunities to render exactly those pictures that we need. Various possible options with examples are presented below.

3.1   Different number of particles per single picture

On Figure 1 in block 2, there is a possibility to change the amount of particles, which will be rendered in a single picture. In this case, the number of pictures changes proportionally as the program tries to arrange the same number of particles in all the pictures. The limiting options are the following: (i) one particle in each picture (in this case the number of particles will correspond to the total number of particles); (ii) all the particles rendered in on a single picture. The examples of different amount of particles on a picture is illustrated on Figure 2.
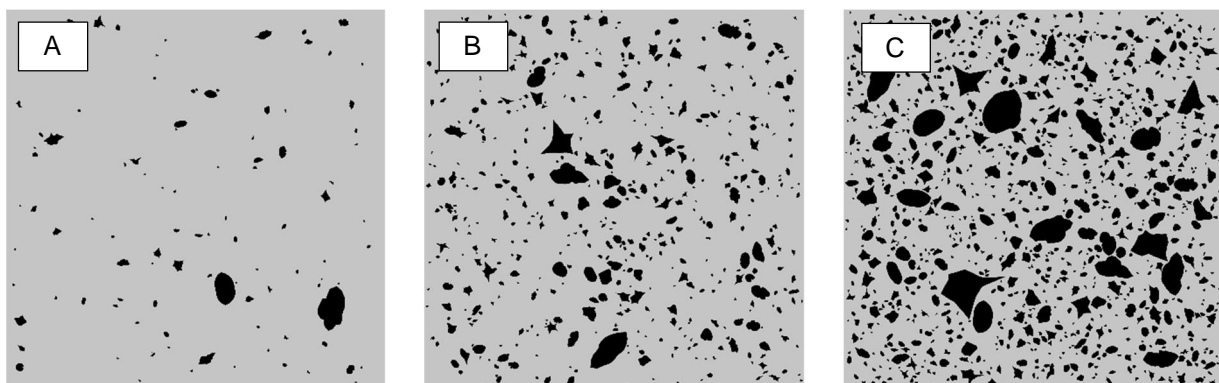

Figure 2. Example of different particles number per single rendered picture. A –100 part.; B - 500 part., C – 1000 part.

3.2 Different picture scale

On Figure 1 in block 3, there is a possibility to change the picture scale in terms of µm/pix. It can be done in two ways – change the scale parameter itself, or change the picture size. This is very important parameters, because the very large scale will lead the situation where all the particles will be represented by only several pixels. Obviously, the information about particles shape will be lost in this particular case. Examples of different scale of pictures is illustrated on Figure 3.
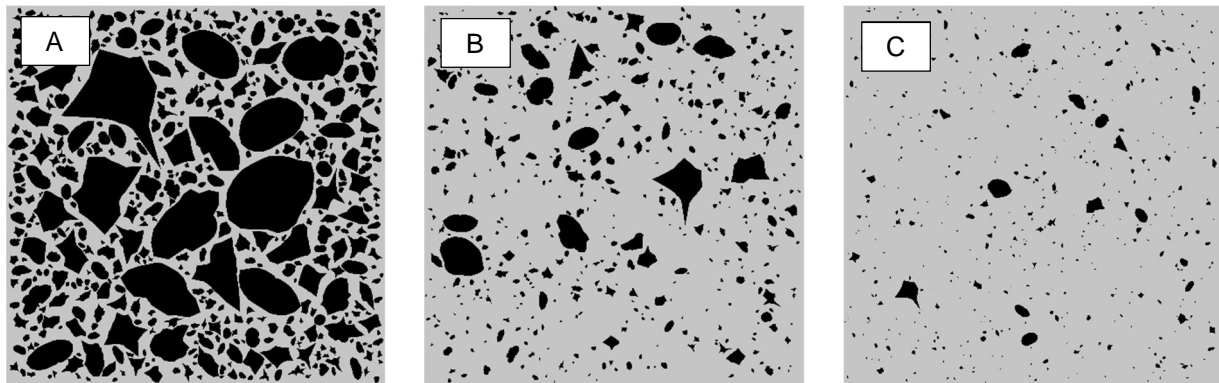

Figure 3. Example of pictures that contain 500 particles in different scales. A – 0.1 µm/pix; B – 0.2 µm/pix, C – 0.4 µm/pix

3.3 Different picture colors

The button with image of wrench in block 4 on Figure 1 opens a separate window where it is possible to change the colors of picture background and particles. The examples of pictures with different colors are illustrated on Figure 4.
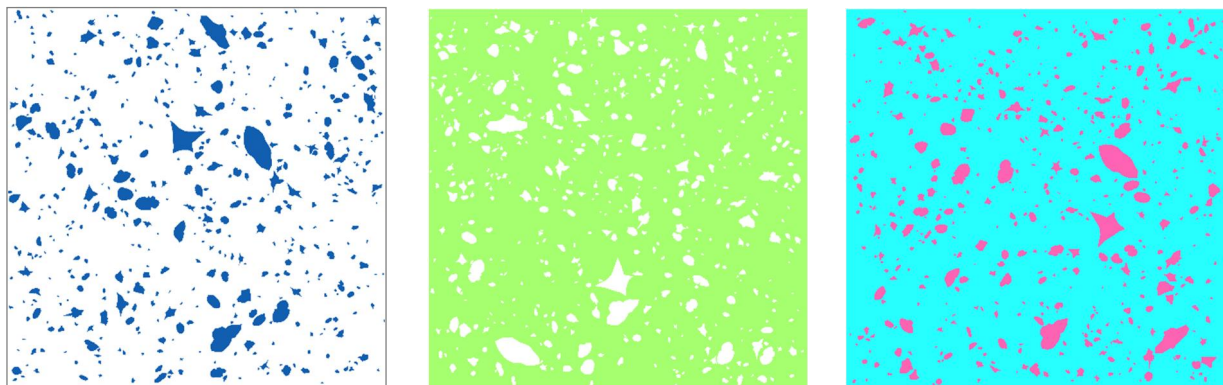

Figure 4. Example of pictures with different colors of background and particles.

3.4 Different particles blur

The parameters in block 5 on Figure 1 – blur particles and blur value – can simulate the situations when the particles are not in camera focus and so blurred. Blurred particles have fuzzy boundaries and they are more difficult to detect by any image recognition algorithms. The examples of pictures where particles have different blur values are illustrated on Figure 5.
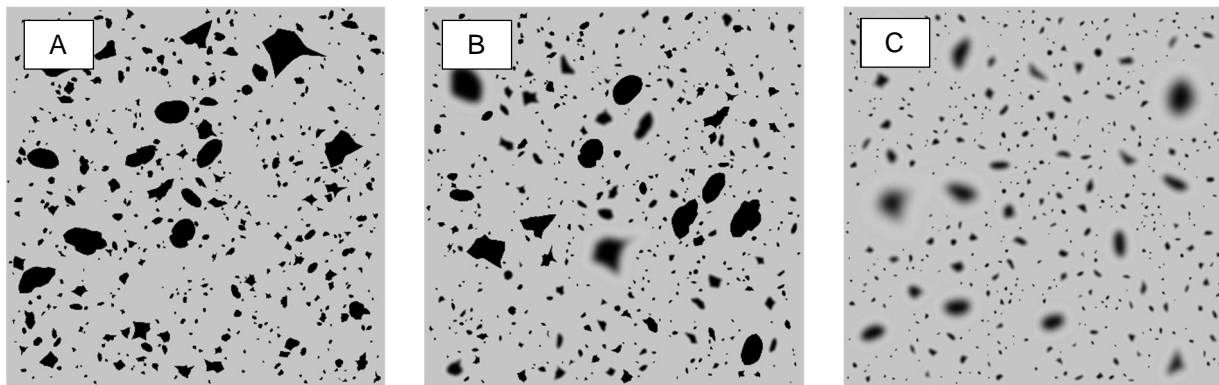
Figure 5. Example of pictures with different particles blur. A – blur particles 0%, blur value 0%; B – blur particles 50%, blur value 50%; C – blur particles 100%, blur value 100%.

3.5   Overlap simulation

Block 1 on Figure 3 has an option to turn the particles overlap enabled or disabled. When the option is disabled, the tool algorithm is trying to find an empty space for a particular particle. This means that if the proposed position is already occupied by another particle the algorithm is searching for a new place. This functionality take an additional computational time. Another story with the behavior when the overlap option is enables. In this case, every particle is put on a random position not caring if the place is already occupied by another particle or not. With this option enabled, the whole render is carrying out much faster. The example of overlapping for needle like particles is illustrated on Figure 6.
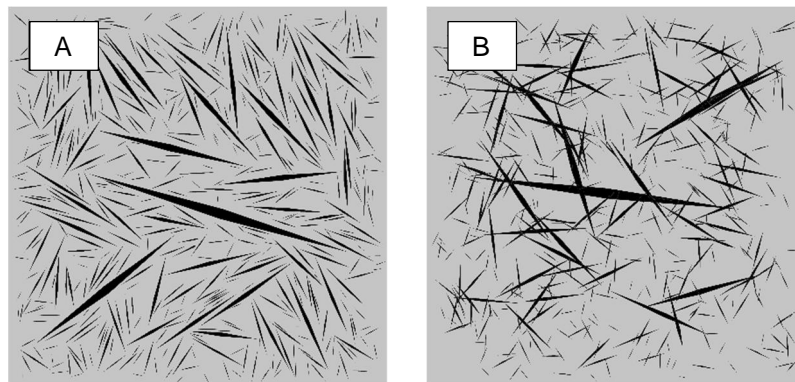

Figure 6. Example of pictures with disabled (A) and enabled (B) option of particles overlap.

3.6   Scale drawing option

In window for changing the picture colors, shown on Figure 2, there is an option to show the picture scale with other important information or not. If the option is enabled the scale is drawing in the bottom part of every picture as it is illustrated on Figure 7.
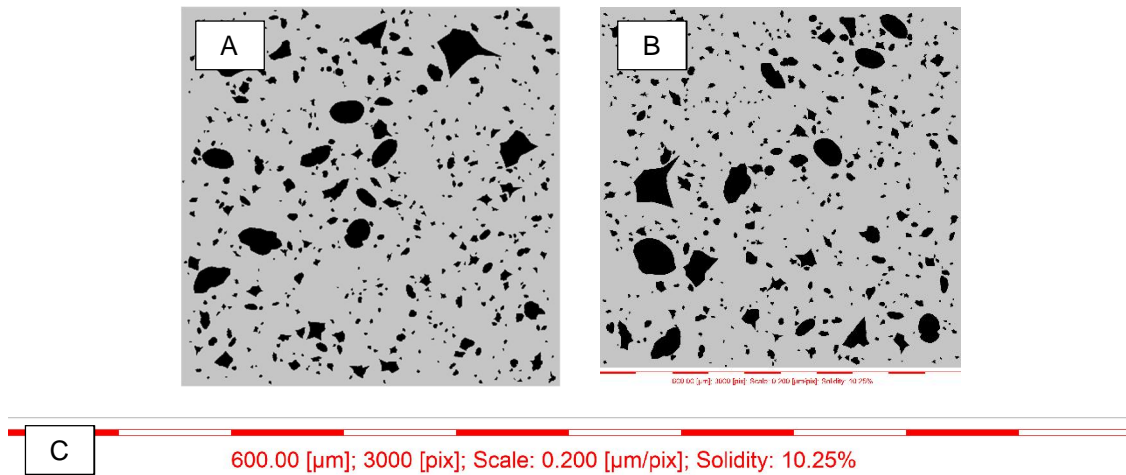
Figure 7. Example of pictures without the scale in the bottom (A) and with the scale (B). Enlarged part with the scale is shown in (C). The solidity here is a ratio between area occupied by particles and area of the picture (on pix or µm).