

ODEON

COMBINED

≡ Quick Start Guide





ODEON Room Acoustics Software

Version 18

Quick Start Guide for Combined Edition

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1. About ODEON

ODEON is a room acoustic prediction and measurement program that uses state of the art algorithms from geometrical acoustics. The program will help you obtaining accurate predictions and measurements on room acoustics.

Remember: To check which features are included in each edition, read the [feature sheet](#) found under Buy>Price List on the ODEON's home page.

How to learn

- This **Quick Start Guide** gives an introduction to the use of ODEON **Combined**, the edition that includes all features available in the **Industrial** and **Auditorium** editions. The **Quick Start Guide** can be found both from inside the software and on our website.
- Supplement with **Video Tutorials** from our website. Begin with the series called *Get Started* that will guide you through making a model and using it in Odeon. Go to: <https://odeon.dk/video-tutorials/>
- You can always get help for a specific function or menu in ODEON. A context sensitive **Help File** is available using the F1 short-cut key throughout the program. The help includes description of the facilities available in a particular window, suggestions on the choice of calculation parameters, hints on the evaluation of calculation results, etc. Press F1 and you will get help for the specific menu you have opened in ODEON.
- In the **Full Manual** you will find everything else. From how to use different tools, to explanation of acoustical parameters, or the calculation principles. ODEON is a comprehensive software, so the manual is comprehensive as well. Therefore we recommend to by use the **Quick Start Guide** and *Get Started* videos before using the manual. The **Manual** is available from both inside the software or on our website (Learn>User Manual).

Buttons, hints and menus

The most common operations can be carried out using buttons. Hovering the mouse over a button will display a hint telling the function of that button. You can also operate the program using menus and short-cut keys. Less common operations are available from the drop-down menu in the top of the ODEON application window.

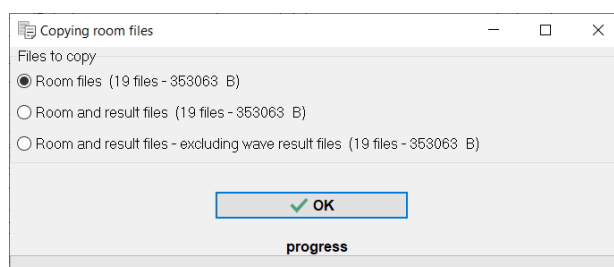
For each windows in ODEON, a window-specific dropdown button will appear in the Menu Bar when the window is activated. If looking for a facility in a window, it is quite likely that it can be found in that drop-down button.

Saving and manipulating data

ODEON automatically saves the user-entered data, such as sources and materials with the room when the corresponding window is closed. Whenever data need to be updated in order to carry out calculations, ODEON will prompt whether to accept or discard changes. If the changes are accepted, ODEON will automatically erase results that are no longer valid, ensuring that results are always consistent with data entered.

If you want to make larger changes to a model but still be able to go back you can save a new version of the project. This is similar, but not the same, as the *Save as* option in other programs.

To save a new version of the project you are working on, just click File>Copy Files, enter a new name and choose which files you want to copy. Copying only the Room files keeps all information needed for defining a project completely.



You can then re-run the calculations for the new version later on. If the calculations are large and recalculation would take much time, you can copy the Room and Result files as well, but this often uses much more space on the hard drive.

ODEON files

ODEON creates multiple files for different setup and calculations: A file for a material list, a file for the geometry, a file for the placement of sources and receiver etc. For most usages this is irrelevant for the user, but be aware that if you want to move a project you should use the internal zip function found in File>Zip>Create Archive. See the full list of files in the ODEON **Help File** (F1 short-cut key) by searching for File management.

Tip: If you wish to delete specific files from a project, choose File>Delete files and select the particular type.

Computer system requirements

Operating Systems: ODEON is a 32 bit Windows® application running on Windows® XP, Windows® Vista, Windows® 7, Windows® 8 and Windows® 10 and Windows® 11 (32 bit version as well as 64 bit version). ODEON can in principle run on a MAC system using a Windows emulator. Many users choose this option instead of a PC, but since possible system instabilities may occur such a use is solely responsibility of the user.

RAM: recommended 2 GB.

Free Disk Space: Minimum 20 GB, recommended 300 GB. Unlike other applications ODEON is a fairly light program, consuming small space in temporary (RAM) memory, but it needs a generous space on Hard Disk. During calculations it creates files that are written on the Hard Disk, releasing the temporary (RAM) memory. Both simulation and auralisation files can be quite big, but their size depends heavily on the type of room project. So, managing the disk space is very much up to the user.

CPU: Minimum 1 GHz Pentium® recommended. Multi core processors are recommended for fast parallel calculations.

Graphics card: SVGA graphics display/adaptor.

Sound card: Sound card (for surround loudspeaker playback the sound card should typically support multiple channels e.g. 4.1, 5.1 and 7.1 - up to 50.1 supported).

Ports: USB port for plugging in the Dongle.

Tip: ODEON consumes modest amount of RAM and it is a very light software which responds very fast to the user actions.

Remember: ODEON works as a locally installed application. This means that server installation or remote desktop control are not possible. For multiple-user operation within the same Company or Institution extra licenses (dongles) are offered at a discounted price. Due to the nature of ODEON (writing many files during simulations) saving room files on a server hard disk is not recommended. Calculation speed can significantly be reduced and the whole process can get stuck usually due to limited network capacity.

2. Get Started

For the installation procedure please refer to the full ODEON manual.

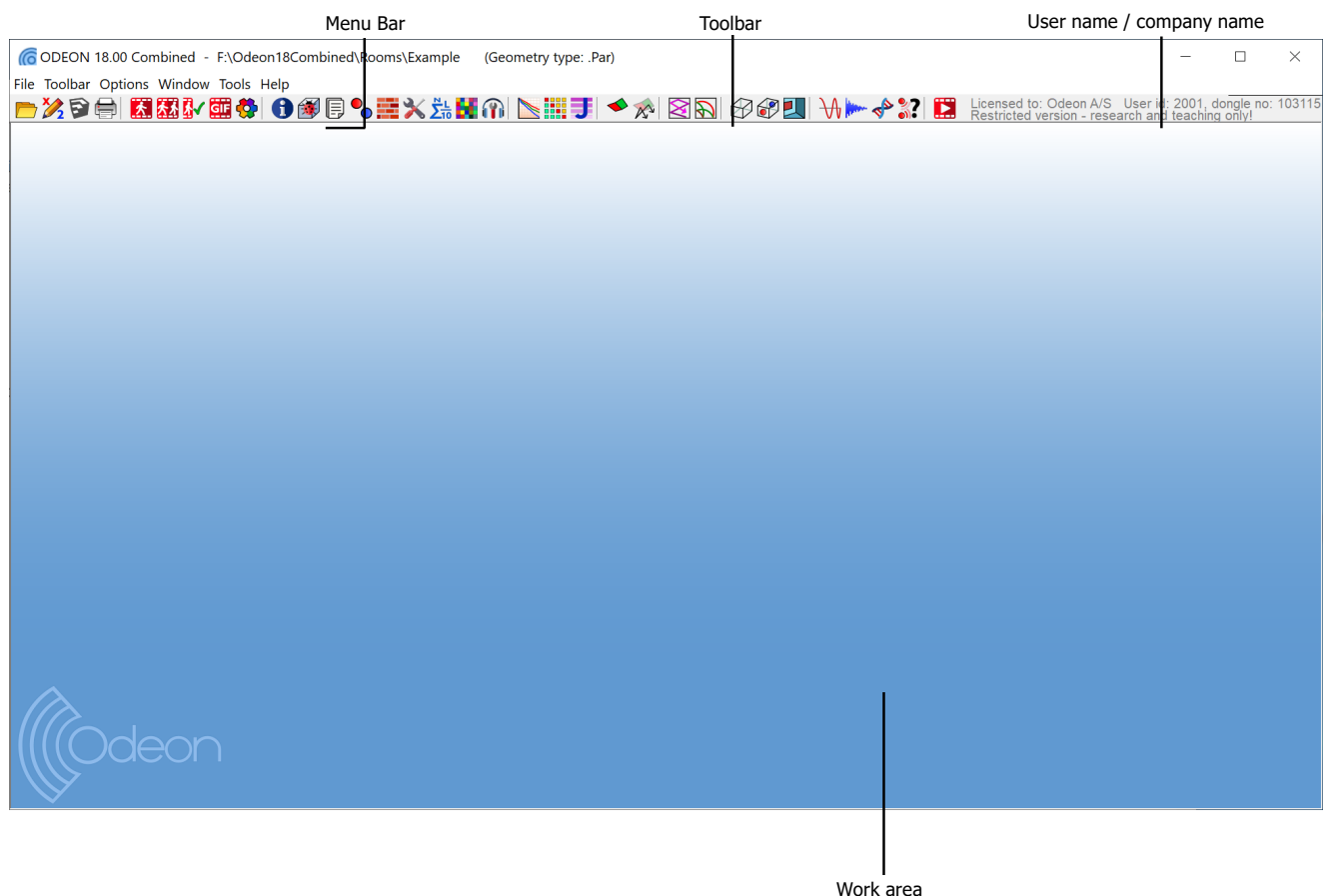
Tip: Find the exact edition and version of your ODEON installation by choosing Tools>License information.

Run ODEON Combined

You will find the ODEON Combined program at the Windows Start Menu > Program files(x86) > Odeon Combined> Odeon. It is handy to make a short-cut to the desktop by right-clicking on the application and selecting Sent to>Desktop (create short-cut). Then ODEON will be available from the desktop. Run the program and begin the tour.

The Workspace

The workspace of ODEON Combined consists of the menu bar, the toolbar and the work area. On the right hand side of the menu bar the type of installation and the owner of the ODEON license is shown.



- The **Menu bar** is *context-sensitive*, meaning that an extra menu is added between the **Toolbar** and the **Options** menus when a new window becomes active in the work area. This menu brings options corresponding to the active window.
- Initially the **Tool bar** has many of its buttons inactive. These buttons can only be used when a room is assigned. The rest can be used any time independently of rooms. For example, the buttons associated to the measuring system are always available, since measurements can be performed without the need of a room model being assigned.

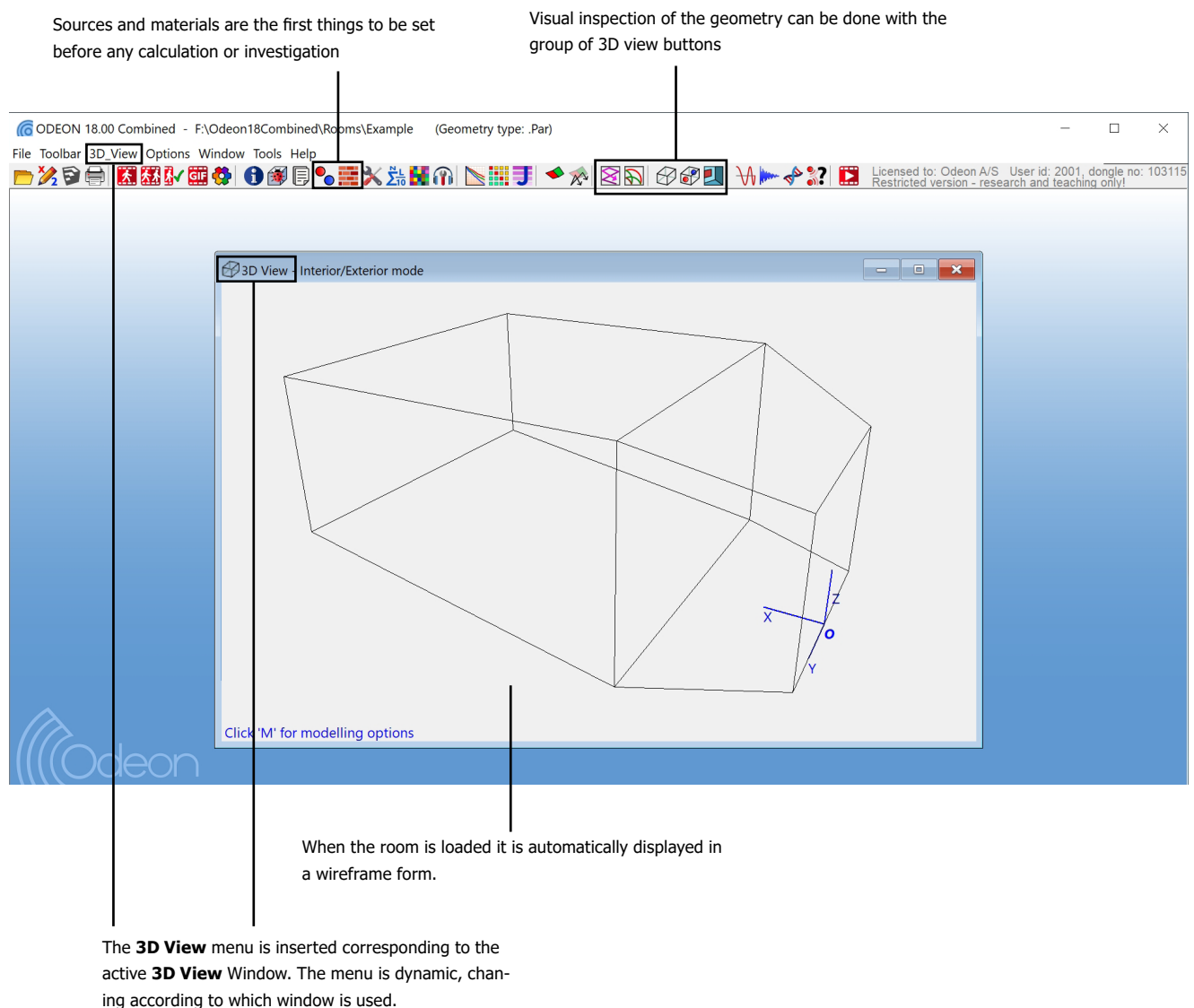
Open a room model to work on

Odeon can import a range of different formats from different 3D modelling softwares. This Quick Start Guide will only cover already made projects (for information about import and file types look in the ODEON manual).

Click the Open Room button to select a room. Default rooms are found in the Rooms subfolder inside the main ODEON folder on your PC. The usual path is C:\Odeon-15Combined\Rooms. The models in the Rooms subfolder cover different types of projects that can be investigated with ODEON. For this guided tour select the room model named Example.par.

The Toolbar

Once the room Example.par is loaded all buttons in the toolbar become active and can be used with this room. The buttons are grouped in an order that helps executing the tasks needed in a project.



Tip: Press **F1** to get overview of facilities in the 3D View and their use.

Remember: LMB stands for *Left Mouse Button* while RMB stands for *Right Mouse Button*.

Tip: You can locate a surface of the model directly in the 3D View: Click on the 3D View and press M (this activates the Modelling Options). Now the mouse cursor is transformed into a cross symbol. Approach any point that defines the surface you want to locate and click ALT+LMB. ODEON will highlight the surface that uses this point. Since normally a point is used by three joining surfaces, ODEON might highlight a different surface. Click Yes in the message dialog that shows up to continue highlighting the next surface that uses the selected point. When the desired surface is found click No in the message dialog and press M again to exit the Modelling Options mode.

Remember: If a model delivered from an architect contains high detail, care has to be taken to simplify it before using it in ODEON. You can see more on what objects can be modeled and what objects can be excluded in the full ODEON manual.

3DView

Whenever ODEON loads a room, it is displayed in a 3DView. Immediately a new menu called 3D View is added between the Toolbar and the Options menus in the Menu Bar. Have a look at the room. This allows you to investigate the geometry as a wireframe model and check it for errors.

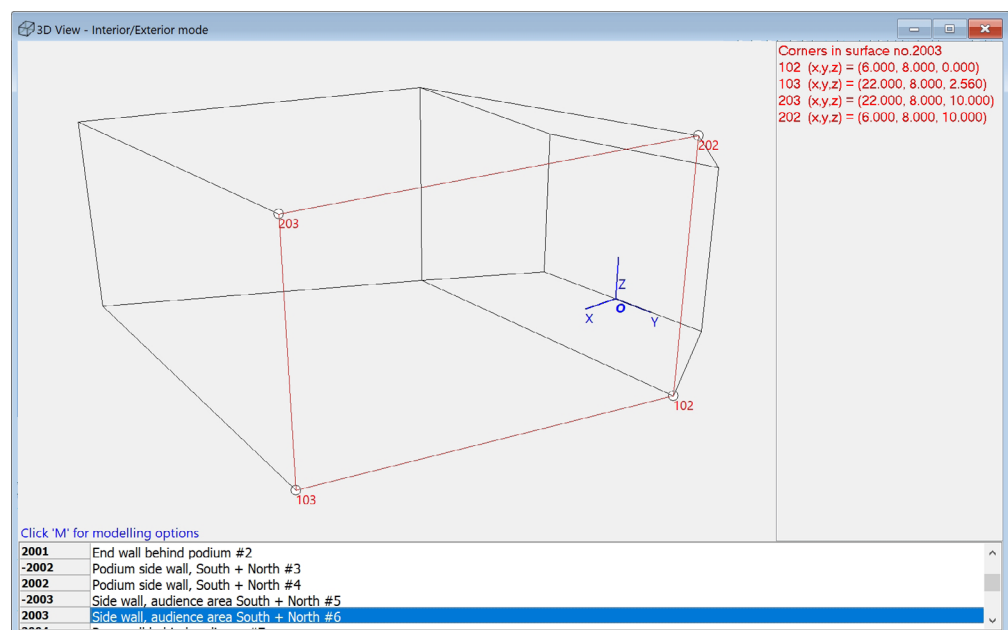
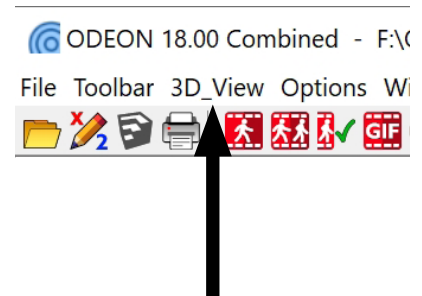
Use the mouse to:

- Rotate/orbit the geometry (LMB)
- Pan the geometry (RMB)
- Zoom the geometry (ALT+LMB - dragging from bottom left to top right)

Having assigned a room, this is a good time to get familiar with the MDI concept (Multiple Documents Interface). At this point the title bar of the 3DView will be blue (or some other colour) indicating that this is the active window. Being the active window, the 3DView menu item is added to the menu bar next to the Toolbar drop-down menu. You can operate the functions of the window using this menu or the short-cut keys displayed in the menu.

Several facilities are also available in the 3D View menu. The most important are:

- Rotation (CTRL+Left/Right/Up/Down Arrow)
- Panning (ALT+Left/Right/Up/Down Arrow)
- Zooming (CTRL+U, CTRL+I)
- Highlighting (H) of selected surfaces and corner numbers (N) etc.
- Navigating through front, side, top, perspective and other views of the model (SPACEBAR).

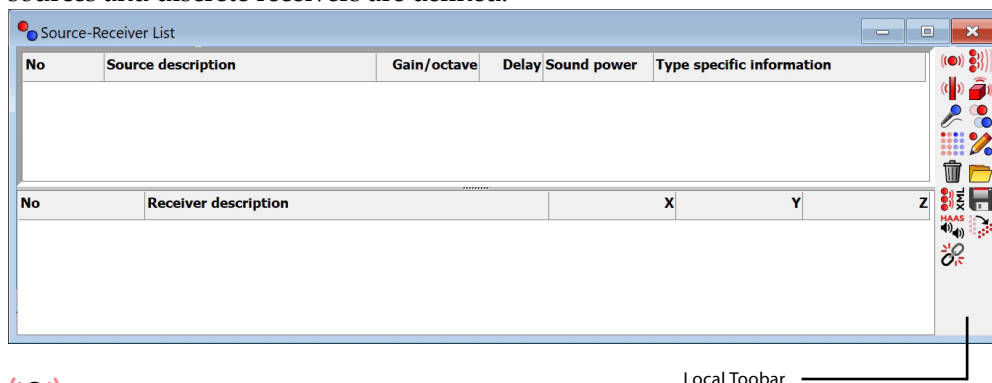


3. Setting-Up the Model

Define sources and receivers

Before any calculation can be carried out in ODEON, one or more sources have to be defined. Of course a receiver will also have to be defined in order to calculate a point response, but it is not necessary when calculating global reverberation time. In this guided tour we shall define a *point*, a *line* and a *surface source*. Finally we shall define some *receivers*.

Click the Source-receiver List button at the Toolbar to open the Source-receiver List from which sources and discrete receivers are defined.

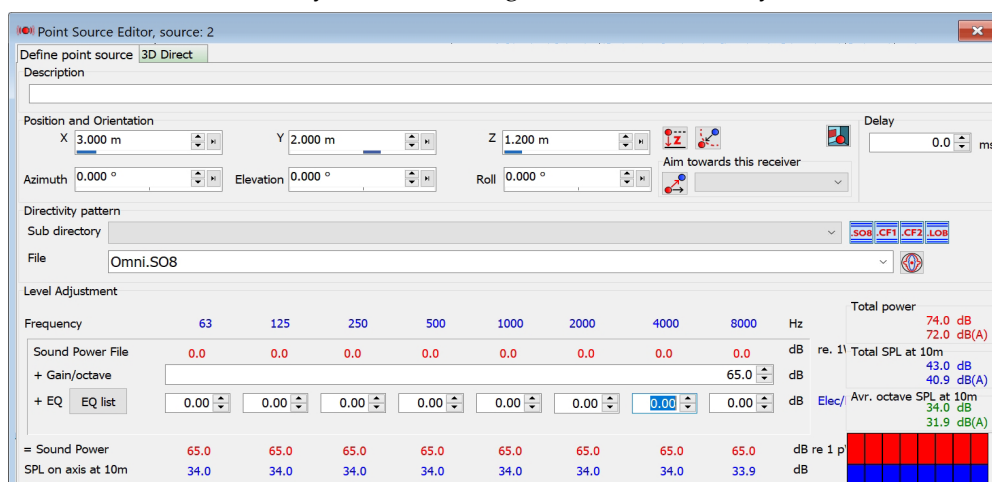


Define a point source

Click the New point source button in the Local Toolbar at the right side of the Source-receiver List to open the Point source editor. Alternatively, press CTRL+RMB (Right Mouse Button) to create a source from the menu that pops up. Enter the values $x = 3$, $y = 2$ and $z = 1.2$ (metres). Rotate the 3D Edit Source display (hold and drag with LMB) to see the location of the source you are placing. You can notice how the menu item 3D_Edit_Source_Receiver appears on the *Application Bar*, when this window becomes active. All navigation commands that was available in the 3D View are available in the 3D Edit Source Receiver (eg. SPACEBAR to switch between different predefined views).

Finally, set the overall gain of the source to 65 dB (arbitrary value). Keep the default values for the rest fields. To save the new source just close the Point Source Editor. New sources are by default turned OFF, therefore they will not be visible in the 3D Edit source display.

You can re-edit a source by double-clicking on the list or directly in the 3D view.



Tip: If the Source-receiver List is already open, but hidden behind other windows, etc., clicking again the button will rearrange the windows as needed.

Remember: Depending on the language selected on your computer '.' or ',' is used as decimal point. The decimal separator to use internally in ODEON may also be selected from the Options>Program settings>Other settings entry.

Tip: It is possible to change source position directly on the 3D Edit Source display using CTRL+LMB. As you rotate the geometry a grid is adjusted to the visible plane to help anchoring the source on its nodes. In the next figure the grid is displayed for the XZ plane.

Warning: The coordinates of a source or receiver must be within the maximum and minimum coordinates of the room. If a bigger or a smaller number is entered in the coordinate fields ODEON replaces it with the maximum or minimum allowed value.

Tip: Use the TAB and SHIFT+TAB keys to move between fields.

The **Combined** edition of ODEON offers extra types of sources, such as line and surface sources. These are used whenever the source is not so small to be represented by a point source. The mouth of a human speaker can be modelled as a point source. Traffic noise in a high-way for instance can be modelled by a line source. An engine can be assumed to radiate sound from the entire body, so a multi-surface source can be used in this case.

Define a line source

1. Click the New line source button in the Local Toolbar to open the line source editor. Enter the values $x = 4$ (metres), $y = 2$ (metres), $z = 2$ (metres), Length = 2 (metres) and Azimuth = 135° .
2. Finally set the Overall Gain to 65 dB. To save the new source just close the Line Source Editor.

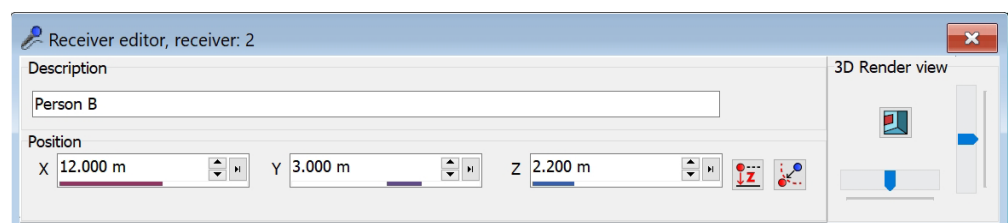
Define a multi surface source

Remember: The greatest advantage of Multi-surface source is that you can enter the total radiated Power, which ODEON then distributes equally to all selected surfaces. This is a typical way to use a machine in your models.

3. Click the New multi surface source button to open the Multi surface source editor.
4. Select surface 2001 End wall behind podium for this source
5. Click the Invert normal button or press the short-cut CTRL+I to make the multi source radiate into the room (a surface in a multi surface source can radiate energy from one of its two sides or from both sides).
6. Finally set the Overall gain to 65 dB. To save the new source just close the Multi surface source Editor and confirm.

Define receivers

1. Click the New Receiver button to open the Receiver editor.
2. Enter the values $x = 1.5$ (metres), $y = -0.5$ (metres) and $z = 1.65$ (metres).
3. To save the new receiver just close the Receiver Editor.
4. Define other receivers at:
 - $(x, y, z) = (12; 3; 2.2)$ meters
 - $(x, y, z) = (8; 7; 1.5)$ meters
 - $(x, y, z) = (21; 1; 3.6)$ meters



Now the source-receiver list should look like the following figure:

| Source-Receiver List | | | | | |
|----------------------|------------------------|-------------|--------|-------------|---|
| No | Source description | Gain/octave | Delay | Sound power | Type specific information |
| 1 | A new awesome source | 65.00 | 0.00 | | Point: (x,y,z) = (8.000, 1.000, 3.500) Directivity file = |
| 2 | A line source | 65.00 | 0.00 | | Line: (x,y,z) = (4.000, 2.000, 2.000) Length = 2.0 m |
| 3 | A multi-surface source | 65.00 | 0.00 | | MSurf: Surfaces:2001 Radiation type = Lambert |
| No | Receiver description | X | Y | Z | |
| 1 | Person A | 1.500 | -0.500 | 1.650 | |
| 2 | Person B | 12.000 | 3.000 | 2.200 | |
| 3 | Person C | 8.000 | 7.000 | 1.500 | |
| 4 | Person D | 21.000 | 1.000 | 3.600 | |

Assign materials

The Material List is where you choose the acoustic properties of the surfaces in the room. Open the Material List by clicking the Material List button or by choosing Toolbar>Material List (SHIFT+CTRL+M). When the menu is open you can have a look at the various tools in the Materials dropdown menu in the *Menu Bar*.

The Material List has two main sections. On the left hand side the list of all surfaces in the room is shown. When clicking any line the corresponding surface is highlighted by red color in the 3DView.

On the right hand side of the Material List the ODEON default materials are shown, each one defined by a series of absorption coefficients for the octave bands 63 Hz to 8000 Hz.

Assign your first material:

1. Click on material No 11001 on the right side.
2. Click on surface No 1001 on the left side.
3. Press the Assign Material (Ins) button on the Local toolbar tools to confirm the assignment.

Material No 11001 has now been assigned to surface No 1001.

Remember: You don't have to worry on saving a project in ODEON. Whenever a change is made, for example whenever a source is created, ODEON stores the information directly on the hard disk.

Diagram illustrating the Material List interface with labels:

- List of surfaces in the model
- Scattering coefficient
- Local toolbar
- List of default materials

The interface displays the following data:

Surface List - description:

| Number | Material | Scatter | Transp. | Type | Surface name | Layer | Area <m²> |
|--------|----------|---------|---------|--------|-------------------------|--------------|-----------|
| 1001 | No Ref. | 0.010 | 0.000 | Normal | Podium floor | DefaultLayer | 78.00000 |
| 1002 | No Ref. | 0.010 | 0.000 | Normal | Main audience floor | DefaultLayer | 259.25600 |
| 2001 | No Ref. | 0.010 | 0.000 | Normal | End wall behind podium | DefaultLayer | 75.00000 |
| -2002 | No Ref. | 0.010 | 0.000 | Normal | Podium side wall, South | DefaultLayer | 58.69700 |
| 2002 | No Ref. | 0.010 | 0.000 | Normal | Podium side wall, South | DefaultLayer | 58.69700 |
| -2003 | No Ref. | 0.010 | 0.000 | Normal | Side wall, audience | DefaultLayer | 139.52000 |
| 2003 | No Ref. | 0.010 | 0.000 | Normal | Side wall, audience | DefaultLayer | 139.52000 |
| 2004 | No Ref. | 0.010 | 0.000 | Normal | Rear wall behind | DefaultLayer | 119.04000 |
| 3001 | No Ref. | 0.010 | 0.000 | Normal | Podium ceiling | DefaultLayer | 84.50000 |
| 3002 | No Ref. | 0.010 | 0.000 | Normal | Ceiling over audience | DefaultLayer | 256.00000 |

Visible Area = 1268.23 m²
Selected Area = 1268.23 m²

Transmission data: unassigned (wall type: Normal)

Global material library (MATERIAL.LIB)

| Number | Specification |
|--------|--|
| 10009 | Ventilation grille (approx. per sq. m.) (Krstensen, 1984) |
| 10010 | Open panel, opening area 20 % Panel 10 x 80 mm, 20 mm slits, 50 mm mineralwool (Ref. Multiconsult, |
| 10011 | Open panel, opening area 30 % Panel 10 x 70 mm, 30 mm slits, 50 mm mineralwool (Ref. Multiconsult, |
| 10012 | Open panel, opening area 50 % Panel 10 x 50 mm, 50 mm slits, 50 mm mineralwool (Ref. Multiconsult, |
| 10013 | Open panel, opening area 50 % Panel 20 x 20 mm, 20 mm slits, 50 mm mineralwool (Ref. Multiconsult, |
| 10100 | (Example 10100-10199) S-LINE Office screen, wood Strict Line (href= "http://www.sline.se/en/") |
| 11000 | Orchestra with instruments on podium, 1.5 sq.m per person (Bobran, 1973) |
| 11001 | Areas with audience, orchestra or choir including narrow aisles (Bobran, 1973) |
| 11007 | Floor with cloth-upholstered seats (Bobran, 1973) |
| 11003 | Audience on wooden chairs, 1 per sq. m (Meyer, Kunstmann, & Kuttruff, 1984) |
| 11004 | Audience on wooden chairs, 2 per sq. m (Meyer, Kunstmann, & Kuttruff, 1984) |
| 11005 | Empty chairs, upholstered with leather cover (Beranek, 1962) |
| 11006 | Empty chairs, upholstered with cloth cover (Beranek, 1962) |

Find next Find previous Match case

Absorption Coefficients of material assigned to the specific surface.

| 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz | α(w) |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

Absorption Coefficients and color spectrum of selected material.

| 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz | α(w) |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 0.60000 | 0.60000 | 0.74000 | 0.88000 | 0.96000 | 0.93000 | 0.85000 | 0.85000 | 0.95000 |

Tip: Hit the F1 short-cut to learn more about scattering coefficients and other material specifications.

Tip: A scattering coefficient of eg. 50% can be entered as 0.5 or 50. ODEON takes care of any necessary conversion.

Remember: Even if you are able to change only one value of scattering coefficient per material ODEON in fact extrapolates this value for lower and higher frequencies, so that the whole range between 63 Hz and 8000 Hz is taken into account.

Apart from the absorption coefficient, each material is associated with a scattering coefficient which controls the way sound is reflected from the wall. For scattering coefficient equal to 0 (or 0%) the reflection is purely *specular*, meaning that the angle of reflection is equal to the angle of incidence. For a scattering coefficient equal to 1 (or 100%) the reflection is purely *diffuse*, meaning that the angle of reflection is completely random. It is also said that a diffuse reflection is a *memoryless* reflection. The scattering coefficient depends on the geometry of the surface and therefore it is adjusted in the list of surfaces (left hand side of the Material List). By default ODEON suggests a scattering coefficient of 0.05, as a minimum value, meaning that in reality no surface can reflect sound completely specularly and it is often more realistic to assume at least 5% of scattering. A guide on how to choose scattering can be found in the full manual in the *Material* chapter.

Assign the following material data to the surfaces in the model:

| Surface Number | 1001 | 1002 | 2001 | 2002 | 2003 | 2004 | 3001 | 3002 |
|------------------------|-------|-------|------|------|------|------|------|------|
| Material | 11001 | 11005 | 4042 | 4002 | 4042 | 4042 | 4042 | 4042 |
| Scattering Coefficient | 0.7 | 0.7 | 0.05 | 0.05 | 0.05 | 0.7 | 0.05 | 0.05 |

Notice that high scattering coefficients are used on the floor and side walls in order to represent machinery and beams, which are not included explicitly in the model. Such simplification is common practice in 3D models that are used in room acoustic calculations.

Quick Estimate

From within the Material List you can run the Quick Estimate calculation to get an idea of the global reverberation time in the room. Notice the longest reverberation time among octave bands. This calculation is very useful while assigning materials for direct evaluation of different configurations and their impact on the reverberation time. However since this calculation is based on very simple formulas that do not include the actual geometry (Sabine, Eyring and Arau-Puchades) the results might deviate significantly from the more advanced simulations in the Job List (follows in Sec.4). Before leaving the Quick Estimate you may want to try different materials and see the change in the reverberation time. It is possible to select among the defined sources at the bottom of the window. However, the source position will only have minimal effect on the global estimated reverberation time, unless strong coupling effects are present in the room.

Room setup

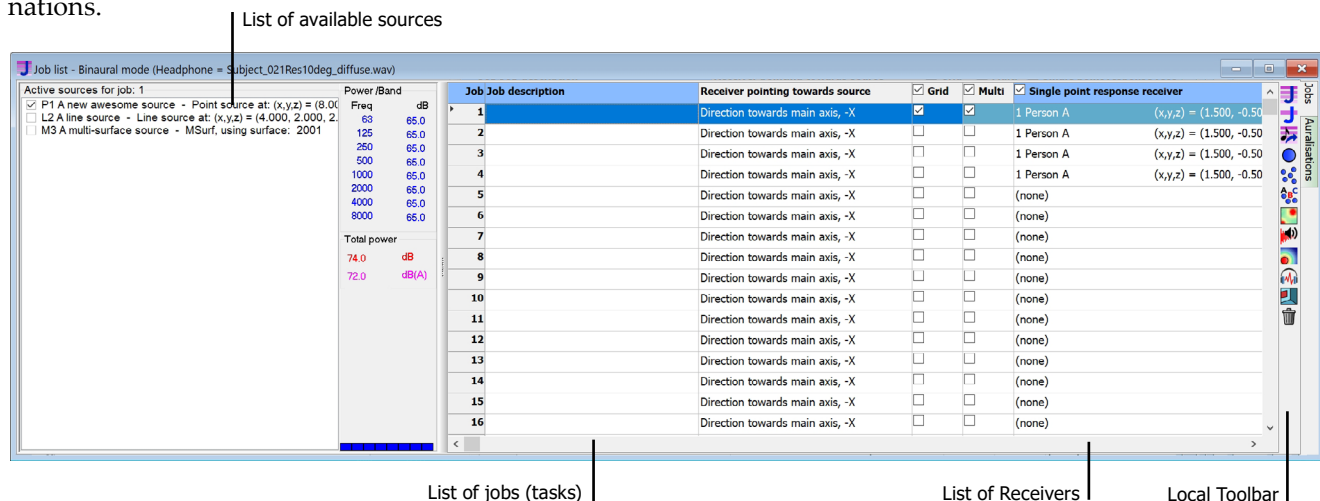
At this point you should have an idea of the order of magnitude of the reverberation time. To continue the series of calculations you should enter the Room setup (Tool-bar>Room Setup) and specify the *Impulse response length*. The Impulse response length should cover at least 2/3 of the decay curve - or T_{30} cannot be calculated. In this case 2000 ms should be sufficient. Since ODEON 17 it is possible to run the Quick Estimate from within the Room setup, in order to obtain the correct impulse response length directly. To learn more about the other parameters available in the Room setup, use the F1 shortcut.

4. Performing Calculations

The job list

Now you are ready to make point response calculations. Open the Job list from the *Toolbar*. The Job list is where you setup acoustical calculations based on the geometry, materials and source/receiver positions. All the most used result types in ODEON are found and made in the Job list. Up to 300 jobs (tasks) can be defined for a room in order to obtain various acoustic results for different source(s) - receiver(s) combinations.

Remember: Do note that a result cannot be viewed before it has been calculated. Once a result has been calculated the relevant cell in the Job List will turn green in order to indicate that this result is available.



Three main types of calculations are available in the **Combined** edition:

- Single Point Response that offers detailed calculation results and auralisation options for one selected receiver.
- Multi Point Response which offers room acoustical parameters and statistics for all the receivers defined in the Receiver list at the Source-receiver list.
- Grid Response offering a calculated color map of room acoustical parameters, as long as a grid has been specified from the Define grid menu.

Calculate a Single Point Response

Setup and run a Single Point Response:


1. Optionally: Select source number 1 as the Receiver pointing towards source for each of the jobs 1 – 4. Notice how the blue cross changes into red in the 3D Source-Receiver view, indicating that it has been selected as orientation of the receiver for the selected job.
2. Select receiver number 1 as the Single Point receiver for job 1, 2, 3 and 4.
3. Activate source 1 in job one, source 2 in job two, source 2 and 3 in job three and source 1 in job 4. You can see which sources are active in a selected job by looking at the 3D Source Receiver View.
4. Make sure the Single point response receiver title at the column is checked.
5. Click the Run all button in the Local Toolbar at the right side to run the jobs. The four Single Point response responses will be calculated. Finishing the calculations should be a matter of a few seconds under normal circumstances.

Remember: Defining direction of a source is relevant for calculating directional parameters, such as LF_{80° and for auralisation.

Remember: To learn more about the results and options available from this display press F1. You may also select the page of interest and investigate the corresponding drop down menu in the Menu bar.

Remember: Reflectograms are only used with point sources and will not contain any relevant information for line and surface sources. They are also available only if the results include early reflections from a point source. If the Transition order is set to zero in the Room setup, then the Reflectogram will, at most, contain one 'reflection' - the direct sound.

View Single Point Response

1. Select job number 1 in the Job List
2. When the calculations have ended, click the View Single Point response button in the right side menu to see the results .

You will find nine tab-sheets available in the Single Point Response window displaying:

- Parameter Curves
- Energy parameters
- Decay curves
- Decay Roses
- Reflection density
- Reflectogram
- 3D reflection paths/Active Sources
- Binaural Room Impulse Response (BRIR) filters
- Dynamic diffusivity curves
- Dietsch echo curves

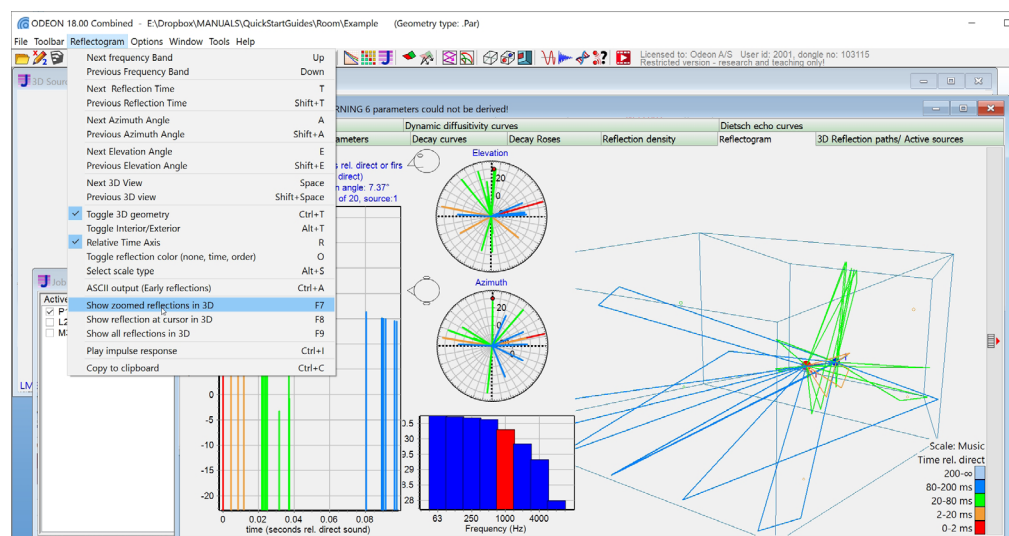
You can view results for each of the four jobs by first selecting the job in the Job List, then clicking the View Single Point Response button. To learn more about the results and options available from the Single Point Response window please press F1 to consult the **Help File**.

You may also select the tab-sheet of interest and investigate the *context-sensitive menu* that appears at the top Menu Bar within the single point response window. In the *context-sensitive menu* all available functions are listed together with their short-cuts. Of particular importance are the short-cuts for navigating through different acoustic parameters:


- Use the Left/Right arrow keys to change parameter.
- Use the Up/Down arrow keys to change frequency.

As a last option play the Binaural Room Impulse Response through headphones using the Ctrl+I shortcut.

Tip: In the right figure the **Reflectogram** tab-sheet is active in the **Single Point Response View**. The Menu bar includes now the extra menu **Reflectogram** that reveals all possible functions for the particular tab-sheet. Press **Show all reflections** to display them in the 3D view. For clarity, only the early reflections are shown.



Calculate and View Multi Point Responses




1. Activate the Multi option for job 4 in the Job list. Make sure the Multi title in the column is also checked.
2. Click the Run all or Run Selected Job button.
3. When calculations have finished, select job number 4 in the Job list and click the View Multi button  to view the Multi point response results.

The display can have two modes *Simulated* and *Measured*, which allow seeing results from simulations or measurements (if any) respectively. You can alternate between the two modes by pressing M. Nine tab-sheets are available:

- 3D Sources and Receivers
- Energy parameters
- Energy parameter bars (1)
- Energy parameter bars (2)
- Parameter versus distance
- Statistics
- Spatial decay curves
- STI versus distances
- Measured versus Simulated



If a tab-sheet is irrelevant for a job, it will be invisible. Note that point responses calculated using the Multi point response option are calculated much faster than Single point responses, because no filters are created for auralisation use.

Define a receiver grid

1. Enter the Define Grid menu .
2. Select the two floor surfaces (surface 1001 and surface 1002) using the small hand sign . Alternatively click  so that ODEON adds these two surfaces automatically. The software detects that since they are not totally vertical, their projection to the horizontal plane is not of zero area. So they are included by the *auto* hand tool.
3. Specify the Distance between receivers to 2 (metres) then click the Show grid button in the local toolbar.
4. Close the Define Grid dialog to save the grid definition.

You can also use the Auto grid detection. This will automatically find the almost horizontal surfaces from which a elevated grid can be reached with direct sound from the defined source.

Calculate a Grid Response

1. Click the Job list button again.
2. Activate the Grid option for job 1.
3. Click the Run all  button or Run single Job button .
4. ODEON will now start calculating the Grid response for this job. This may take a while, because ODEON calculates results for each of the receivers (squares) in the grid. When calculations are finished, select job number 1 in the Job list and click the

| <input checked="" type="checkbox"/> Grid | <input checked="" type="checkbox"/> Multi | <input checked="" type="checkbox"/> Single point response receiver |
|--|---|--|
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 1 Person A (x,y,z) |
| <input type="checkbox"/> | <input type="checkbox"/> | 1 Person A (x,y,z) |

Warning: If the Define Grid button is disabled this is because some process is open, which requires data to be saved. In this case, it is probably the Estimate Reverberation display that needs to be closed. To find this open window, use the Windows menu item on the menu bar. Other displays containing calculation processes may cause the same kind of disabling of miscellaneous options.

Tip: The grid may also be used for easy positioning the point sources and discrete receivers, which are usually defined in the Source-receiver list. To learn how to operate the 3DGrid display, select the display (and the 3DGrid tab in that window) - then select the 3DGrid| Parameters dropdown menu.

View grid button  to view the grid results.

5. Use the arrow keys UP, DOWN and LEFT, RIGHT to navigate between octaves and parameters respectively.



Since ODEON 15, grids are displayed with colours interpolated between the grid receivers. This provides very smooth and attractive results for reports. If you want to see the individual squares press the I shortcut or choose 3D_grid>Interpolate grid from the context-sensitive menu, to deactivate interpolation. Deactivating interpolation also helps navigating between the different grid results much faster.

To learn more about the results and options available from this display press F1.



Calculate Reflector Coverage

Reflector coverage calculates the coverage provided by chosen reflecting surfaces, at the specified order of reflection. This is an efficient tool for investigating whether the receiver area is covered by the reflectors or not and if the reflectors are positioned correctly. The 3D billiard display may also be useful for this purpose.

1. Enter the Define reflector surfaces menu  from the application bar
2. Select the podium-ceiling surface (surface 3001).
3. Click the Calculate reflector coverage button  on the main toolbar to calculate the reflector coverage for the selected surface(s).

Several options are available in the menu to facilitate the reflector investigation.

- Use of layer colors for display of coverage.
- Display coverage as points or rays (Draw rays option).
- Include rays from reflector and/or source.
- Adjust number of rays used to track the coverage.
- Adjust order of reflection included.

Tip: Run the Free run function for tracking leaks in a room model. You can enable the Display sticky lost rays only option to obtain a cleaner view of the places of leak in the model.



3D Investigate Rays

This tool visualises the ray tracing as it is carried out during any point response calculation. By default its calculation parameters are also set up as the parameters used for the multi point response calculations. This display is a very valuable tool for debugging new models, e.g. to detect missing or misplaced surfaces. It may also give an impression of what is happening in the calculations, e.g. the effect of the scattering assigned to the surfaces.

1. Enter the 3D Investigate Rays menu from the *Application Bar*.
2. Click the OK button, then
3. Click the Single forward button a few times and note the behaviour of the ray tracing.
4. Click the Free run to investigate behavior and check for holes in the geometry



3D Billiard

The 3D billiard display is a tool that can be used for investigating or demonstrating effects such as *reflections*, *scattering*, *flutter echoes* or *coupling effects*. A number of billiard balls are emitted from the source and reflected by the surfaces in the room.

Remember: In the 3D Billiard balls change color every time they hit on a wall. No information about absorption and energy decay can be seen with this tool, which is mostly intended for investigating geometrical issues.

1. Enter the 3D Billard menu from the *Application Bar*.
2. Try to change the plane between XZ, YZ, XY and 3D random
3. Speed up the process, set the Dist. per update to a higher value.
4. Enlarge the balls increase the Ball size.

To visualize a flutter echo, a large Number of billiard balls should be used, e.g. 10000 balls. It's easier to visualize a flutter echo if rays are only emitted in the relevant plane (XZ, YZ or XY). If the geometry is complicated it may be hard to see the billiard balls. In that case toggle interior and exterior parts of the geometry off using the T short cut.

Remember: Auralisation is the process that makes acoustic simulations audible. The actual process of combining the sound clip with the impulse response is called convolution and it is a technique directly coming from the field of digital processing.

5. Auralisation (Listen to the Rooms)

At this point you have tried calculation of room acoustical parameters, operating visual displays like *decay curves*, *3D reflection paths*, *reflectograms* etc. It is time to move on, trying to play sounds in the model and listen to the result as if you were inside the real room (!)

This is done with the auralisation tools in ODEON. Auralisation is the art of combining a sound clip with the impulse response of the room. The outcome can be played back through headphones or a specified loudspeaker system. It is a great way to demonstrate the acoustic behaviour of your room to your clients, who might not be familiar with technical terms. You can read much more about auralisation in the ODEON **Manual**, but here is a quick overview.


Two ways of auralisation are available in ODEON:

- **Streaming convolution** which produces one or two channel auralisation on the fly (with some latency) and doesn't store any files. Auralisation on the fly means that convolution and auralisation of different sound clips happen almost simultaneously. This is the quick way, but has limited options so is mainly for quick glances while working with the model.
- **Off-line convolution** which requires a pre-calculated calculation for any sound clip chosen. Off-line convolution can perform mixing and auralisation with up to 300 simultaneous channels which may be assigned individual audio file, delay and audio level. The result of the off-line convolution is stored in .WAV files for later playback. Off-line convolution supports binaural auralisation using headphones as well as auralisation using a loudspeaker setup (surround sound).

Warning: Real-time/streaming convolution still requires a pre-calculated impulse response. This means that position of the receiver cannot be changed in real time.

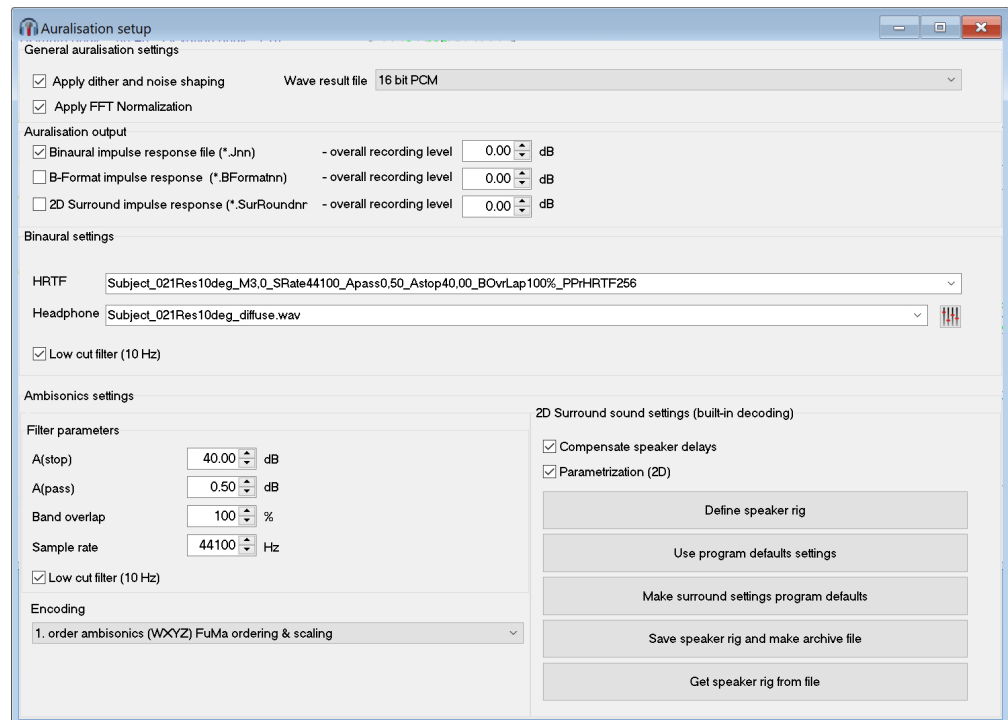
Setting up for binaural auralisation

Before performing any auralisation you have to make sure that a binaural or surround impulse response is created.


1. Click the Auralisation setup button .
2. Make sure the Create binaural impulse response file option is checked.
3. Select the HRTF and Headphone settings as in the figure below.
4. Close the window to save the changes.

Remember: Binaural means “with two ears” and describes the way humans perceive sound in real life. Binaural listening involves the geometry of the ears, head and body and differs from stereo listening which is just the result of panning the sound towards left and right.

Tip: Press F1 from within the Streaming Convolution display to learn more about operating the options available.



Listen to the binaural auralisation/Streaming convolution

1. Select job number 1 in the Job List
2. Click the Streaming convolution button  in the local toolbar. This will open the Streaming convolution dialog.
3. Select the *Voice Sabine Short* file in the Source signal field (this is an anechoic recording of voice stored in a Windows Wave file residing in the directory set in the Options>Program setup>Auralisation>Wave Signal file Directory).
4. Listen to the output over **headphones**, to benefit from the binaural quality of the auralisation.

Read in the [User Manual](#) in the *Auralisations* chapter for more information. Or press F1 when the window is open for the **Help File**.

5. Before leaving this example you may want to try the Listen to input signal option, which plays the sound clip without the room acoustics.

Here in this quick start guide, only the streaming convolution is covered. To make larger auralisation with mixes of different sound source positions and audio files, see the [User Manual](#) in the chapter *Auralisations*.


There are generally two types of sound sources that you make auralisations of. The one is sound sources present in the room like voices, instrument or machines. The other is speakers playing music or similar if you are simulating a music venue or cinema. Both are covered in the [User Manual](#).

6. Measure Acoustics in Real Rooms

The ODEON software is not only for simulations but also for measurements of room acoustics. The impulse response of real rooms can either be measured using ODEON's recording facilities or using imported .wav files, recorded externally. ODEON automatically calculates a range of different results from the measurements.

Load Impulse Response

The import option can be used for impulse responses measured either using ODEON's sweep recording facilities, hand-clap measurements made with a portable recorder (or phone - seriously), or an old impulse response done with another acoustic software.

1. Inside ODEON, press Load Impulse Response .
2. For this example open the folder Measurements\Auditorium21_ImpulseResponses and choose any of the .wav files.

This should open a menu with the following result tabs. Investigate the different results:

- Raw Impulse Response (at particular band)
- Raw Decay Curve (at particular band)
- Decay Curves (at particular band)
- Decay curves (all bands)
- Energy Parameters
- Parameter bars
- Frequency Response
- Cepstrum
- Spectrogram
- Play it!

Tip: Every time you double the sweep duration you lower the background noise by 3dB.


Read more about the results in the **ODEON Manual**.

Measure Impulse Response

The measurement system is easy to use and produces very accurate results with low background noise level.

To use the measurement system, you need a **loudspeaker** and **microphone** attached to your PC. For most cases, both the loudspeaker and microphone need to be omnidirectional. For this quick exercise it does not matter which hardware you use, but the microphone needs to be an external and not the microphone of the PC. Read more about suited hardware in the [User Manual](#) in the *Measurements Chapter*.

You can also choose to skip this exercise for now and return later if hardware is an issue.

1. Plug in microphone/soundcard and possibly the speaker/soundcard as well.
2. Place the microphone and speaker in the positions for the measurements
3. Inside ODEON, press Measure Impulse Response  in the top bar menu.
4. Press Test and while it runs move the output-input sliders to get a high sound level without making the speakers distort.

5. Press Start and thereby make a measurement. When it is done, save the .wav file.
6. When the results pop up, investigate the different tabsheets and see if they look good. Missing values in the Energy Parameters tabsheet (displayed as **.*) would indicate inadequate Signal to Noise Ratio (SNR) in the measurement. The SNR can be improved by increasing the sine sweep length, or by increasing the Output/ Input level.
7. In the Measurement settings panel there is a range of options for measurements, described in detail in the [User Manual](#).

Using the wrong hardware, or other misuses of the measurements system, might give wrong results. If you want to use the measurement system for reliable measurements, please read the *Measurements Chapter* in the [User Manual](#) for much more information.

7. Getting further

Pre-calculated Rooms – Round Robins

At this point you have tried the basic functions in ODEON and may want to view results for more realistic rooms. Some pre-calculated examples are covered in the ODEON manual. The examples include rooms which were used in the 2nd and 3rd Round Robins on Room Acoustic Computer Simulations along with the measured and simulated results.

8. Overview of the Calculation Methods

Tip: You can find many pre-stored rooms in the main folder of your ODEON installation. The usual path is C:\Odeon12Combined\Rooms. Studying these rooms will be invaluable in understanding the main features of an acoustic model: simplicity in the geometry, correct handling of scattering and wall type etc.

Global Estimation of reverberation time

There are two calculation methods for the calculation of global reverberation time built into ODEON. The two global estimation methods for reverberation times, estimate reverberation time for the complete room with one selected source position and independently of receivers.



Quick estimate

Quick estimate is the fast method, which is found in the Material List. This method is based on the Sabine, Eyring and Arau-Puchades formulas and as such assumes diffuse field conditions. Diffuse field cannot be assumed if:

- Room absorption is unevenly distributed.
- Room contains de-coupling effects, e.g. connected corridors or niches.

Thus the results given by Quick Estimate should not be considered to be a final result. Even so the method is useful in the initial work on assigning reasonable materials to the surfaces in the room.



Global estimate

Global estimate is a more precise method, which does not make any assumptions about diffuse field conditions and as such, it is a more reliable method for estimation of

global reverberation time:

- for workrooms where all absorption is often situated in the ceiling region and sources are situated in the floor region the RT predicted by Global Estimate will typically be longer than the values predicted by Quick Estimate, a factor of two is not unlikely if walls are basically smooth.
- in auditoriums the opposite is the case, because the dominant absorption area (the audience) is close to the source.

In any case the RT's predicted by Global Estimate is the most reliable – provided that proper scattering coefficients have been entered. The principle of the method was first suggested by Schroeder (Schroeder, 1970).

Point Response calculations

The Point response calculations estimate not only RT, but also room acoustic parameters like Clarity, Definition (Deutlichkeit), SPL, SPLA, STI and LF_{80} (see the ODEON manual). The calculated results can be thought of as a simulated measurement.

Calculated results relate to:

- a number of active sources
- one receiver position
- orientation of the receiver (for LF_{80} , LG_{80} , IACC and auralisation)

The orientation of the receiver(s) in a particular job is set in the Job list by selecting a point source through which the receivers are looking. There are three kinds of point response calculations; the Single Point Response, the Multi Point Response and the Grid Response.

Single Point Response

The Single Point Response is calculated for a selected receiver position, which must be defined in the Source-Receiver list. The Single Point Response is the most detailed calculation method allowing:

- Prediction of room acoustical parameters (including stage parameters).
- Display of predicted Decay curves.
- Tracking of individual reflections in a Reflectogram and display and tracing the reflection(s) in 3D displays of the room e.g. for tracking down echo problems.
- Auralisation.

Multi Point Response

Multi point response calculates room acoustical parameters for all the discrete receiver positions defined in the Source-receiver list.

Grid Response

Grid Response calculates room acoustical parameters and provides statistics for a mapped receiver area. The surfaces over which grids are calculated are selected in the Define Grid display.



Auralisation setup

In order to create auralisations, make sure to activate the binaural impulse response file (.Jnn) in the auralisation setup.



Auralisation

Auralisation features are available from within the Job list. Auralisation is based on impulse responses (BRIR's and Surround Impulse responses), which may be calculated as a part of the Single Point Response. Fast and easy to use binaural auralisation is provided by the Streaming convolution facility – to learn more about this facility use the online help from within the Job List. If greater flexibility is needed a separate auralisation display appears when using the Auralisations tab-sheet in the right most side of the Job List.

9. Other facilities in ODEON

Apart from the features demonstrated in the above tour, ODEON also contains many extra facilities. These are described in the [User Manual](#), but you can also go to our website and find the tutorials and news videos. Try for example to investigate the Sound Transmission options or the Genetic Material Optimizer.

We hope you enjoy working with the software!