Development of a software integrated with a graphical user interface for the study of light scattering studies on dust particles

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INTRODUCTION

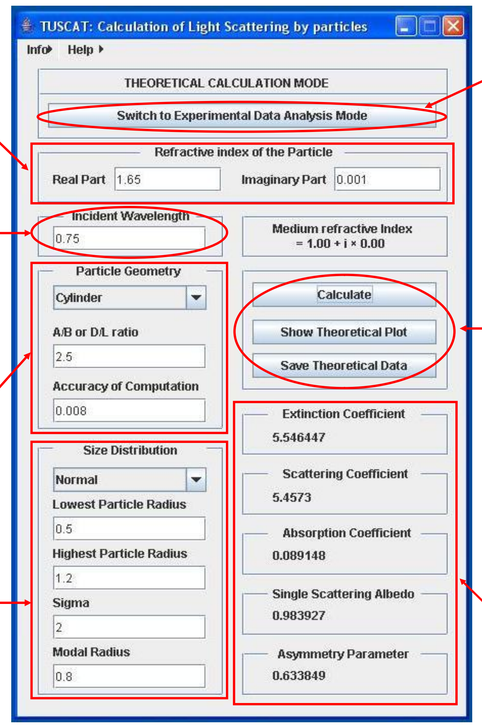
An integrated software package TUSCAT (Tezpur University SCATtering Software) incorporated with a graphical user interface (GUI) was developed for modeling electromagnetic scattering from small particles and also to yield characteristic properties of the scattering particles from experimental data. Its interactive features enable the user to observe the changes in output scattering properties in real time. In addition to its ease of use,it has high computational accuracy, efficiency, reliability and adaptability.

DESCRIPTION OF THE GRAPHICAL USER INTERFACE

Input box for entering the real and imaginary part of the refractive index.
Default value = 1.00 + i × 0.00

Input box for incident wavelength micrometers.
Default value = 1.00 µm

User can select the shape under consideration in the drop down menu. Default shape is sphere.
For cylinder and spheroid, the user has to enter the diameter to length ratio, C/L and the axial ratio, A/B respectively. Also for such nonspherical geometries, one has to specify the accuracy of T-matrix computation.



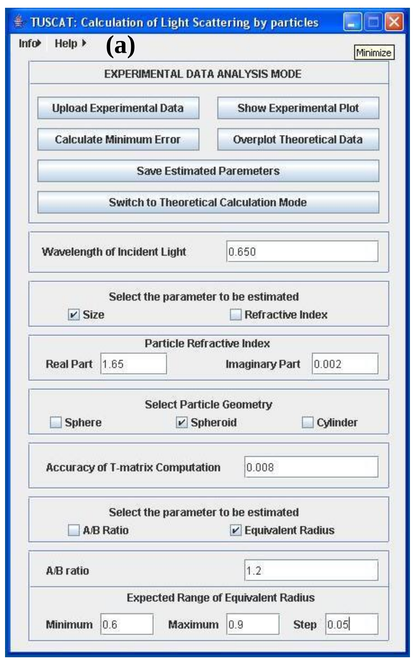
The user can switch to the Experimental data analysis mode by clicking in this button.

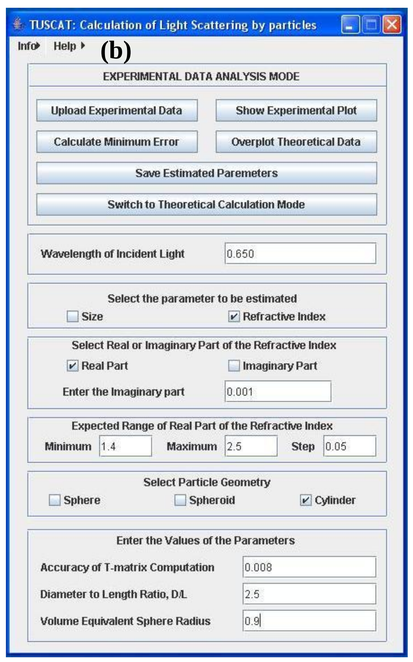
The theoretical calculations are initiated when the 'Calculate' button is pressed and similarly when 'Show Theoretical Plot' button is pressed the software generated plots for S_{11}, $-S_{12}/S_{11}$, S_{33}/S_{11} and S_{34}/S_{11} are displayed in a separate window. The result can be stored in a user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

Output panel for light scattering coefficients, albedo and asymmetry parameter.

Figure 1. Screenshot of the control panel the 'Theoretical Calculation Mode' of TUSCAT.

Drop down menus are used to select the desired size distribution. If gamma, normal and lognormal distribution is selected, the user has to give the lowest and highest particle radius (in micrometer), sigma (for normal and lognormal distribution) and alfa (for gamma distribution), and the effective radius of the particles (in micrometer).





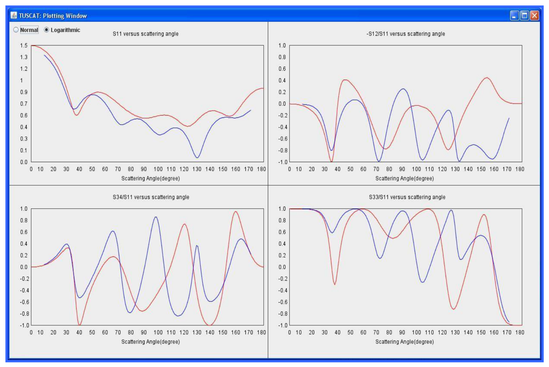


Figure 3. (a) Screenshot of the control panel in the 'Experimental Data Analysis Mode' of TUSCAT for size estimation, (b) Screenshot of the control panel the 'Experimental Data Analysis Mode' of TUSCAT for refractive index estimation, (c) screenshot of the plotting window of TUSCAT showing the superimposed plots of the experimental (blue solid line) and theoretical (red solid line) results.

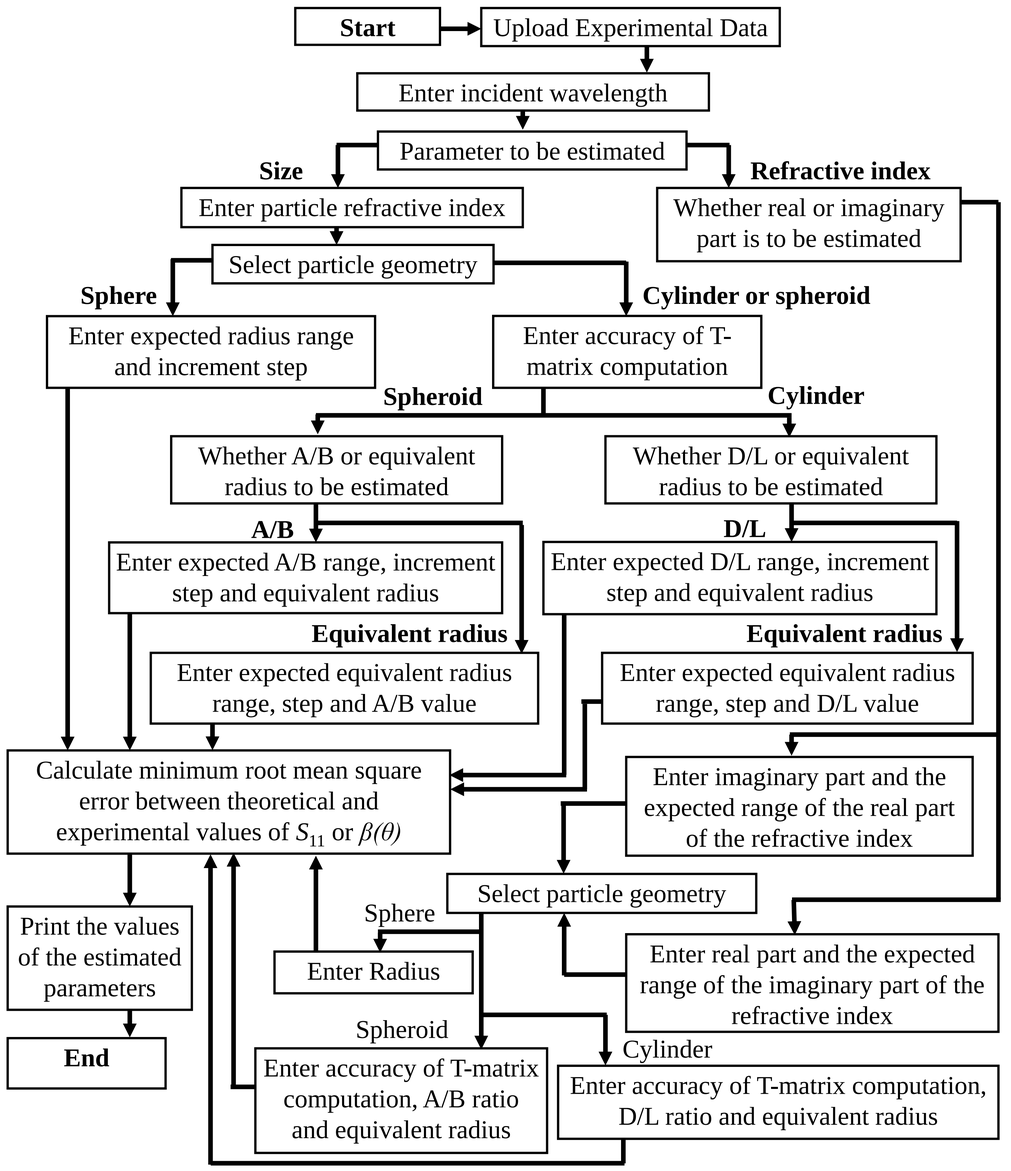


Figure 2. Flowchart of "Experimental Data Analysis Mode" of TUSCAT.

CONCLUDING REMARKS

❖An interactive software package, TUSCAT was developed as an analytical tool for modeling light scattering properties of small particles and for the analysis of the experimental results from some unknown scatterer.
❖TUSCAT can be used to not only investigate the theoretical scattering properties of different types of aerosols and hydrosols having different size distribution but also couple these results with experimental results to find some unknown parameters (such as size, refractive index etc.) of the experimental samples.
❖Works are in progress to improve the software package for the calculation of light scattering properties of other nonspherical shapes like Chebyshev, star shaped etc.

Related Journal Paper

1. Ankur Gogoi, Pritom Rajkhowa, Amarjyoti Choudhury, Gazi A. Ahmed. Development of TUSCAT: a software for light scattering studies on spherical, spheroidal and cylindrical particles. Journal of Quantitative Spectroscopy and Radiative Transfer, 112 (17), 2713 – 2721, 2011.

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