Description of TUSCAT 1.1:

It is an efficient and reliable software package developed on java platform to calculate and display the plane wave scattering from small particles. The package uses and involves a user friendly GUI in order to enable the users to enter the required input parameters for light scattering calculations and observe the results more intuitively. The numerical results of the scattering matrix elements and the efficiencies can also be saved in a user defined data file. The computational programs behind TUSCAT are based on Mie theory for spherical particles and T-matrix approach for nonspherical particles (cylindrical and spheroids). Another very important facility for comparing experimental results from some unknown particle with theoretical results was also incorporated in the software so as to provide an analytical tool for light scattering experiments from monodisperse and polydisperse particles.

Features of TUSCAT 1.1

1. TUSCAT 1.1 runs under Windows 98/NT/2000/XP/7 operation systems. There are no special hardware requirements.
2. It can calculate and display the results for of extinction, scattering and absorption efficiencies, single scattering albedo and asymmetry parameter.
3. It can calculate the nonzero elements of the scattering matrix and plots graphs for S_{11}, $-S_{12}/S_{11}$, S_{33}/S_{11} and S_{34}/S_{11}.
4. It has provision for saving the theoretical results in a user defined data file.
5. Can upload experimental data file in '.txt', '.dat' or '.csv' format containing the values of scattering angle, S_{11}, $-S_{12}/S_{11}$, S_{33}/S_{11} and S_{34}/S_{11} serially separated by a comma and plot graphs for S_{11}, $-S_{12}/S_{11}$, S_{33}/S_{11} and S_{34}/S_{11} as functions of scattering angle.
6. The experimental graphs can be compared with the theoretical graphs generated by varying the input parameters, to find the characteristic properties of that particle responsible for the scattering results.

What was used to design TUSCAT 1.1 (Beta version)

We have used Java Swing in J2SE1.5 platform to design the software package TUSCAT 1.1. Swing is a widget toolkit for Java. It is part of Sun Microsystems' Java Foundation Classes (JFC) — an Application Programming Interface (API) for providing a Graphical User Interface (GUI) for Java programs. Swing was developed to provide a more sophisticated set of GUI components than the earlier Abstract Window Toolkit (AWT). It provides a native *look and feel* that emulates the *look and feel* of several platforms, and also supports a pluggable *look and feel* that allows applications to have a *look and feel* unrelated to the underlying platform.

Advantages of Java Swing:

1. Platform independence,
2. Extensible,
3. Customizable,
4. Configurable,
5. Lightweight User Interface,
6. Loosely-Coupled and MVC (Model/View/Controller).

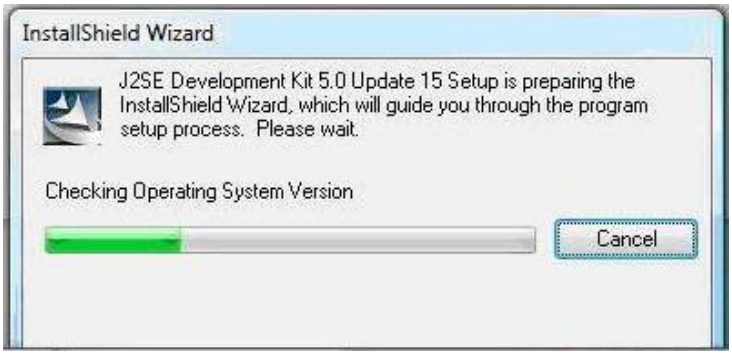
Installation Instructions:

Step 1. Copy or download the file TUSCAT 1.1.rar.

Step 2. Unzip TUSCAT 1.1.rar and a directory named 'TUSCAT 1.1' will be created. The contents of the directory are as follows:

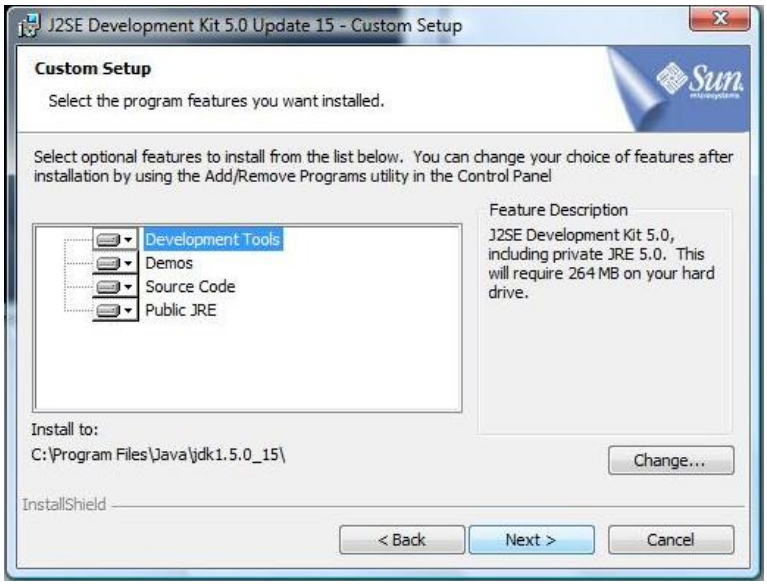
Serial No	File name	File type	Description
1	JavaInstaller.bat	Batch file	Installs the J2SE (Java 2 software enterprise) environment.
2	jdk-1_5_0_15-windows-i586-p.exe	Executable file	J2SE installer
3	SetClassPath.bat	Batch file	Set the environment variable of that system.
4	TUScatBatch.bat	Batch file	Batch file for executing the application.
5	TUScat.jar	Executable jar file	Executable file of the application
6	help.pdf	pdf file	help file

Step 3. Double click on the JavaInstaller.bat. This will run 'jdk-1_5_0_15-windows-i586-p.exe' and install java environment in your system as described below.



Screens as shown above will appear first.

Read the license agreement. Accept the agreement and click next.



Then a screen as shown above will appear where by default 'Development Tools' is selected. Click next.

Click finish to complete installation.

Step 4. Double click 'SetClassPath.bat' file. It will set the environment variable.

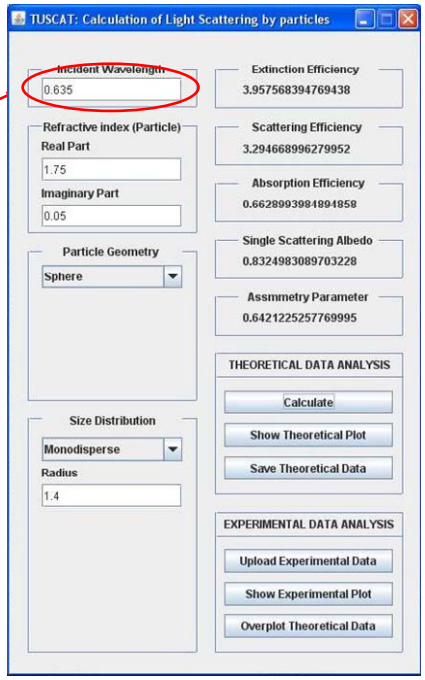
Step 5. Double click 'TUScatBatch.bat' file to execute 'TUScat.jar'.

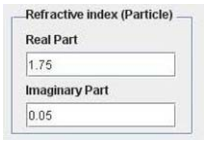
Note: If java environment is already installed then an error message as shown below will appear. Ignore the message and follow the step 5 to execute the application.

Description of the GUI:

In this input box the user should give the wavelength of the incident light in micrometers.

Default value = 0.00 µm

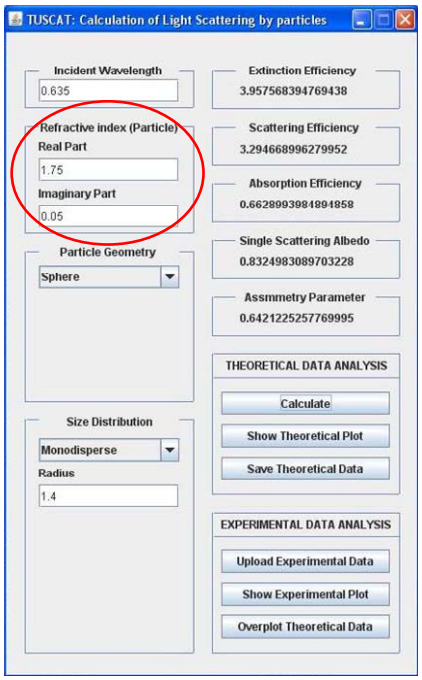


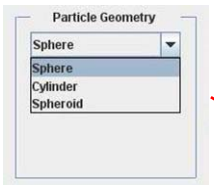


In this input box the user should give the real and imaginary part of the refractive index.

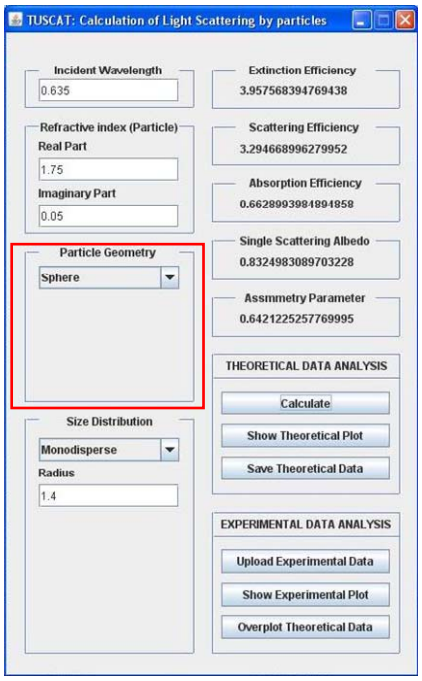
Default value = 0.00 + i × 0.00

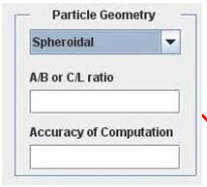
**The refractive index of the scattering medium is considered as 1.0+i×0.0 (air).





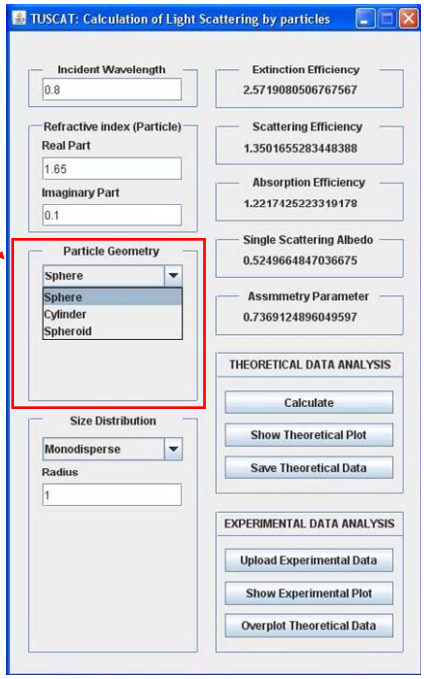
In this particle geometry box the user has to select the shape under consideration in the drop down menu. Default shape is sphere.

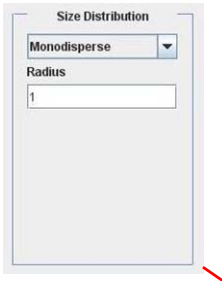


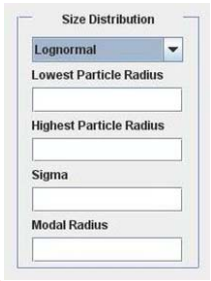


If anyone of the shapes ‘cylinder’ or ‘spheroid’ is selected, the user has to enter the axial ratio, A/B (for spheroid) or the diameter to length ratio, C/L (for cylinder). The default value of both A/B and C/L is 0.00.

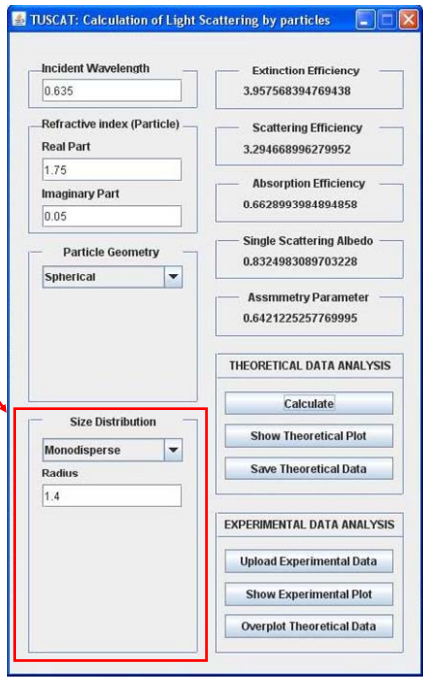
Also for such nonspherical geometries, one has to specify the desired accuracy of computation.

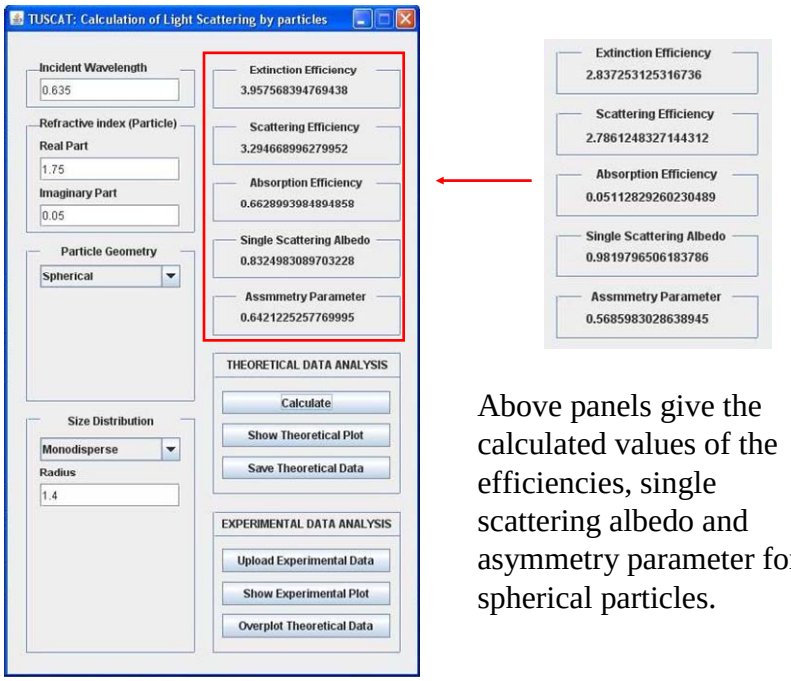




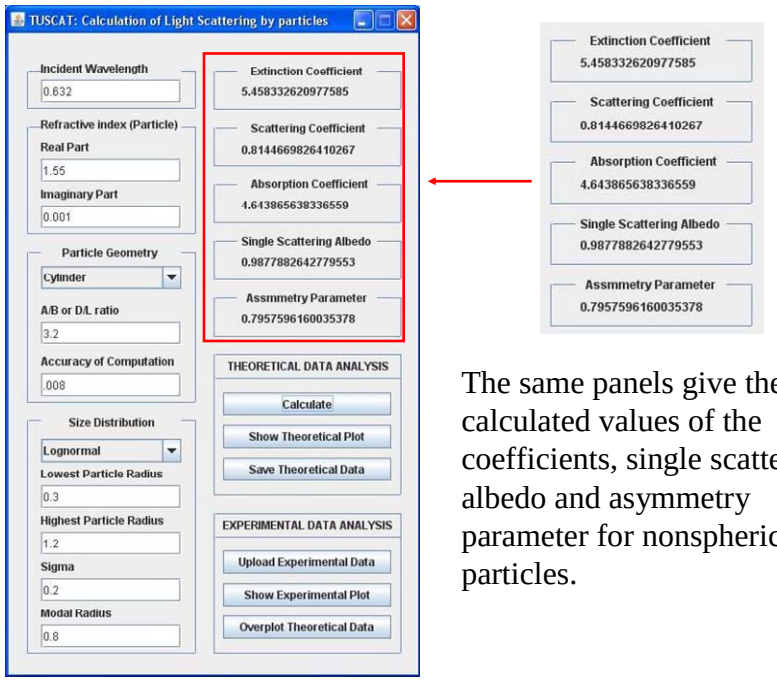


If gamma, normal and lognormal distribution is selected, the user has to give the lowest and highest particle radius, sigma (for normal and lognormal distribution) and alfa (for gamma distribution), and the effective radius of the particles.

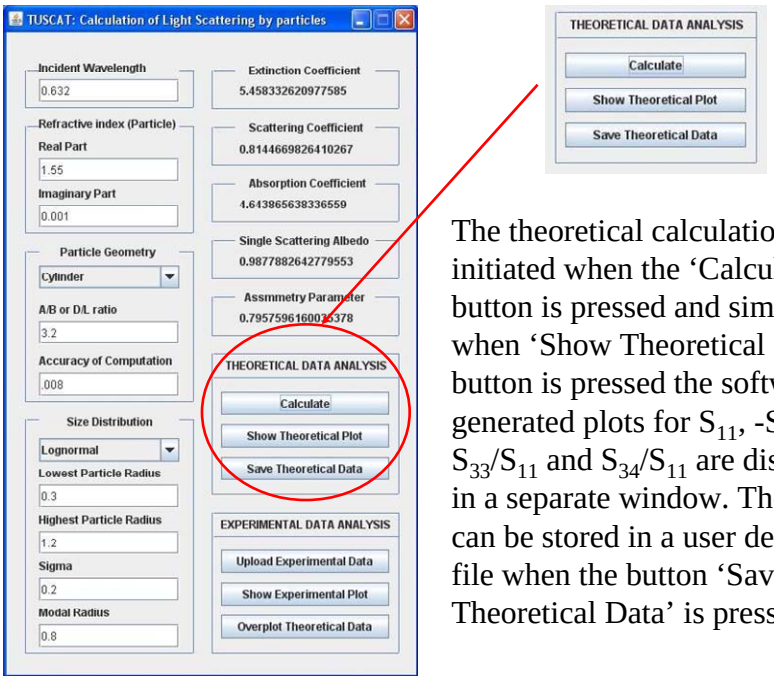




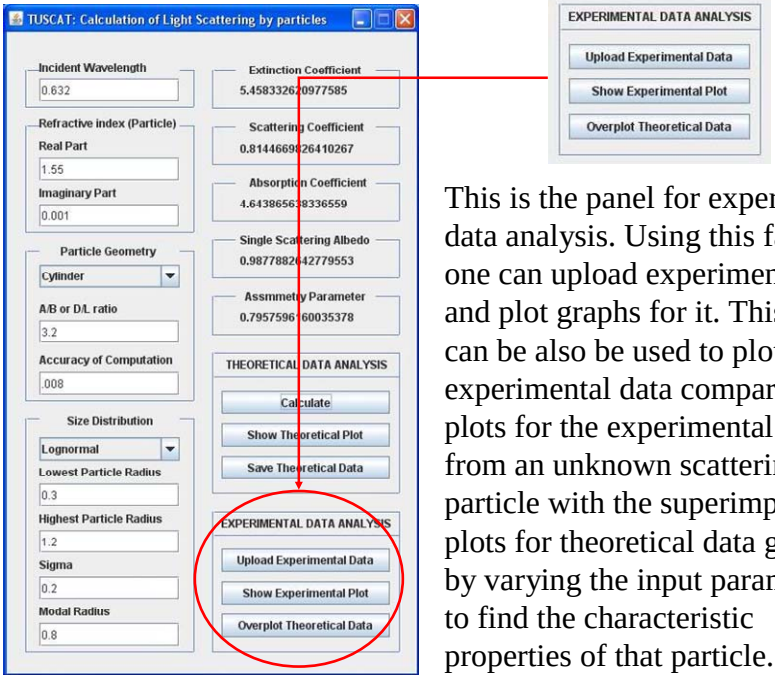
Above panels give the calculated values of the efficiencies, single scattering albedo and asymmetry parameter for spherical particles.



The same panels give the calculated values of the coefficients, single scattering albedo and asymmetry parameter for nonspherical particles.

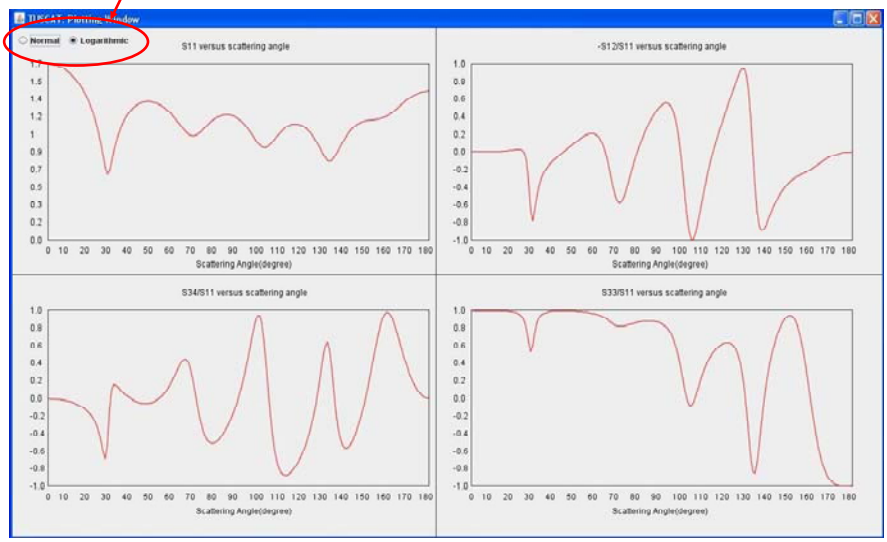


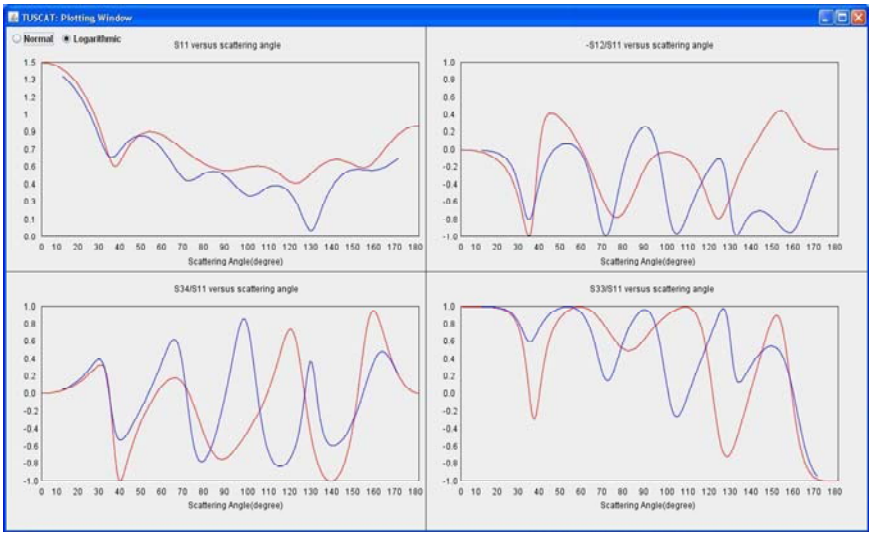
The theoretical calculations are initiated when the 'Calculate' button is pressed and similarly when 'Show Theoretical Plot' button is pressed the software generated plots for S_{11}, $-S_{12}/S_{11}$, S_{33}/S_{11} and S_{34}/S_{11} are displayed in a separate window. The result can be stored in a user defined file when the button 'Save Theoretical Data' is pressed.



This is the panel for experimental data analysis. Using this facility one can upload experimental data and plot graphs for it. This facility can be also be used to plot experimental data compare the plots for the experimental data from an unknown scattering particle with the superimposed plots for theoretical data generated by varying the input parameters, to find the characteristic properties of that particle.

The user can select either normal or logarithmic plot for S11 using these buttons.





Plotting window of TUSCAT showing the superimposed plots of the experimental (blue solid line) and theoretical (red solid line) results.

Future Prospects:

1. Other light scattering theories like DDA, SVM, FDTD etc. will be incorporated with the software in the near future.
2. The software package will be improved for the calculation of light scattering properties of other nonspherical shapes like chebyshev, star shaped etc.
3. Data acquisition and data processing part will also be added to the software so as to make it self contained for the complete analysis of the experimental results.