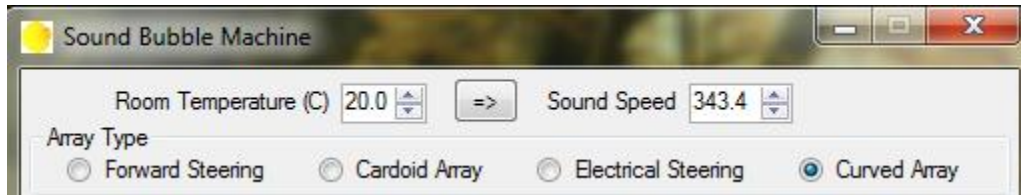# Sound Bubble Machine User Guide

Sound Bubble Machine is a delay calculator for a subwoofer array. Each subwoofer is assumed to be omnidirectional at low frequency.
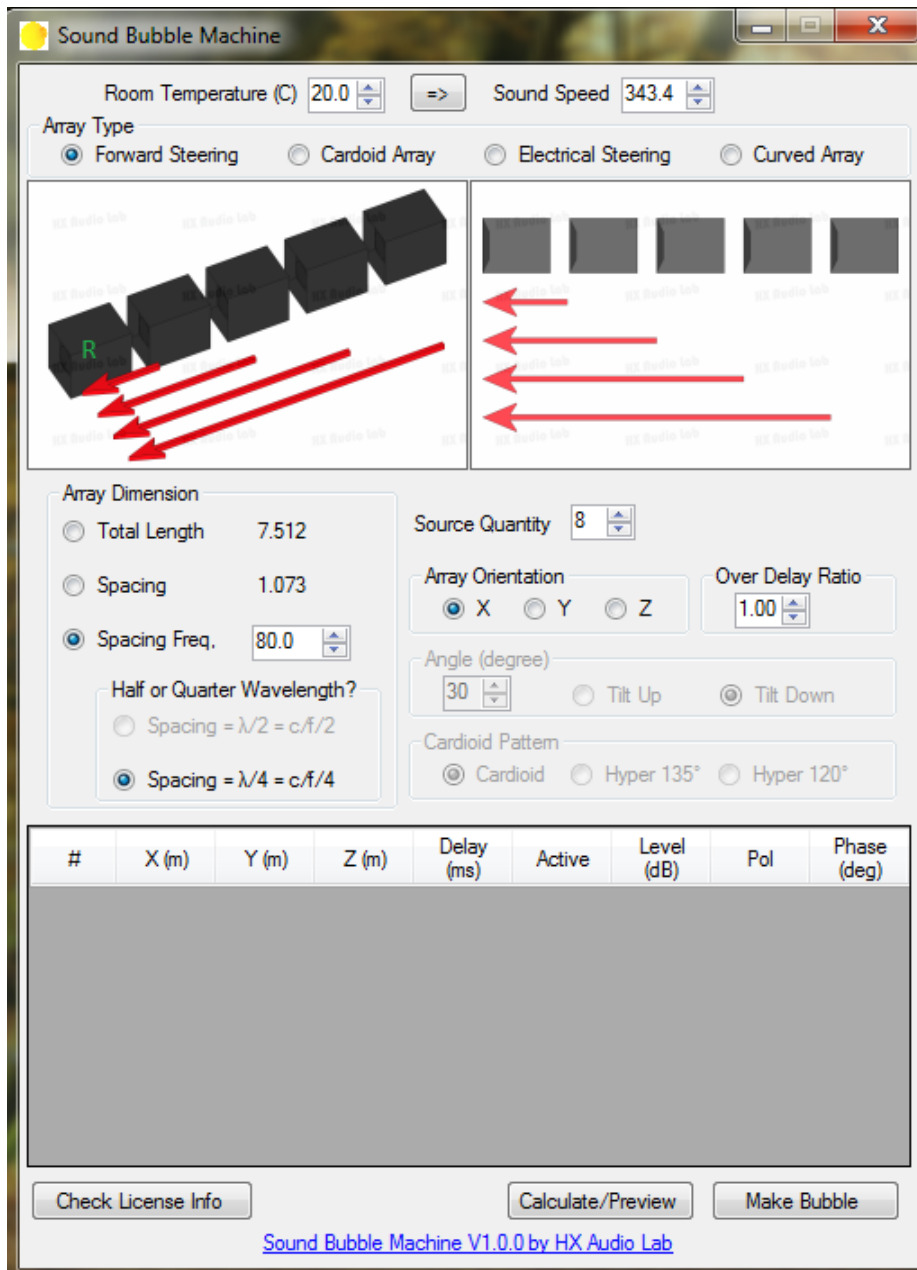

Temperature/Speed of sound

Temperature will affect speed of sound. Since delay calculation relies on speed of sound, it should be defined correctly.

Array Type

There are four calculation modes: Forward Steering, Cardioid/Hyper-Cardioid Array, Electrical Steering and Curved Array.

Forward Steering

The red arrows in the pictures show the relative delay distance for each sound source. This is done by cascading delay time for the front subwoofers. The reference subwoofer (0ms delay time) is the subwoofer at the back (noted by green "R" letter in the picture above). This arrangement requires at least three subwoofers to work effectively. The calculated delay time can be tweaked using over delay ratio, enabling user to control the width of the dispersion.
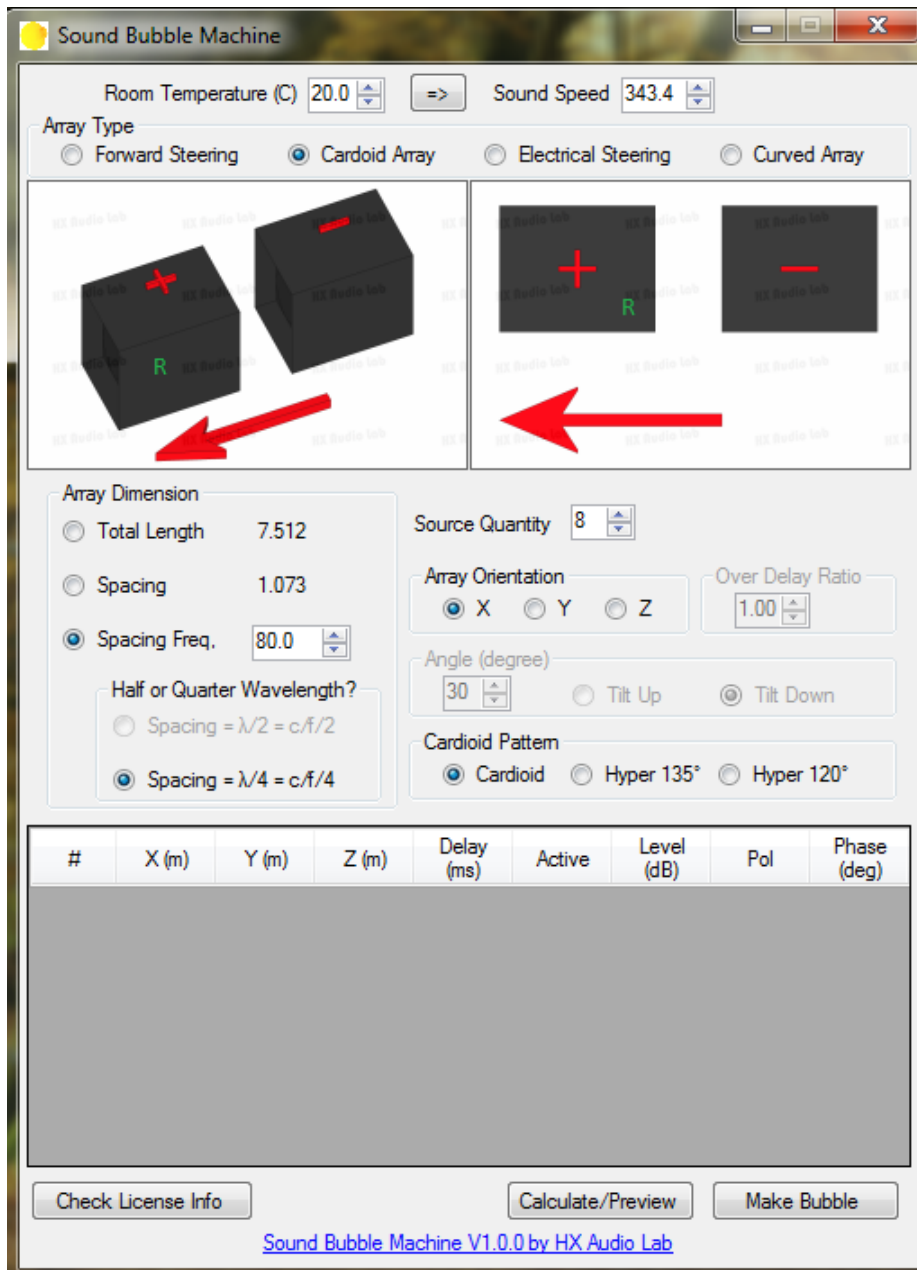
Cardioid/Hyper-Cardioid Array

The red arrows in the pictures show the steering direction. The reference subwoofer (0ms delay time) is the subwoofer at the front (noted by green "R" letter in the picture above). The polar pattern is created by delaying the rear/back subwoofer and reversing its polarity. This arrangement is usually done using a pair of subwoofers. Three different polar patterns are available:

- Cardioid (maximum rejection at the back)
- Hyper-Cardioid 135° (maximum rejection at 135°)
- Hyper-Cardioid 120° (maximum rejection at 120°)
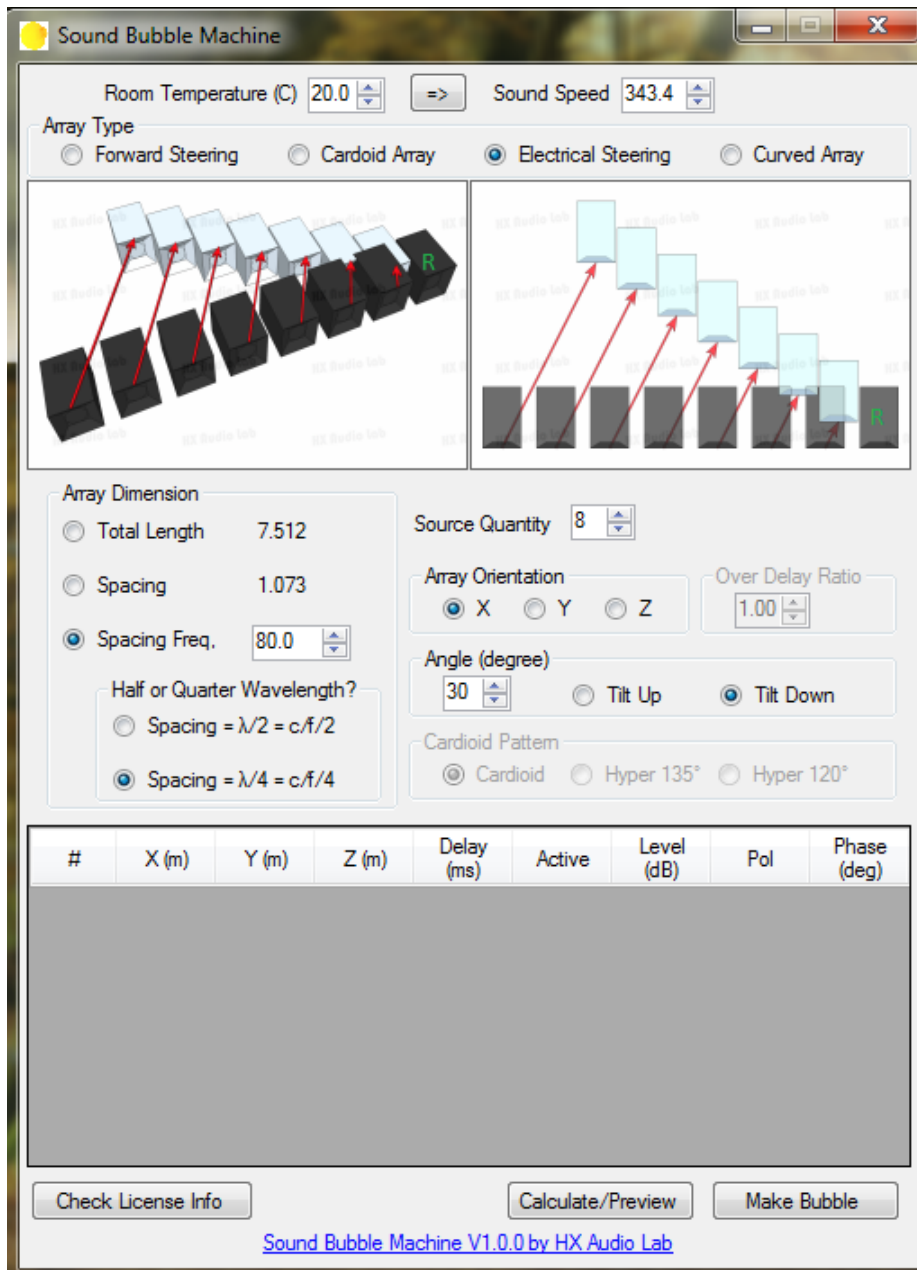
Electrical Steering
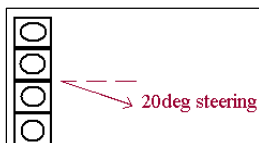
This arrangement enables user to steer the main lobe of the sound to a certain direction. The delay time is calculated based on a straight array to reassemble a tilted array as shown on the pictures. This arrangement usually requires at least three subwoofers to work effectively.
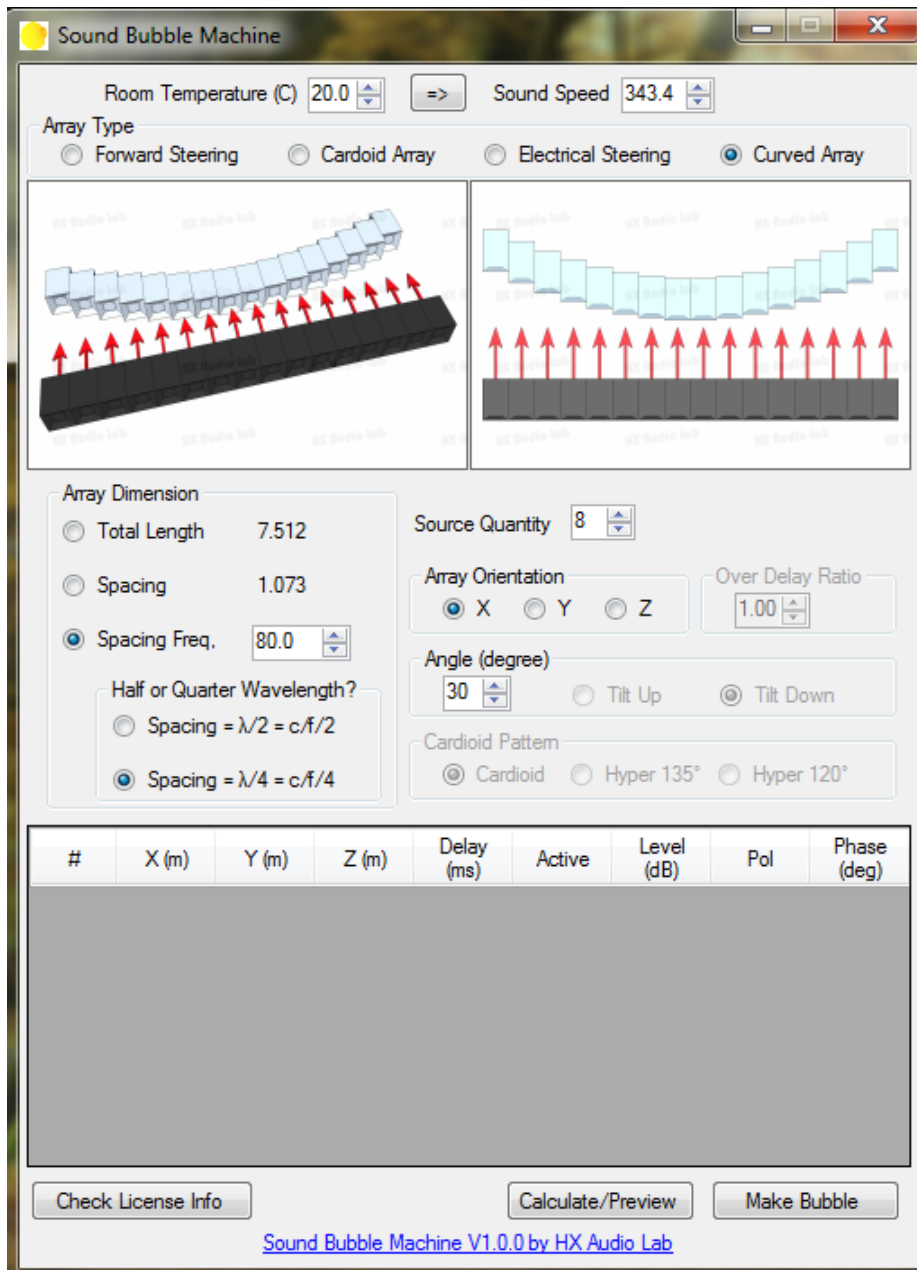
Curved Array

This mode calculates delay time based on a straight array configuration to reassemble a curved array, thus widening the dispersion.

Source Quantity
Total quantity of subwoofer will be used in the array arrangement.

Array Dimension
Spacing refers to center-to-center distance between subwoofers.
Total length refers to the total length of the array.
Spacing frequency refers to the frequency which wavelength is 2 or 4 times of the subwoofer spacing. In other word, the spacing equals to the half or quarter wavelength of the spacing frequency. For cardioid/hyper-cardoid array and forward steering, only the quarter wavelength option is enabled. This frequency should be the highest frequency of the subwoofers' operating range (recommended highest low pass filter frequency point).

Array Orientation
Select the axis you want to place the straight array for calculation purpose.

Calculate/Preview Button
Update the list of the sound source in the table based on the setup.

Make Bubble Button
Output a Sound Bubble file.

Check License Info Button
Authorize/de-authorize the Sound Bubble Machine software.

Basic Steps of Using Sound Bubble Machine

1. Set the temperature or speed of sound.
2. Select the array type/calculation mode.
3. Define the subwoofer/sound source quantity.
4. Define the array dimension.
5. Tweak other parameter such as polar choice (cardioid/hyper-cardioid array), over delay (forward steering), steering direction (electrical steering), angle of the arc (curved array), etc.
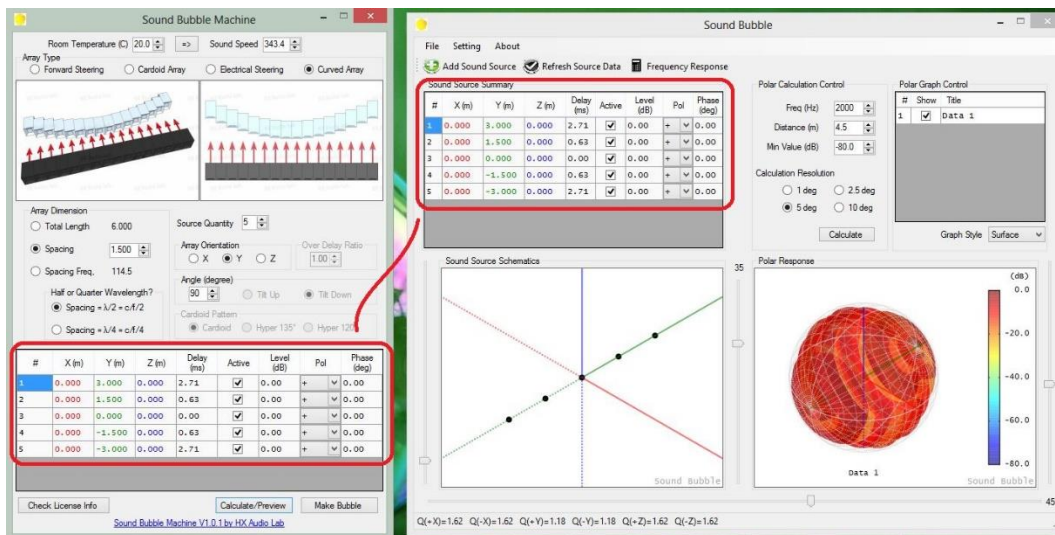6. Click Calculate/Preview Button to get the delay configuration.

# Using the "Make Bubble" Function with Sound Bubble
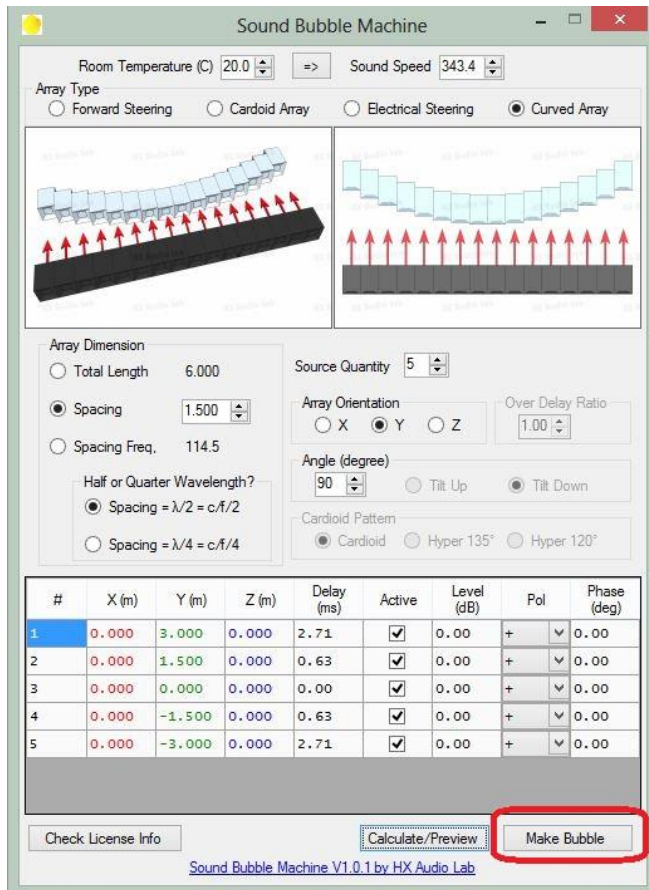
After pressing Calculate/Preview, please click Make Bubble and name the saved file accordingly.
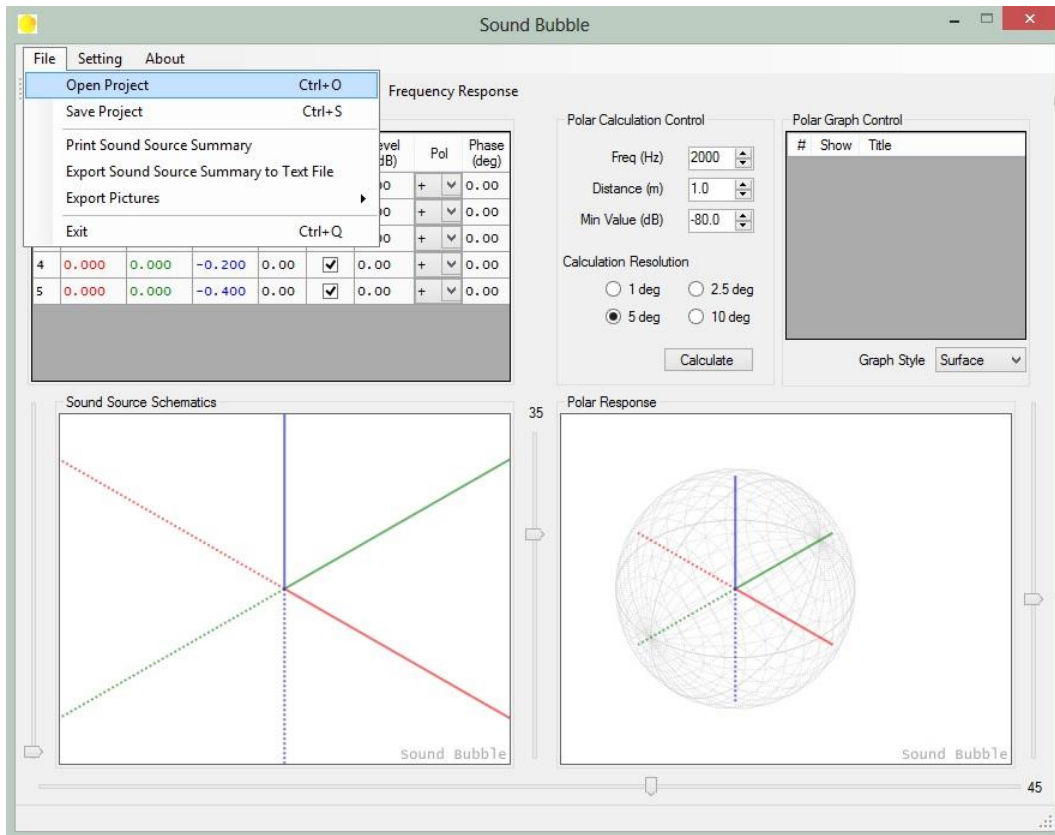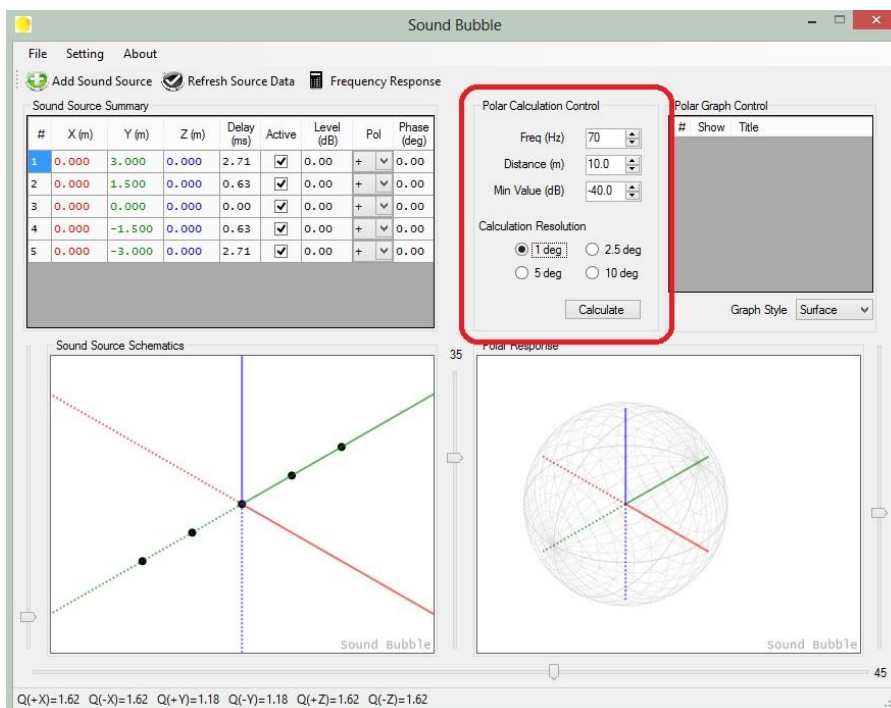
Open Sound Bubble, click on: "Open Project" under File menu. Please open the Sound Bubble
Machine file (*.bub) you just created.

The sound source list in Sound Bubble should be the same with the sound source list in Sound
Bubble Machine.
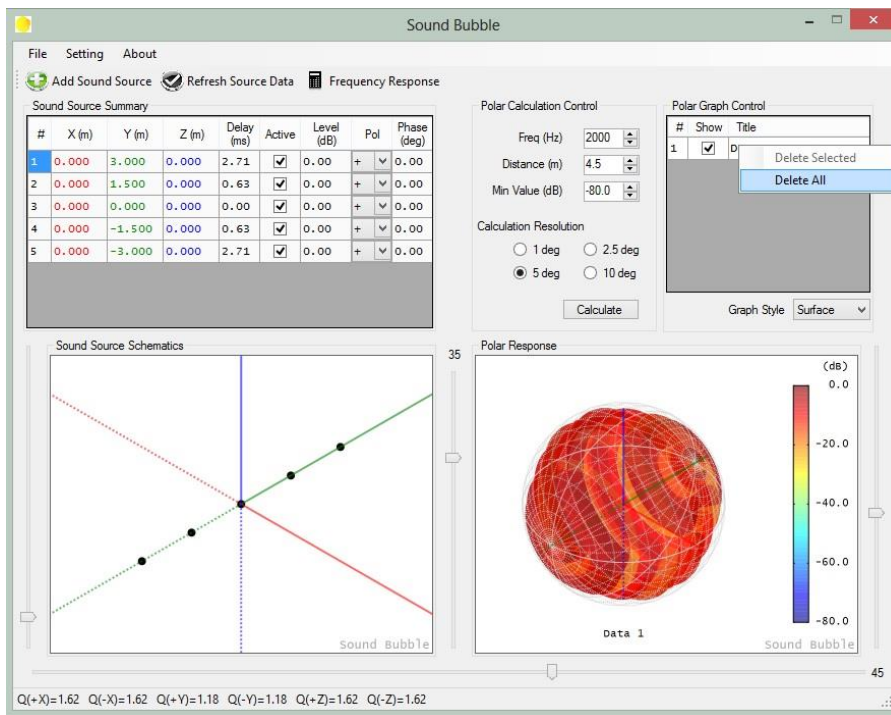
To clean the current polar data, on the right top box (Polar Graph Control), right click on the mouse and select Delete All.


Setup the Polar Calculation Control and then hit Calculate. This will add a new polar data under the Polar Graph Control box. Calculate button need to be clicked every time you change the settings in Polar Calculation Control. Refresh Source Data button need to be clicked if you change the sound source setting.
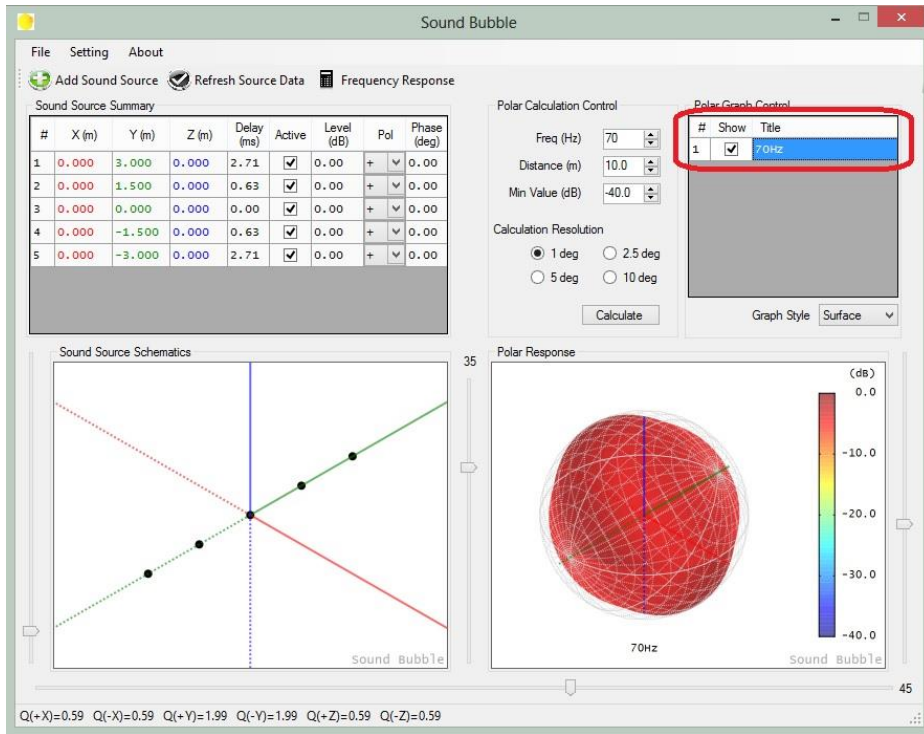
You can rename the title of each calculation.
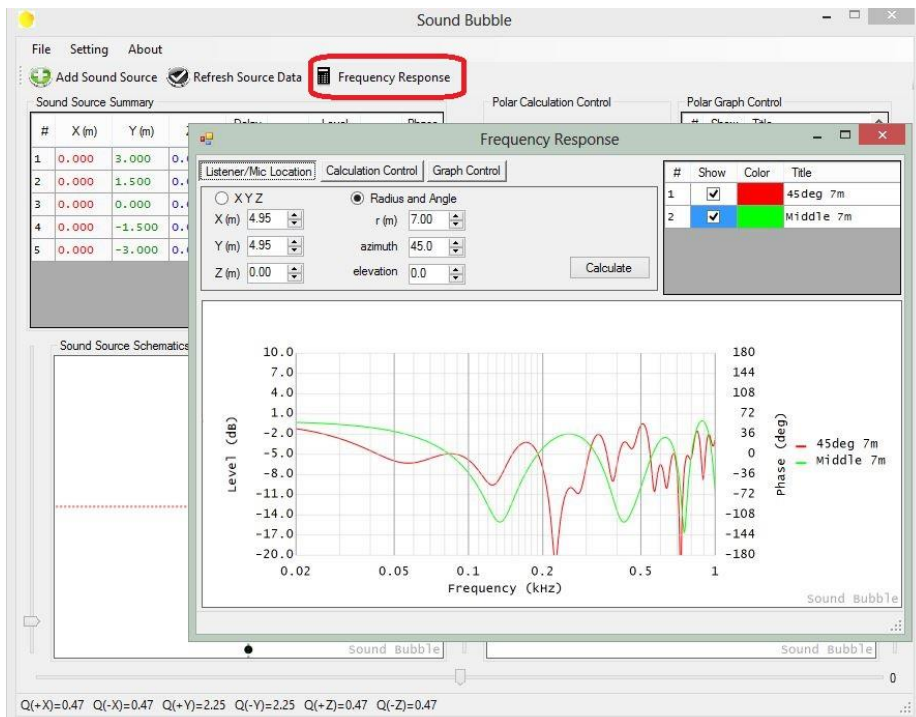
Click on Frequency Response button to open the frequency response prediction module. This module predicts the frequency response, assuming each sound source is omnidirectional at all frequency and has a perfect flat frequency/phase response.
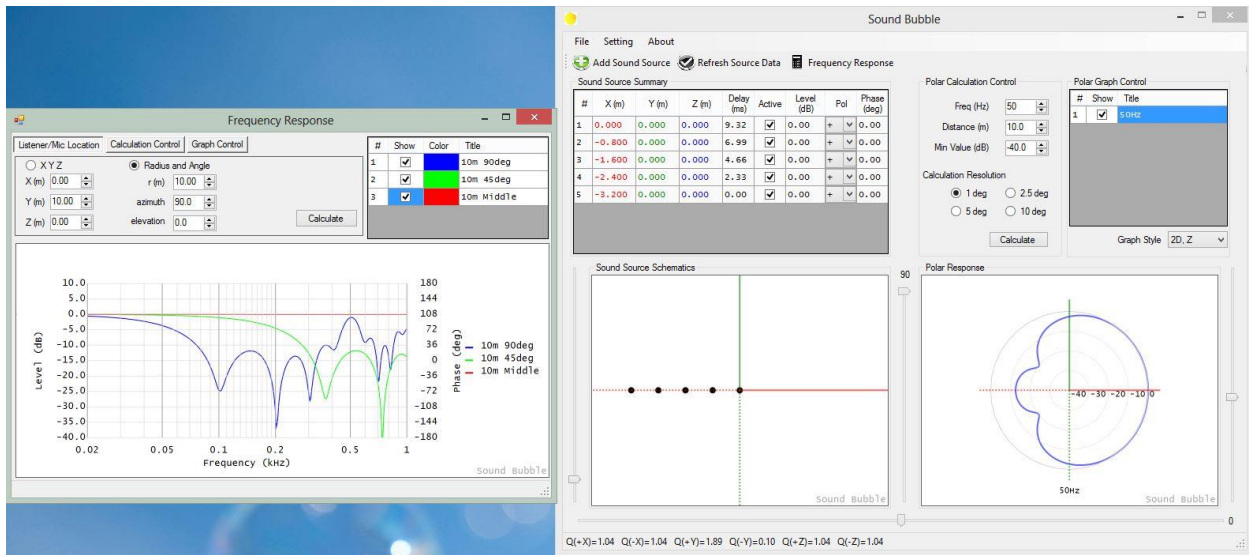
The screenshot above shows an example of a forward steering prediction from Sound Bubble Machine (with 100% delay ratio). The frequency response module is set to calculate 10m in the front of the array, 10m @45deg of the array, and 10m @90deg (side) of the array.
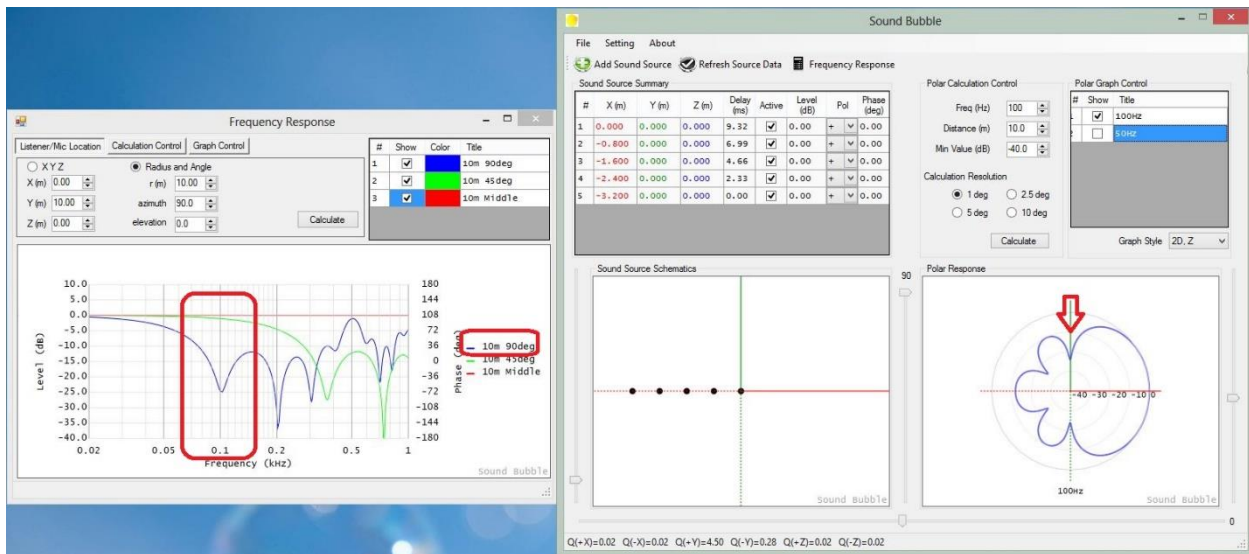

Still at the same configuration, 10m on the left side of the array (blue curve) shows a cancellation/dip at 100Hz in the frequency response. In the Sound Bubble main window, we can change the frequency to 100Hz and calculate the polar, which shows a null at the 90deg direction (marked by a red arrow at the side of the polar).

Tip: Sound Bubble program can be opened multiple time at once.
The next several pages compare polar response of a straight array that is delayed to create an imaginary curved array (straight/no delay, 90deg arc and 140deg arc) calculated from Sound Bubble Machine.
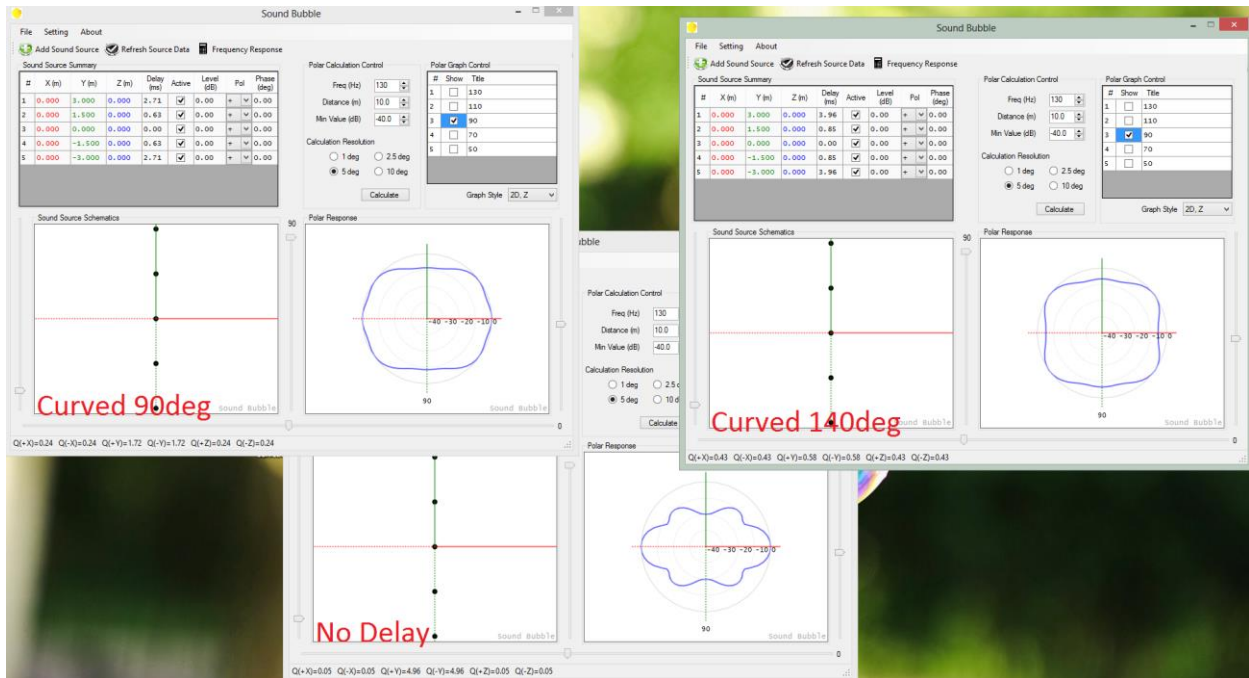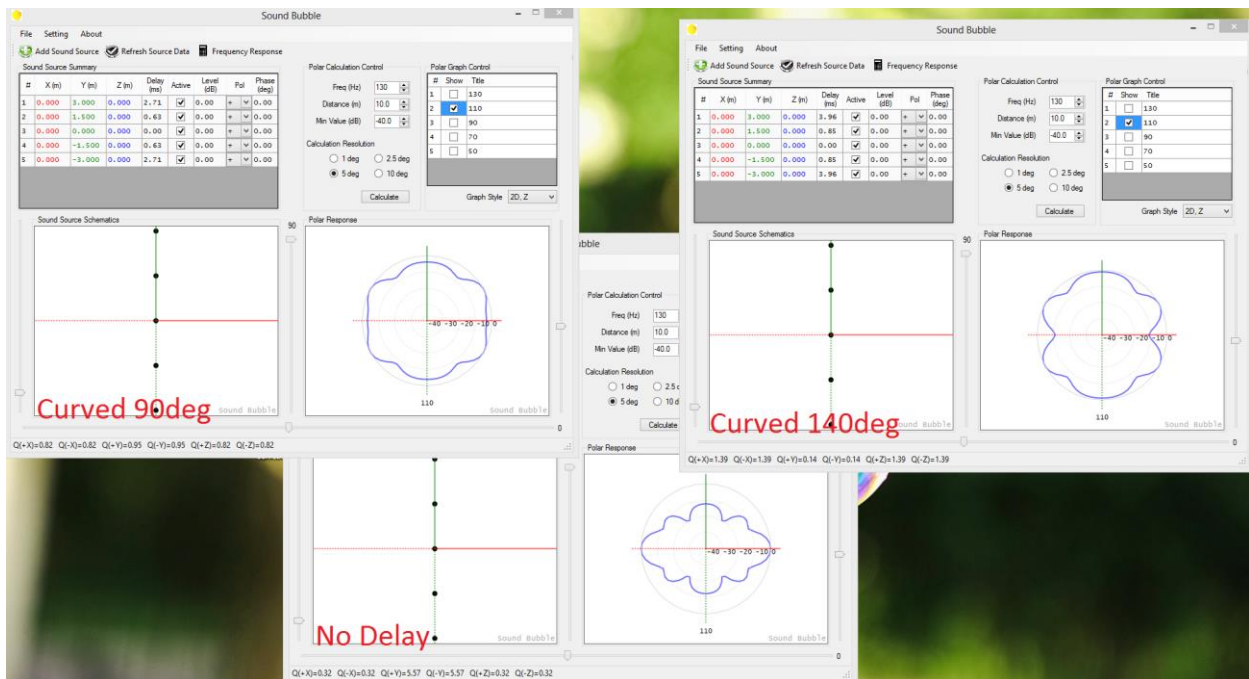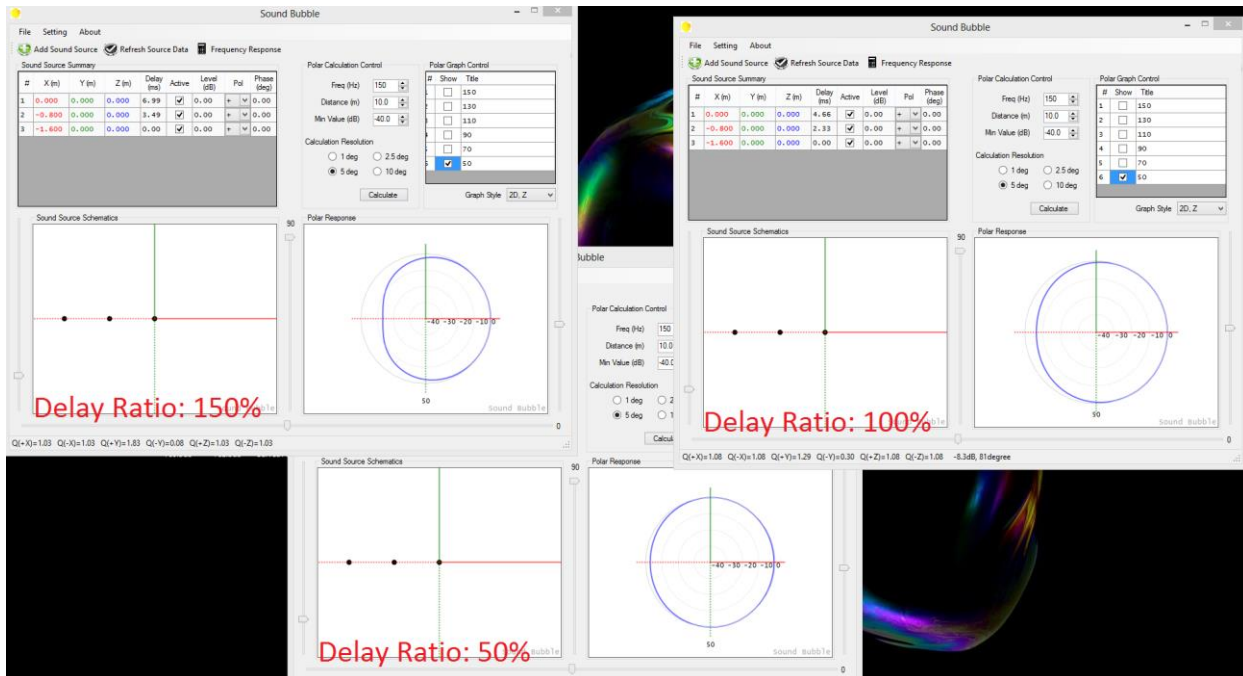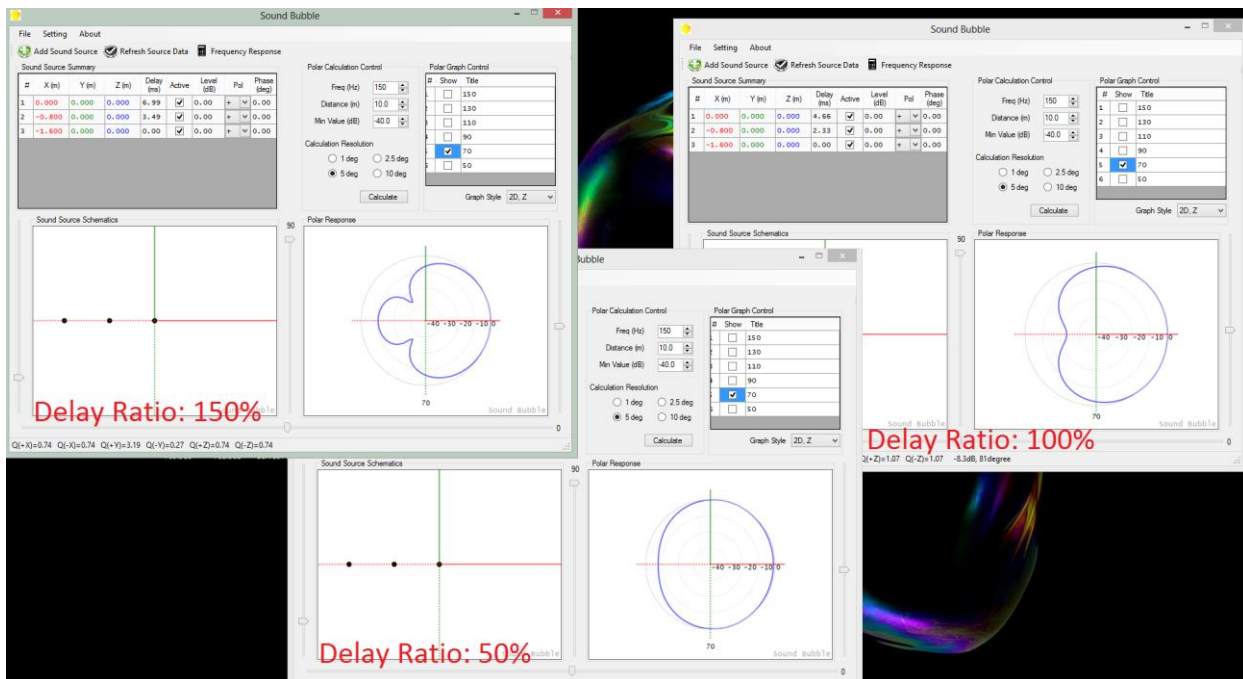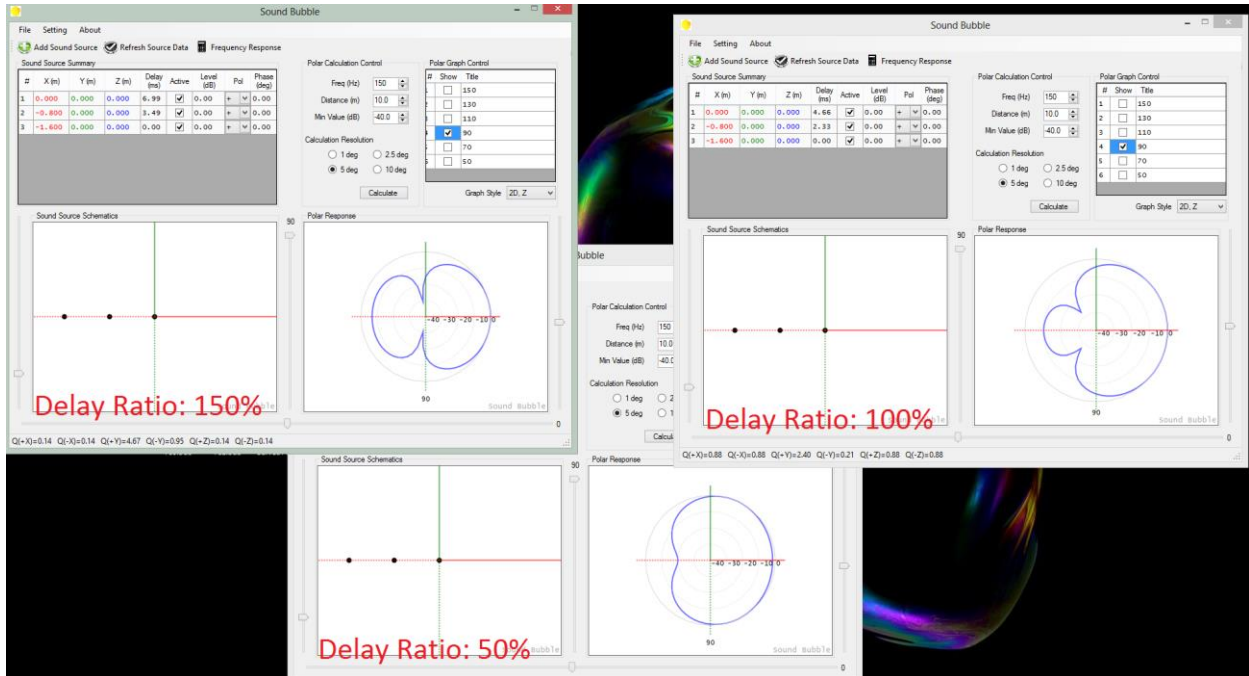
50Hz

70Hz

90Hz

110Hz

The next several pages compare <u>forward steering</u> using five subwoofers with different delay ratio at different frequencies.

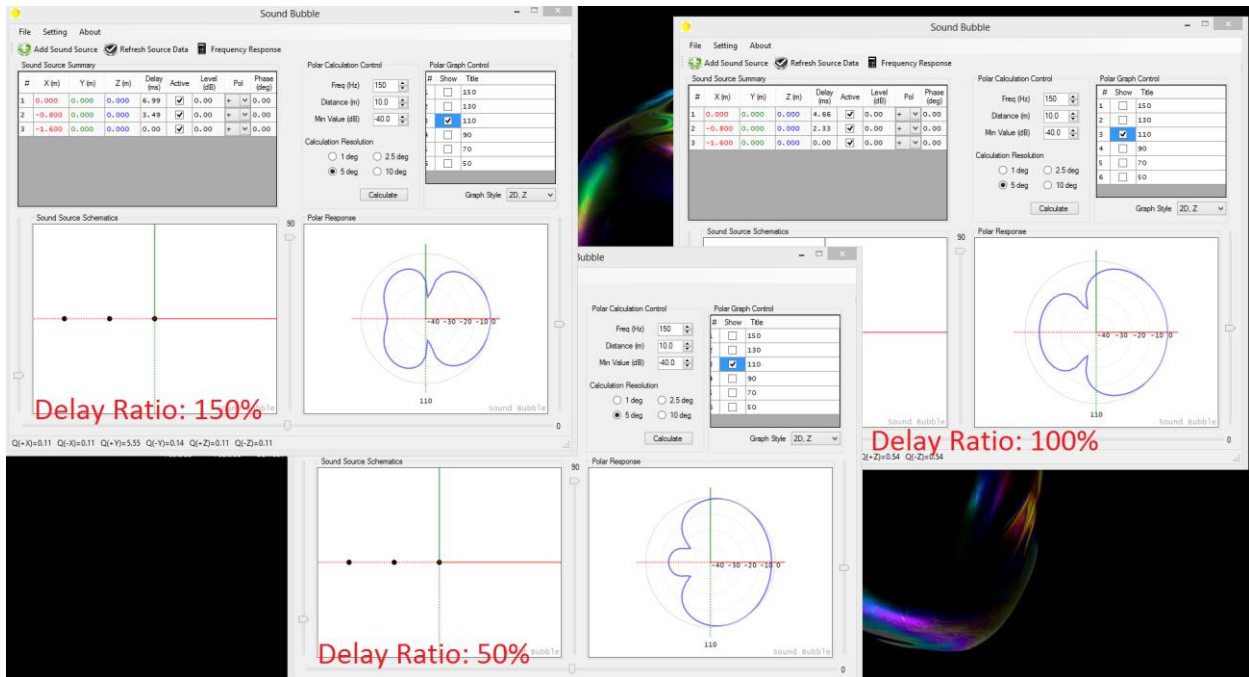50Hz

70Hz

90Hz

110Hz