

Winsph User's Guide

Steve Turley, November 25, 2006

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Introduction

Winph is a program that computes the near-field intensity and far field cross section for scattering of acoustic waves from spheres. The theory behind the program is outlined in a separate document, “Acoustic Scattering from a Sphere” (November 24, 2006). This manual covers installing the program on PC and running the program.

Installation

The winsph program is distributed as a zip file on the website <http://volta.byu.edu/compem.html>. Right click on the download link for winsph.zip and save the file on your computer. After the file has been downloaded, double click on winsph.zip on your computer in order to unzip it. Unzip the contents into a temporary directory of your choice by selecting “extract all.” After the files have been extracted, run the program setup.exe from the temporary directory you created for the files. It will create the files needed to run the program on your computer in the default directory. It will also create shortcuts to winsph on your desktop and in your start folder. The directory in your start folder also contains copies of these installation instructions and the paper on the theory behind the program.

Initial Installation

Unzip the contents into a temporary directory of your choice by selecting “extract all.” After the files have been extracted, run the program setup.exe from the temporary directory you created for the files. It will create the files needed to run the program on your computer in the default directory. It will also create shortcuts to winsph on your desktop and in your start folder. The directory in your start folder also contains copies of these installation instructions and the paper on the theory behind the program.

Refreshing and Program and Updates

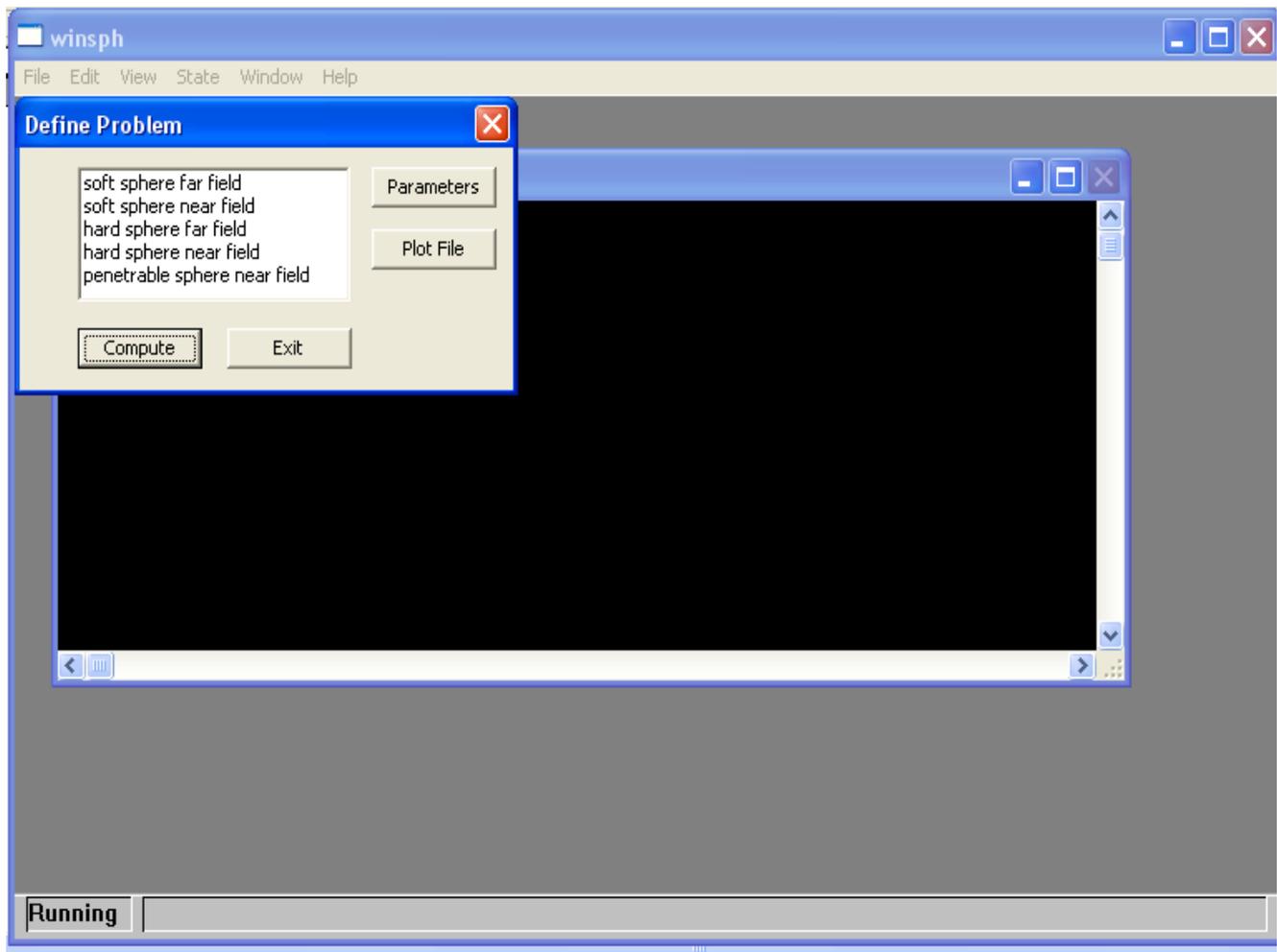
You can reinstall the program again from the temporary directory you created during initial installation. Updates to the program can be installed the same way by first uploading the latest version of the program from <http://volta.byu.edu/compem.html>.

Uninstalling the Program

To uninstall the program, click on the Windows Start button, click on the Control Panel, then click on Add or Remove Programs. Wait a few minutes for the list to populated itself. Find winsph in the list of programs and click on it. Choose the button Change/Remove and then select Remove Program.

Running

You can start running the program by double clicking on the winsph icon on your desktop or in your start menu. After doing so, you will see a window like the following on your screen.



The dialog box called Define Problem is used to control the computation. Using this box you can choose which calculation you wish to perform, do a computation, change the parameters for the computation, and save the graphical results of the computation in a file. When you are finished running the program, click on the Exit button to leave the program.

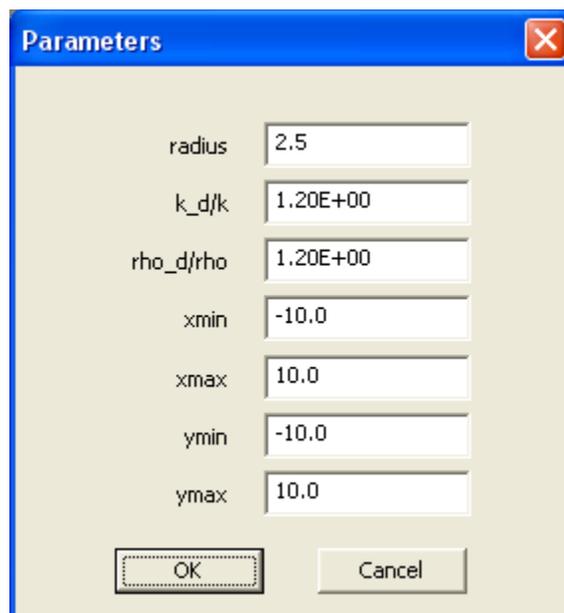
Computations

The program can perform the five computations listed in the box in the Define Problem dialog box. You select which computation or computations you would like to do by clicking on those items in the box. After making your selection, click the Compute button to carry out the calculation and display the results in a graphics window. When you are done looking at the graphical results, right click on the window displaying the graphical results to return to the Define Problem dialog box. The following sections explain how to change parameters of the calculation and generate graphics files. The five computations the program can do are:

1. **soft sphere far field:** this computes the cross section for scattering from an acoustically soft sphere. The cross section gives the angular variation in the intensity far away from the scatterer. An acoustically soft sphere is one where the pressure is zero everywhere on the boundary of the sphere. This would be a good approximation for scattering from bubbles in a liquid.
2. **soft sphere near field:** this computes the total intensity near an acoustically soft sphere when a plane wave is incident from the left (coming from negative infinity).
3. **hard sphere far field:** this computes the cross section for scattering from an acoustically hard sphere. A hard sphere is one where the velocity is zero everywhere on the boundary of the sphere. This would be a good approximation for scattering from a solid hard obstacle in air.
4. **hard sphere near field:** this computes the total intensity near an acoustically hard sphere when a plane wave is incident from the left.
5. **penetrable sphere near field:** this computes the total intensity near a penetrable sphere when a plane wave is incident from the left. The field inside the sphere is shown as zero when actually it just isn't computed.

Changing Parameters

There are several adjustable parameters you can control in the calculations. To change these values from the defaults, click the parameters button in the Define Problem dialog box. A new dialog box with the title Parameters will appear on the screen which looks like the following.



The image shows a dialog box titled "Parameters" with a close button (X) in the top right corner. The dialog box contains seven input fields, each with a label to its left and a value inside the field. At the bottom of the dialog box are two buttons: "OK" and "Cancel".

Parameter	Value
radius	2.5
k_d/k	1.20E+00
rho_d/rho	1.20E+00
xmin	-10.0
xmax	10.0
ymin	-10.0
ymax	10.0

I will explain each of the parameters in this box below.

- **radius**: used for all five calculations. This is the radius of the sphere from which the plane wave scatters.
- **k_d/k**: used in the penetrable sphere calculations. This is the ratio of the wave number inside the sphere to the wave number in the material outside the sphere. This ratio is also the ratio of the speed of sound inside the sphere to the speed of sound outside of the sphere. The wave number is $2\pi/\lambda$, where λ is the wavelength of the wave in each material.
- **rho_d/rho**: used in the penetrable sphere calculations. This is the ratio of the density inside of the sphere to the density outside the sphere.
- **xmin**: used in the near field calculations. It is the minimum value of x for which the near field is computed.
- **xmax**: used in the far field calculations. It is the maximum value of x for which the near field is computed.
- **ymin**: used in the near field calculations. It is the minimum value of y for which the near field is computed.
- **ymax**: used in the far field calculations. It is the maximum value of y for which the near field is computed.

You can change any of these values by typing new values into the boxes and selecting OK. If you select cancel, the previous values for these parameters are used. The new parameters are used for all future calculations until you exit the program and change them again. After you change the parameters, you need to press the Compute button again in the Define Problem dialog box to complete the calculation using the new values.

Generating Plot Files

You can generate graphics files with the results of the last calculation you made by pressing the Plot File button in the Define Problem dialog box. After doing so, it will display the following dialog box.



With this box, you can select the file name and the format of the data file created in the program. By default, the files are created in the plots directory of where the application resides. If you installed the program with the default selections, they will be in C:\Program Files\BYU\Winph\plots. To create a plot file, type in the name of the file (without an extension) into the file name box. Select one of the

radio buttons to choose your preferred file format. Vector formats (EPS, PDF, PS, WMF) are generally better for displaying the far field calculations. Bit-mapped formats (BMP,GIF,PNG,TIFF) are generally better for displaying the near field graphs.

If you specify a file name which already exists in the plots directory, the program will not overwrite it. Instead, it will create a file with a name `life_5.EPS`, where the number is the next consecutive number available and the extension depends on the file format you chose.

Sample Computations

This section has a few examples of computations made by winsph.

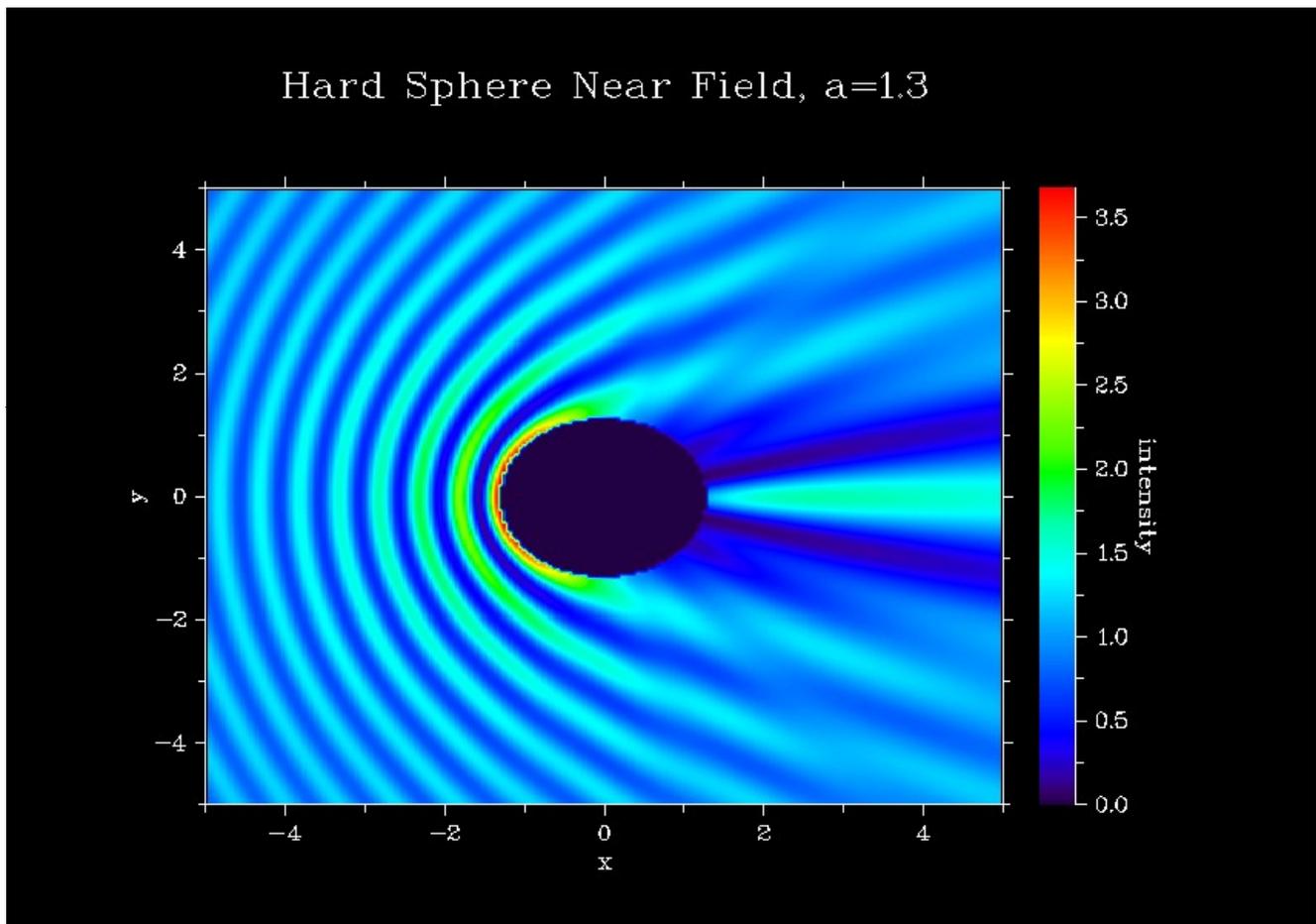
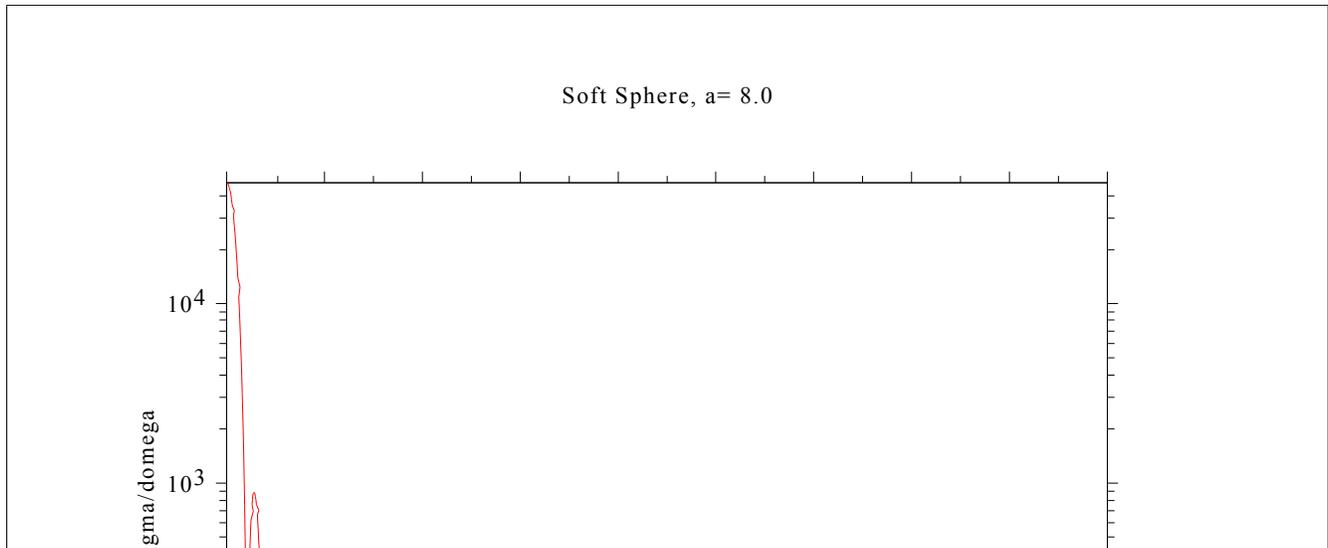


Illustration 2: Near field intensity for a hard sphere is radius 1.3 wavelengths

Penetrable Sphere Near Field, $a=2.5$

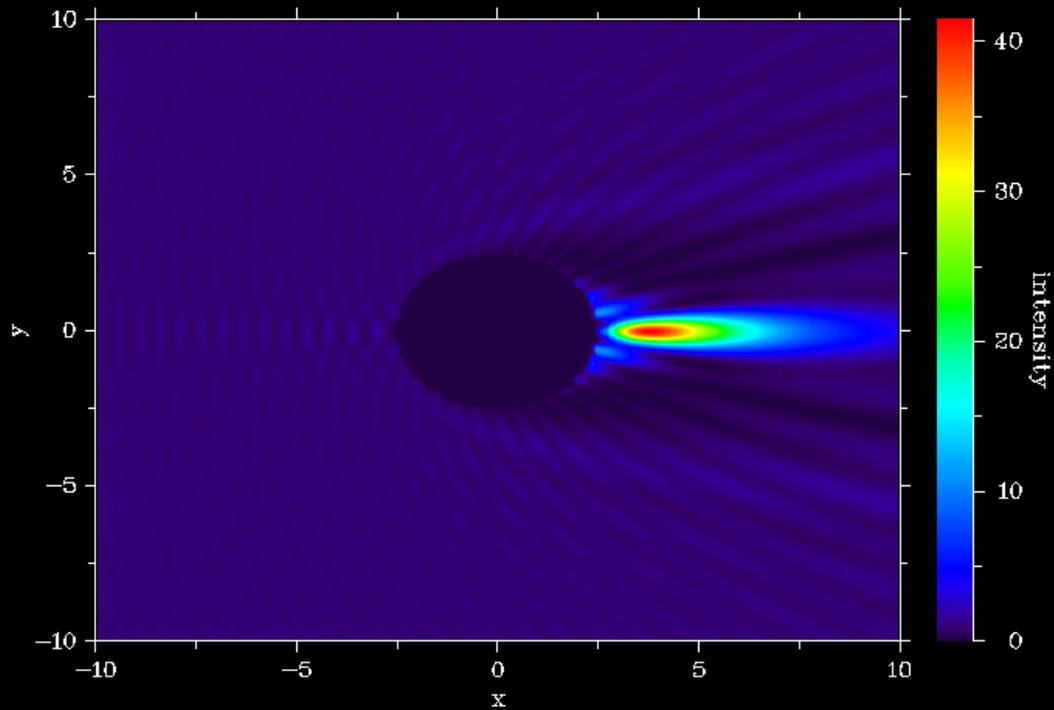


Illustration 3: Near field intensity for a penetrable sphere of radius 2.5 wavelengths with $k_d/k=1.2$ and $\rho_d/\rho=1.2$

Bug Reports

This program has not been extensively tested and there are probably errors in the documentation as well. I'll be happy to fix what I can if you send me email with details about the problem to turley@byu.edu.