

# Information about “Particle finder tool”

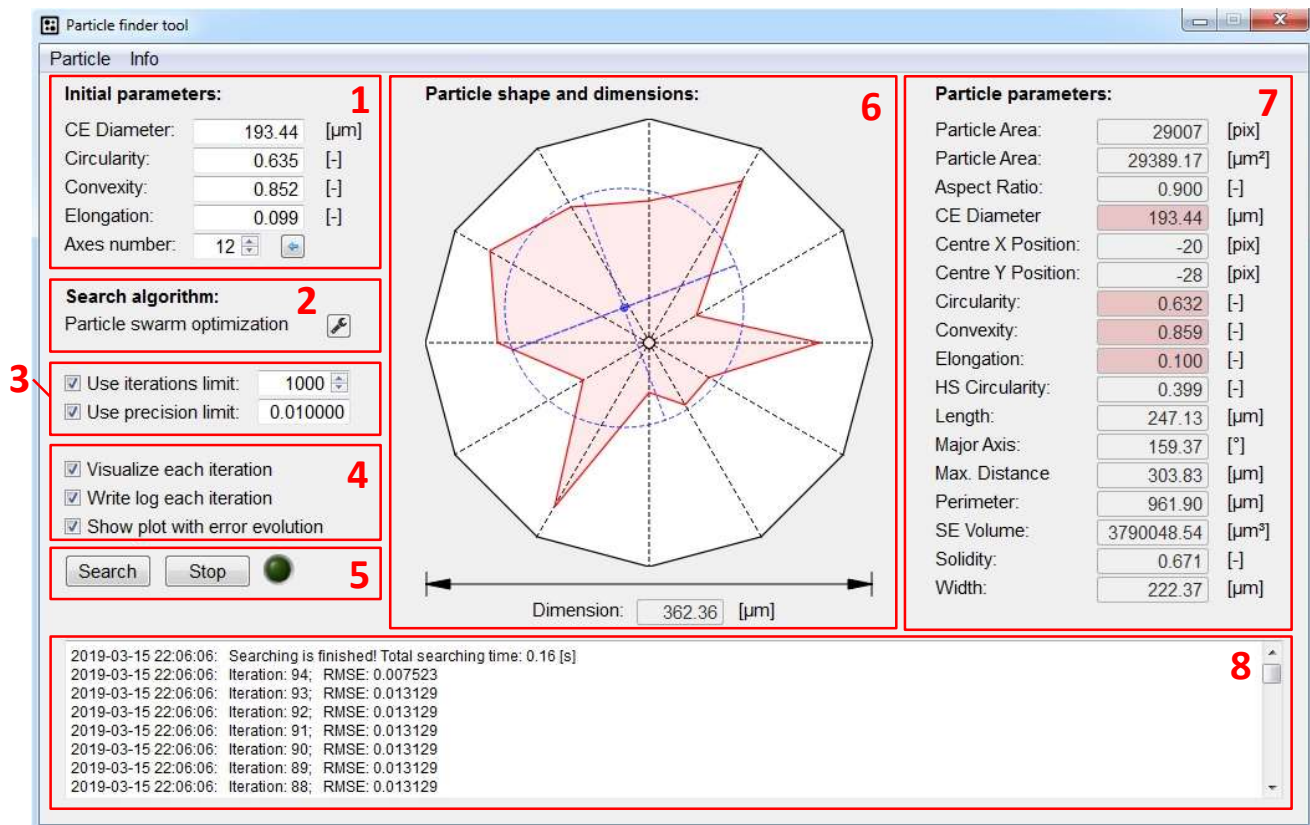
## 1 INTRODUCTION

*Particle finder tool* is a part of the *Particle system generator software*. The main objectives of the tool are: (i) Solving the reverse problem of finding the shape of the particle by given values of the most important particle parameters as CE diameter, circularity, convexity and elongation; (ii) Parameters determination of the found particle shape; (iii) Testing different settings of the optimization algorithm.

## 2 PARTICLE FINDER TOOL INTERFACE

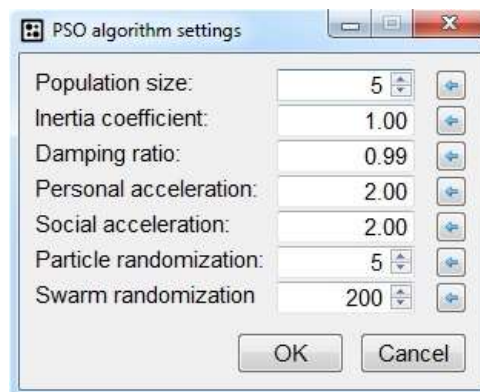
Main window of the particle finder tool with the description of its elements is shown in Figure 1. The interface was developed in python language with the use of PyQt 5.6 library. In the figure, the numbers indicate the following elements:

1. Block with input (initial) parameters of the desired particle. These parameters are: CE Diameter, circularity, convexity and elongation. Block also has a spin box with number which is equal the current number of radius vectors. Button with the blue arrow is able to return the radius vectors number to the default value;
2. Block with name of the searching algorithm as well as button which opens the algorithm settings in a separate window. The description of this window is presented below;
3. Block with parameters for termination the search procedure. It is possible to use and set iteration limit, precision limit or both. The search procedure stops when current iteration number is higher than set iteration limit, or when current value of the searching error is lower than set precision limit;
4. Block with settings of what information will be shown during and in the end of the search process. With “*Visualize each iteration*” enabled each iteration the slider field will display the best particle shape found so far whose shape parameters are closest to the desired input parameters. Option “*Write log each iteration*” allows to write the information about current iteration and the searching error to the terminal every iteration step. Option “*Show plot with error evolution*” allows to build a plot with error at every iteration step after the shape search;
5. This block contains two buttons – “Search” and “Stop” – designed for start and stop searching process correspondingly. There is also a green lamp indicating whether the search is currently running;
6. Field with indication of radius vectors, shape of the particle, major axis, minor axis and current CE diameter (last three parameters are indicated in blue color). In the bottom part of the block there is a field with particle dimension in  $\mu\text{m}$ ;
7. Block with calculated particle parameters for the current particle shape. Parameters colored with slightly red color are the main shape parameters;
8. Block with program terminal designed for printing the important information about the search procedure;



**Figure 1.** Main window of the particle finder tool.





After clicking on the button in block 2 the window with searching algorithm parameters opens illustrated in Figure 2. These parameters – population size, inertia coefficient, damping ratio, personal acceleration, social acceleration, particle randomization and swarm randomization - are the hyperparameters of the algorithm affecting the search behavior. Buttons with blue arrow return the parameter values to the default values.



**Figure 2.** PSO algorithm settings.

Main menu of the particle finder tool and the features it provides is described in Table 1.

**Table 1.** Description of the particle tester tool menu.

<i>Menu item</i>	<i>Icon</i>	<i>Shortcut</i>	<i>Description</i>
<b>Particle menu</b>			
Save data...		Ctrl + S	Open the dialog window for saving the current values of radius vectors and calculated particle parameters.
Load data ...		Ctrl + L	Open the dialog window for loading the saved particle parameters.
<b>Info menu</b>			
Help		Ctrl + H	Open a .pdf file with help information about the tool.
About		Ctrl + A	Open window with some important information about the tool version and its developer.