ODEON

Basics

Quick Start Guide

Odeon

Room Acoustics Software

ODEON Room Acoustics Software

Version 19

Quick Start Guide for Basics 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.

How to learn

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.

- This **Quick Start Guide** gives an introduction to the use of ODEON Basics, 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 spectific 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 avaiable 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 editing

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 Calculation or Result 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 irellevant 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, 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 istead of a PC, but since possible system instabilities my occur such a use is solely responsibility of the user.

RAM: Recommended at least 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 recommeded. 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.

Run ODEON Basics

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

You will find the ODEON Basics 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 Basics 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.

Sources and materials are the first things to be set before any calculation or investigation

Visual inspection of the geometry can be done with the group of 3D view buttons

When the room is loaded it is automatically displayed in a wireframe form.

The **3D View** menu is inserted corresponding to the active **3D View** Window. The menu is dynamic, changing according to which window is used.

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.

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

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)

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

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.

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 trasformed 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.

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 few *point sources* and 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 point sources

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).

Keep the defult directivity pattern Omni.SO8.

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.

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

Define one more source at (x, y, z) = (4; 4.5; 1.7) meters, choosing the file BB93_RAISED_NATURAL.SO8 for the directivity pattern.

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.

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

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

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

We will get back to the receivers and the sources in section 4.

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.

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.

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.

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

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

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.

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

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

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.

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 (Toolbar>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 from this page, use the F1 shortcut.

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

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. You can think of the Job list as a **spreadsheet**, where each row corresponds to a task that can be filled in with various details.

One type of calculations is available in the Basics edition:

- Multi Point Response which offers room acoustical parameters and statistics for all the receivers defined in the Receiver list at the Source-receiver list.

Calculate and View Multi Point Responses

1. Select Job 1 in the Job list, and activate the Multi option on the right. Make sure the Multi title in the column is also checked.
2. Activate Source P1 from the list of available sources.
3. Click the Run all or Run Selected Job button.
4. 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.

Remember: A result cannot be viewed before it has been calculated. Once the calculation is complete, the corresponding cell in the Job List will turn green to indicate that the result is available.

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.

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

5. 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.

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

Load Measured 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 Measured 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
- Spectogram

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

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

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 inadecuate 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.

6. Getting further

To familiarize further with ODEON you should try to change some of the materials, sources etc. in the room and make new calculations.

A suggestion could be to investigate how scattering influence the room acoustics and echo problems.

1. Create a copy of the room using the File>Copy files option and make the changes to the new room model. In this way you will have results from both of the rooms present for comparisons.
2. Change the scattering coefficient on surface 2004 (Rear wall behind audience) from 0.7 to 0.05.
3. Listen to the difference in the auralisations and see if echo problems occur.

If you want to compare different rooms, you can have more rooms open at the same

time using File>Open anonother instance of ODEON.

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.

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.

7. Overview of the Calculation Methods

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.

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 is one kind of point response calculations; the Multi Point Response.

Multi Point Response

Multi point response calculates room acoustical parameters for all the discrete receiver

positions defined in the Source-receiver list.

8. 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