

Depiction of sound sources in relation to the head

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1 General remarks

The program SketchUp Make was used to engender 3D arrangements of sound sources. This is available on <http://www.sketchup.com>. It is supported by Windows and Mac. The data exists in the formats .skp and .dae. Therefore other programs can be used to render images of sound sources arrangements. An alternative to SketchUp Make is the open-source program FreeCAD. This can be downloaded from <http://www.freecadweb.org>. It is available for Windows, Mac, Fedora and Ubuntu.

2 Vorliegende Modelle

To illustrate the positions of sound sources this repository includes the model of a head, a loudspeaker and a diapason. These are shown in figure 1. The size of the models should be proportional.

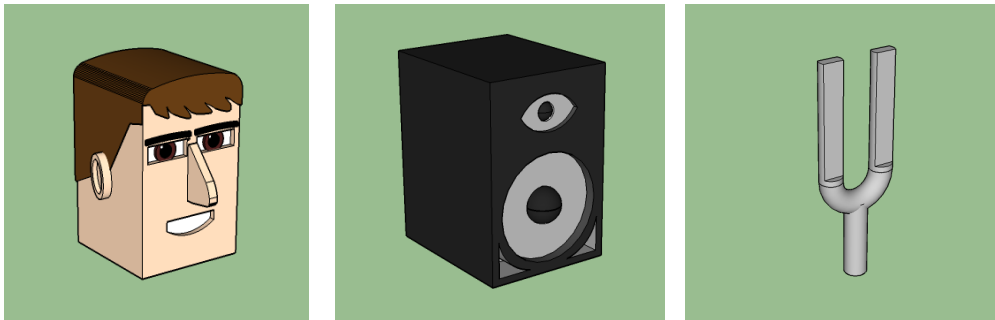


Abbildung 1: Modelle

3 Usage of SketchUp Make

3.1 Templates

At first a template has to be chosen. The templates differ in background color. For the models the „Simple Template“ was chosen because the blue and green background has a good contrast to the models. The templates are available in meter and inch.

3.2 Initial screen

Figure 2 shows the initial screen of the „Simple Template“. The red fringe in the top figure area tags the most important functions. The fringe in the lower right edge marks the box where the dimensions of the currently active function are displayed. As length units are m, cm and mm available. The settings can be change by „Window“ → „Model“ Info → „Units“. The figure shows the three axes of the coordinate system. They ease the positioning of the sound source. But they may disturb the depiction. There is the possibilty to deactivate the axes by „View“ → „Axes“

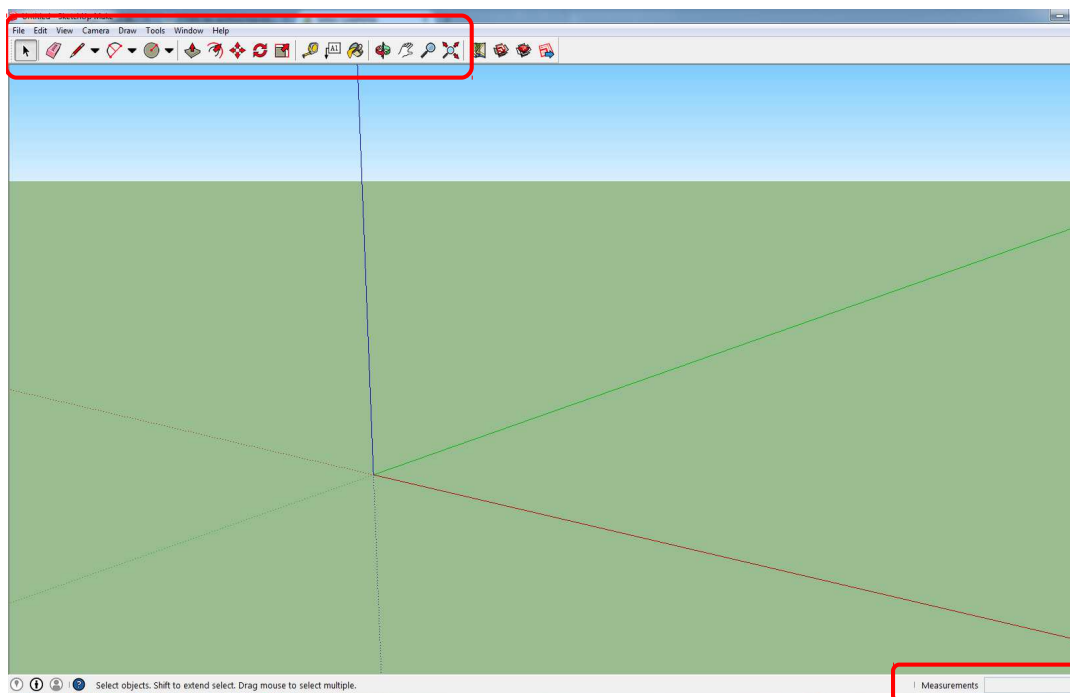


Abbildung 2: Startbildschirm

3.3 Functions

Figure 3 depicts the area of the most important functions enlarged. The functions are named starting lefthand.

- Select
- Eraser
- Line
- Arcs
- Shapes
- Push/Pull
- Offset
- Move
- Rotate
- Scale
- Tape Measure Tool
- Text
- Paint Bucket
- Orbit
- Pan
- Zoom
- Zoom Extents

There are two more functions which are useful to arrange respectively to create new sound sources.

- Follow Me
- Protractor



Abbildung 3: wichtigsten Funktionen

4 Example

The procedure of positioning sound sources is explained by the stereo configuration. The two loudspeakers have an azimuth of $\pm 30^\circ$ related to the median plain. The distance between the listener/head and the loudspeakers is amounted to 2 meters. In order to arrange a frame exactly it is possible to preset points to the arrangement. These points might be added by the Tape Measure Tool or they might be intersections of different lines.

At first SketchUp has to be opened and template has to be chosen by the button „Choose Template“. For this example the „Simple Template“ in meter was chosen. Then an arc of 180° was drawn with the help of the function of the same name, see figure 4.



Abbildung 4: Kreisbogen

In the next step the two azimuth angles were stated by „Tools“ \rightarrow „Protractor“. The median plain is determined by the green and blue axes. The intersections between the arc and the dashed lines were red marked in figure 5. At these intersections the loudspeakers were placed.

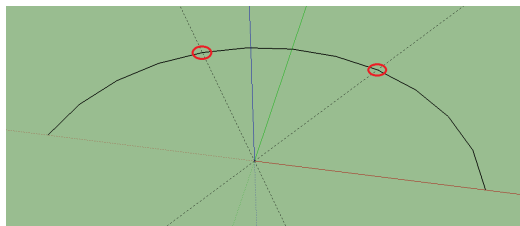


Abbildung 5: Winkel

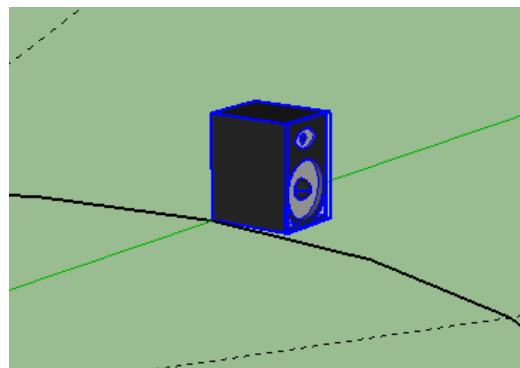


Abbildung 6: importierter Lautsprecher

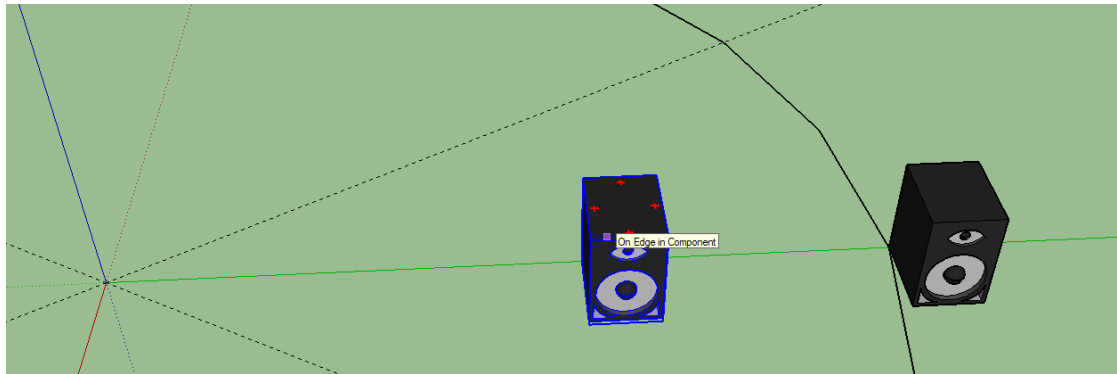


Abbildung 7: duplizierter Lautsprecher

By „File“ → „Import“ a loudspeaker was imported to the model. Afterwards it was positioned at the intersection of the green axis and the arc. The blue fringe in figure 6 denotes that this loudspeaker is selected currently.

The function „Move“ was activated automatically by the import-function. If the Ctrl-key is pressed, the selected frame will be duplicated. The duplicated frame can be moved. A second loudspeaker was placed parallel in relation to the green axis as it can be seen in figure ???. On the surface of the selected loudspeaker are four red crosses. At these points the loudspeaker is turnable.

In figure 8 the loudspeaker was rotated about 60° clockwise. Then the centre of the front was selected and the loudspeaker was placed at the left intersection between the arc and the dashed line. This can be seen in figure 9.

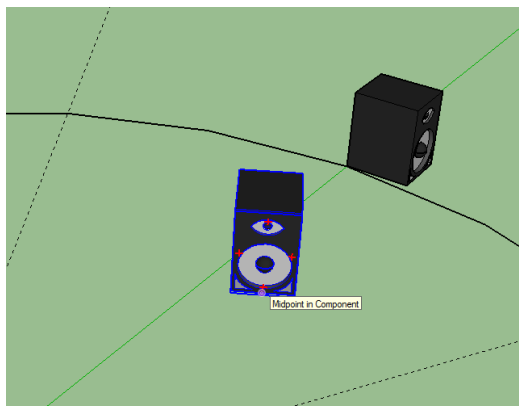


Abbildung 8: gedrehter Lautsprecher

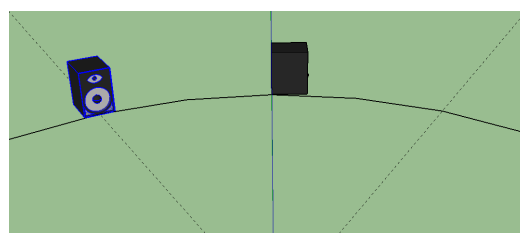


Abbildung 9: linker Lautsprecher positioniert

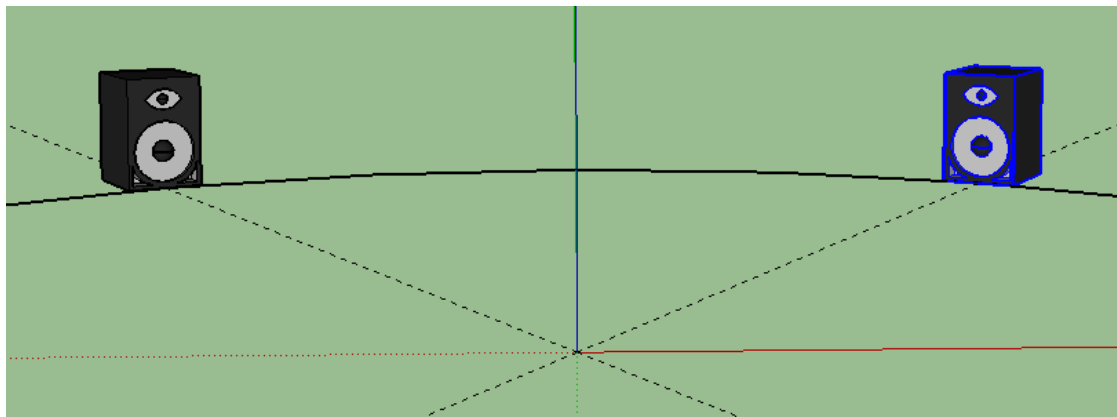


Abbildung 10: Anordnung beider Lautsprecher

With the second loudspeaker was acted in the same manner, just that he was rotated about 120° clockwise. The structure is pictured in figure 10.

A diapason was imported as the last sound source. It shall represent the phantom source in the stereophonic configuration. The diapason was placed in the center between the both loudspeakers. The extended structure is shown in 11.

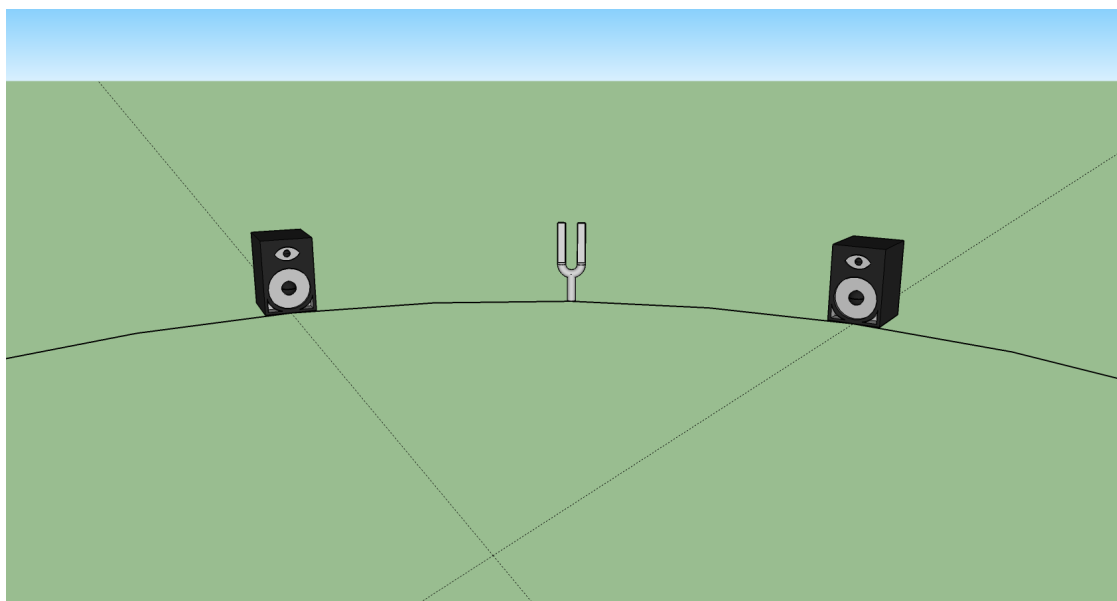


Abbildung 11: Stimmgabel

Finally the head was imported and was placed in the coordinate origin with the center of its bottom side.

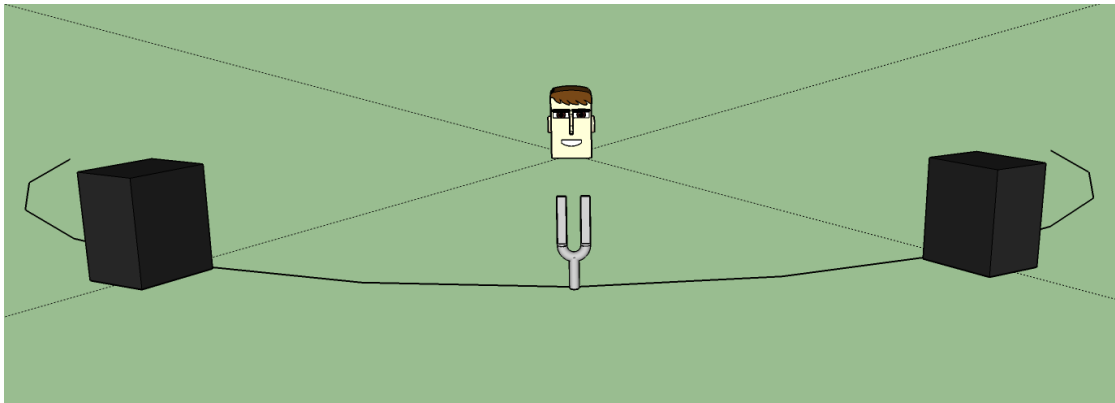


Abbildung 12: vollständiger Aufbau

The arrangement is completed. Therefore the figures can be exported. If the auxiliary lines - the arc and the dashed lines - are necessary to understand a complicate arrangement, they should not be erased. The auxiliary lines had been removed, before the follwing figure was exported.

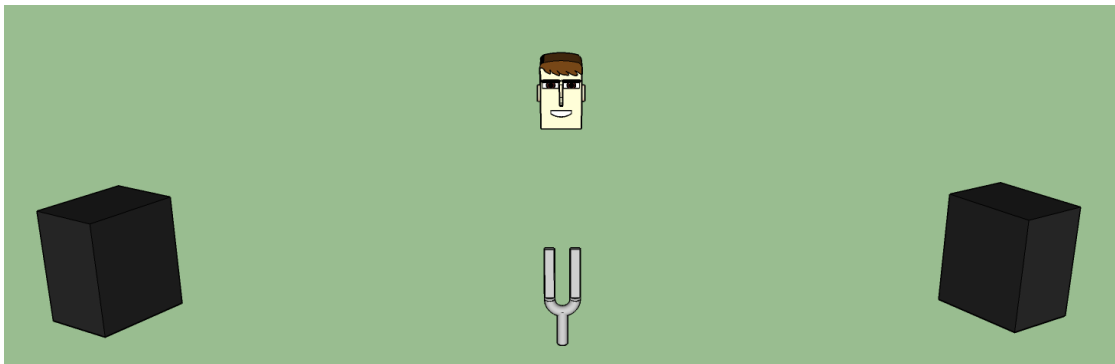


Abbildung 13: vollständiger Aufbau