Space Optimisation and Space Optimisation+

1 Overview

Space Optimisation is a set of tools available to all Linn DS, DSM and Exakt system owners that allow optimisation of the interaction between the customers' loudspeakers and room. Space Optimisation is accessed and controlled through Konfig. Before commencing optimisation please ensure that both your DS/DSM and Konfig are updated to the latest software version.

The document details the basic method for applying Space Optimisation on a Linn DS or DSM, or Space Optimisation+ on a Linn Exakt system. More advanced set-up information is presented in Advanced Space Optimisation.

Konfig allows Space Optimisation set-ups to be saved on a local hard drive and subsequently exported to alternate locations. Irrespective of saved or exported set-ups it is **strongly recommended** that a written note is taken of all relevant dimensions, along with detail of the final optimisation filters. This 'hard copy' should then be stored in the customers file.

Space Optimisation may be applied to all external inputs of Linn DSM products. The SPDIF/TOSLINK, HDMI & headphone outputs will NOT output Space Optimised audio, these outputs pass the unprocessed audio feed.

Contents

1 Overview 1

2 Space Optimisation and Space Optimisation+ set-up 4

2.1 Install the loudspeakers using the tune-dem 4

2.2 Selecting your system and speakers in Konfig 4

2.2.1 Analogue system 4

2.2.2 Exakt system 8

2.3 Turn on Space Optimisation 9

2.3.1 Create a new Optimisation 10

2.3.2 Import the current system optimisation 11

2.3.3 Open an existing optimisation 11

2.4 Entering you room information in Konfig 12

2.4.1 Enter room dimensions 12

2.4.2 Specify room construction and features 12

2.5 Enter listening position 14

2.6 Enter loudspeaker positions 14

2.6.1 Practical position 15

2.6.2 The Virtual Tune-Dem 16

2.7 Additional Subwoofers 16

2.8 Optimise and Apply 17

2.9 Storage of Space Optimisation set-ups 19

2.9.1 Saving your Space Optimisation 19

2.9.2 Loading Space Optimisation 20

2.9.3 Import and Export 21

3 Advanced set-up for Space Optimisation and Space Optimisation+ 23

3.1 Room modes 23

3.1.1 Basic assumptions used for calculations of room modes 23

3.1.2 How room mode filters are displayed and adjusted 24

3.2 Improving the estimated room mode optimisation using tune-dem 28

3.2.1 Room mode filter validity 29

3.2.2 Adjusting room mode filters for best sonic performance 30

3.3 Simplifying room dimensions 31

3.3.1 Simplifying a room to rectangular dimensions 31

3.4 Approach for rooms which may not be simplified 34
3.4.1 Example room 4, L-shaped 35
3.4.2 Example rooms 5, 6 and 7, non-modal rooms 38
3.5 Bass and Treble shelves 41
4 Significant changes to Space Optimisation within Konfig 43
4.1 Speaker selection 43
4.1.1 Disable analogue speakers for stereo Exakt systems 45
4.2 Importing a previous optimisation 46
4.3 Why do I get more room mode filters than before? 47

2 Space Optimisation and Space Optimisation+ set-up

2.1 Install the loudspeakers using the tune-dem

Decide along which axis of the room the loudspeakers should be installed. Use the Tune-dem method to find the 'ideal' location for the loudspeakers which gives the best sonic performance. Correct identification of the ideal loudspeaker position is essential if the full potential of both your hi-fi system and Space Optimisation is to be achieved.

If you are unsure of how find the ideal location for your loudspeakers then contact your expert Linn retailer.

2.2 Selecting your system and speakers in Konfig

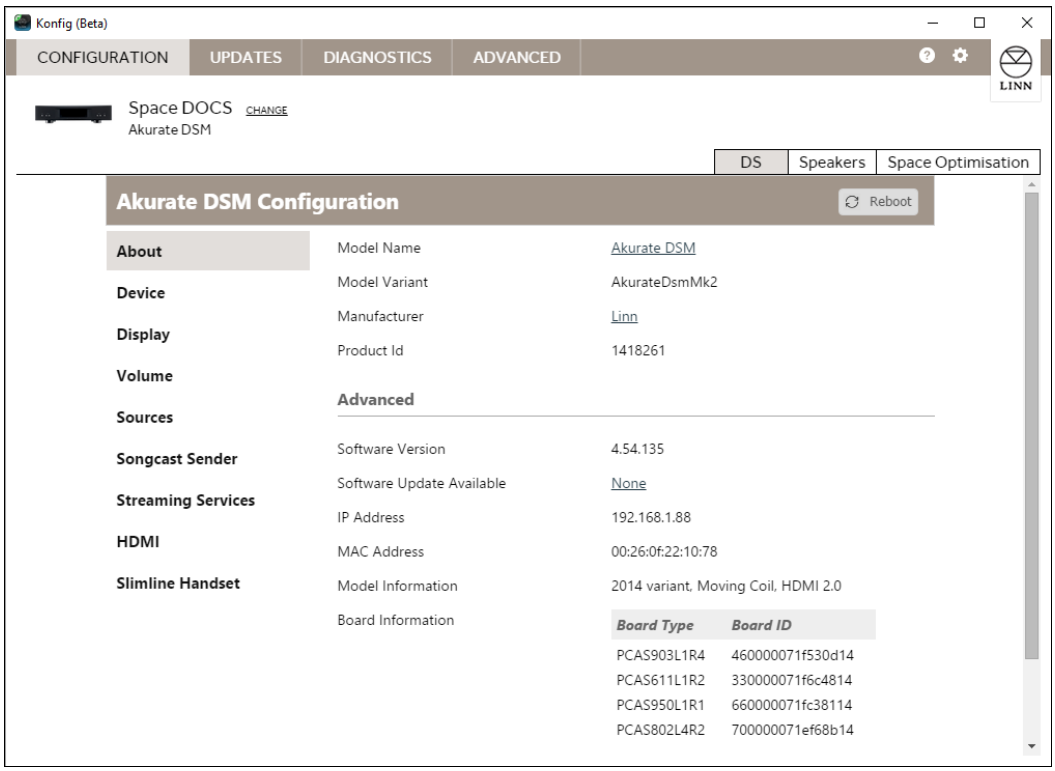
Before Space Optimisation can be applied to your system Konfig must be informed of the speakers being used in your system. Making this selection informs Konfig of the physical and acoustical attributes of your loudspeakers. This information is used by SPACE optimisation for calculation of room modes and placement optimisation. In SPACE optimisation + the information is also used to set the individual drive unit delays to ensure coincident arrival of the music signal from each drive unit.

This process differs between conventional analogue systems, and Exakt systems. The differences are detailed in the sections below.

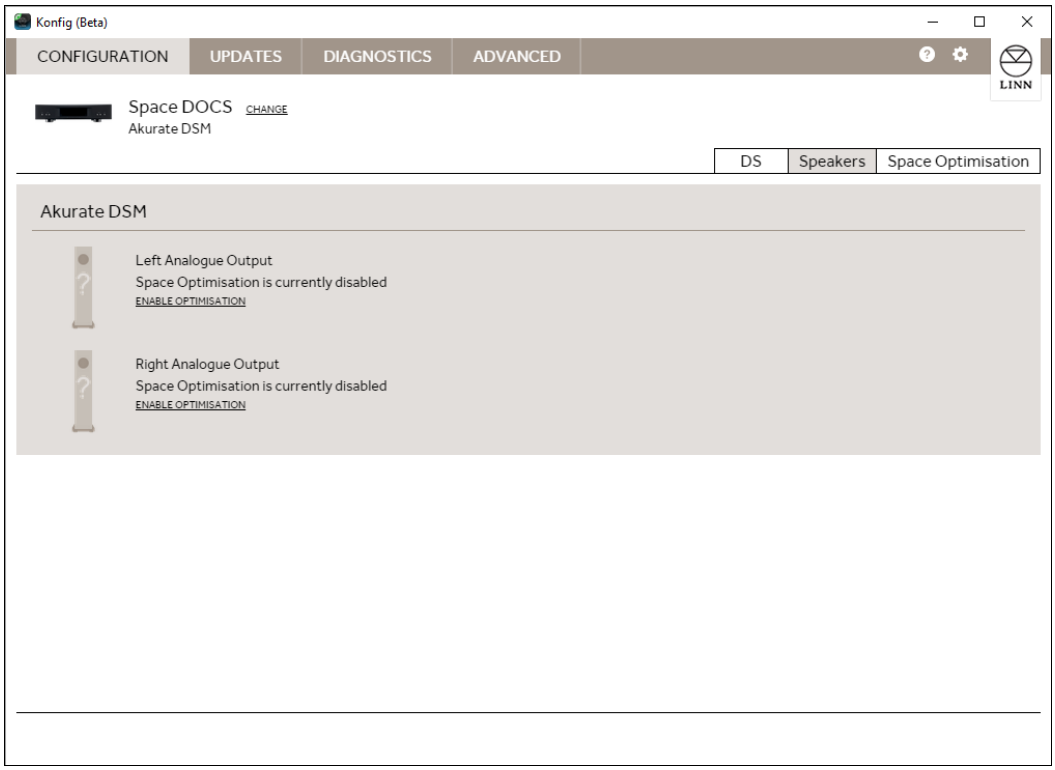
Open Konfig and select the DS/DSM or Exakt system to be optimised. You will notice three tabs to the top right of the screen.

2.2.1 Analogue system

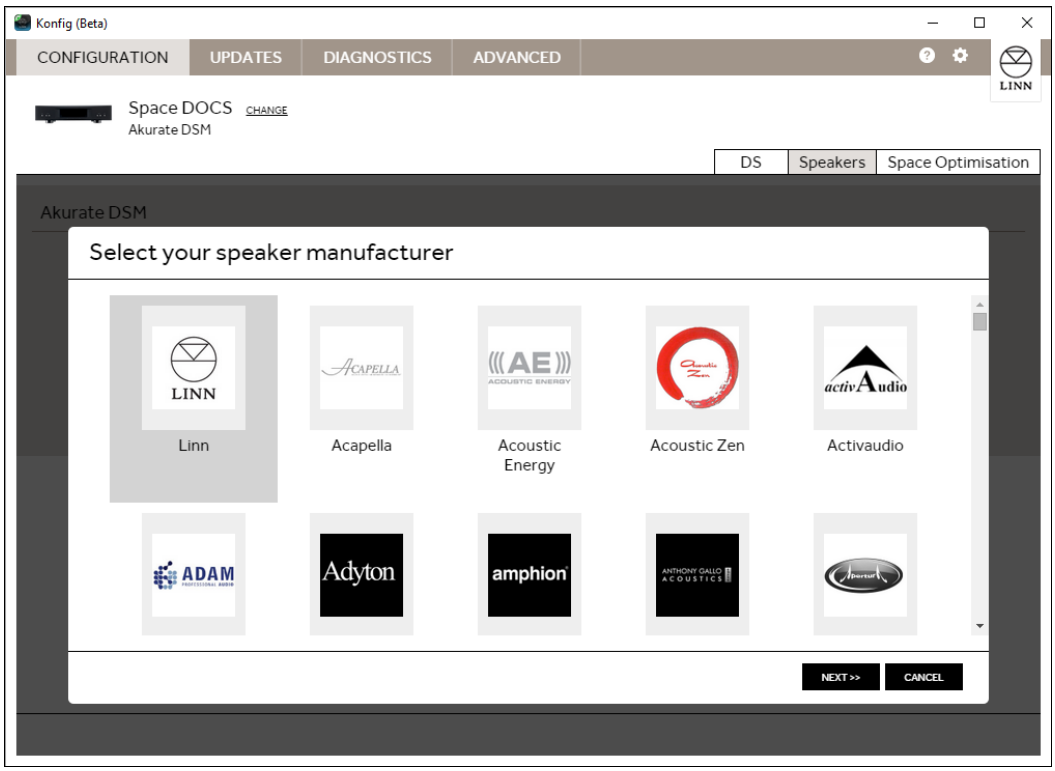
Open Konfig and select the DS/DSM system to be optimised. You will notice three tabs to the top right of the screen; DS, Speakers and Space Optimisation.



Click on the ‘Speakers’ tab, you will see the screen below

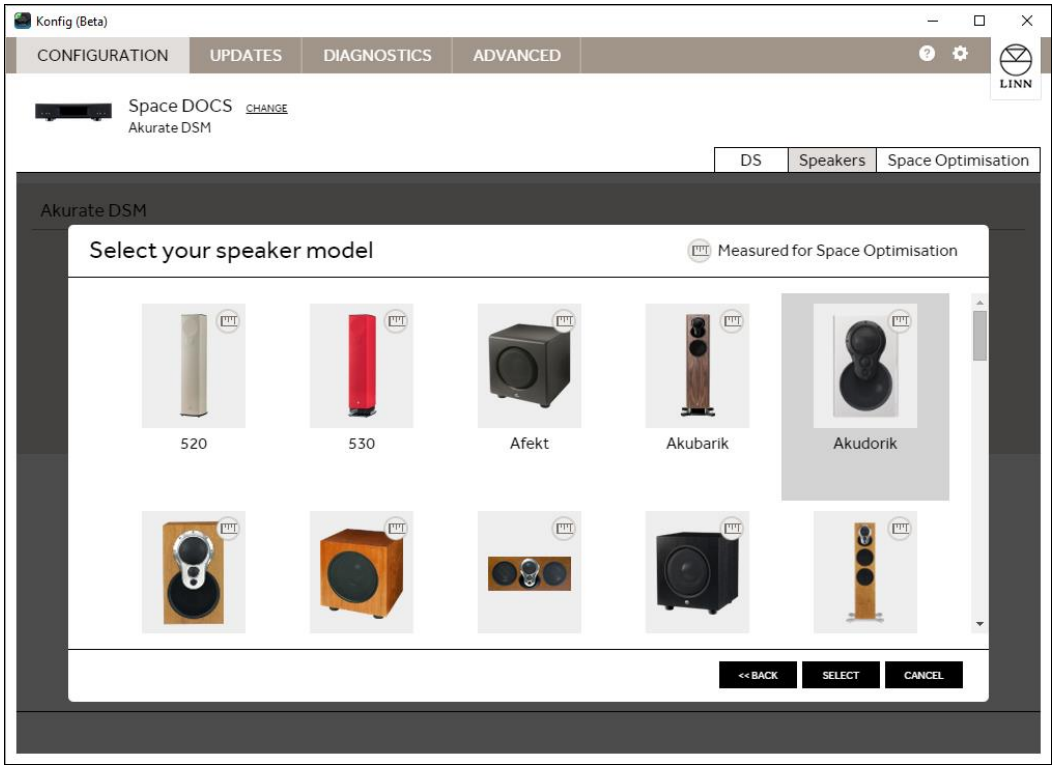


Click on ‘ENABLE OPTIMISATION’ for either speaker to select the make and model of your loudspeakers. Select the manufacturer of your loudspeakers, then click ‘NEXT’.

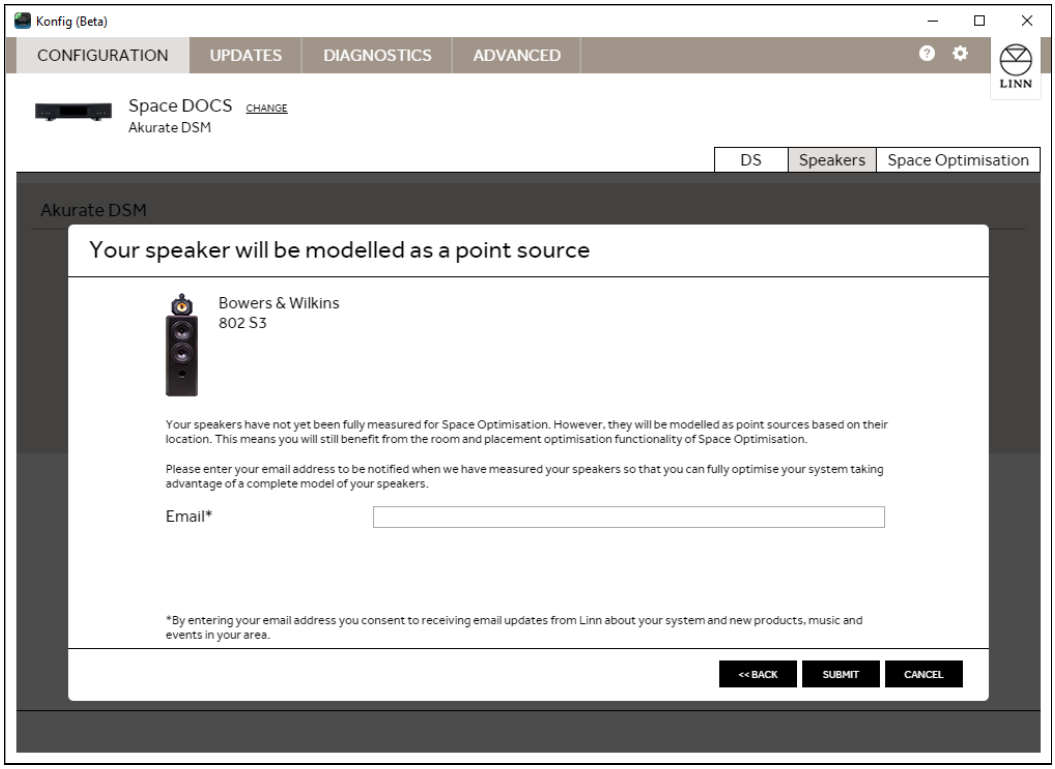


If the manufacturer of your loudspeakers does not appear in the selection you should select ‘other’ from the end of the list.

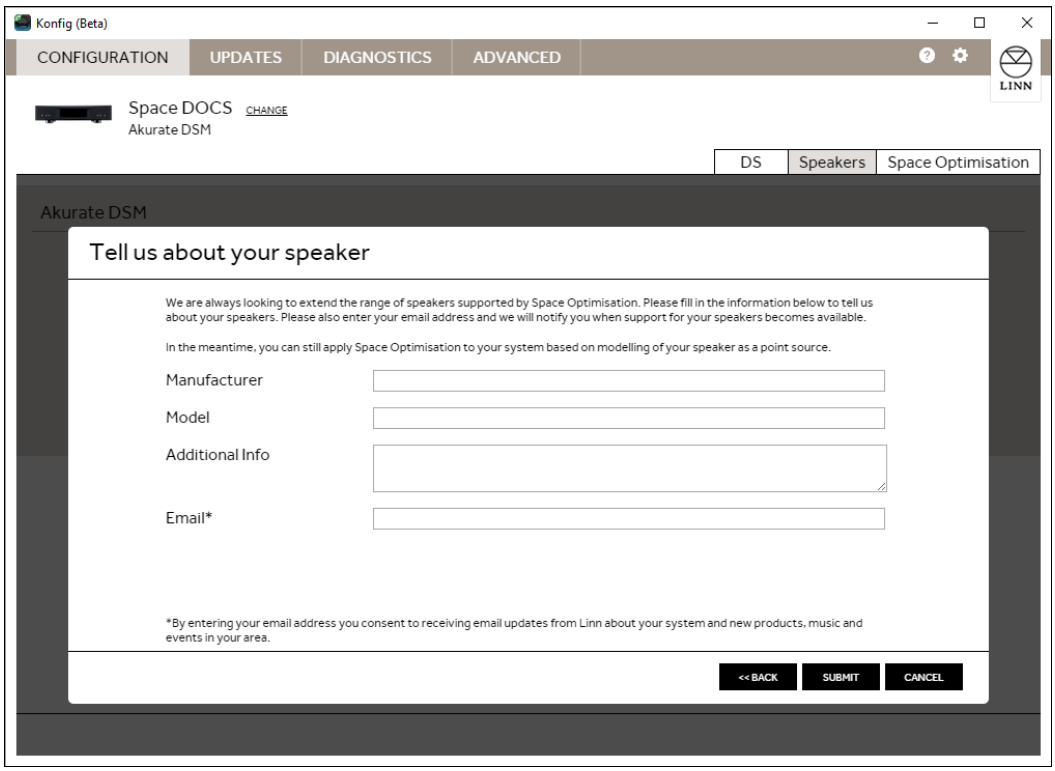
Select your loudspeaker model and click the ‘SELECT’ button.



Loudspeakers which have been measured for SPACE optimisation by Linn are indicated by a symbol in the top right corner. If your loudspeaker model is not selectable you should select ‘other’ from the end of the list. Any model which has yet to be measured will raise the message below:



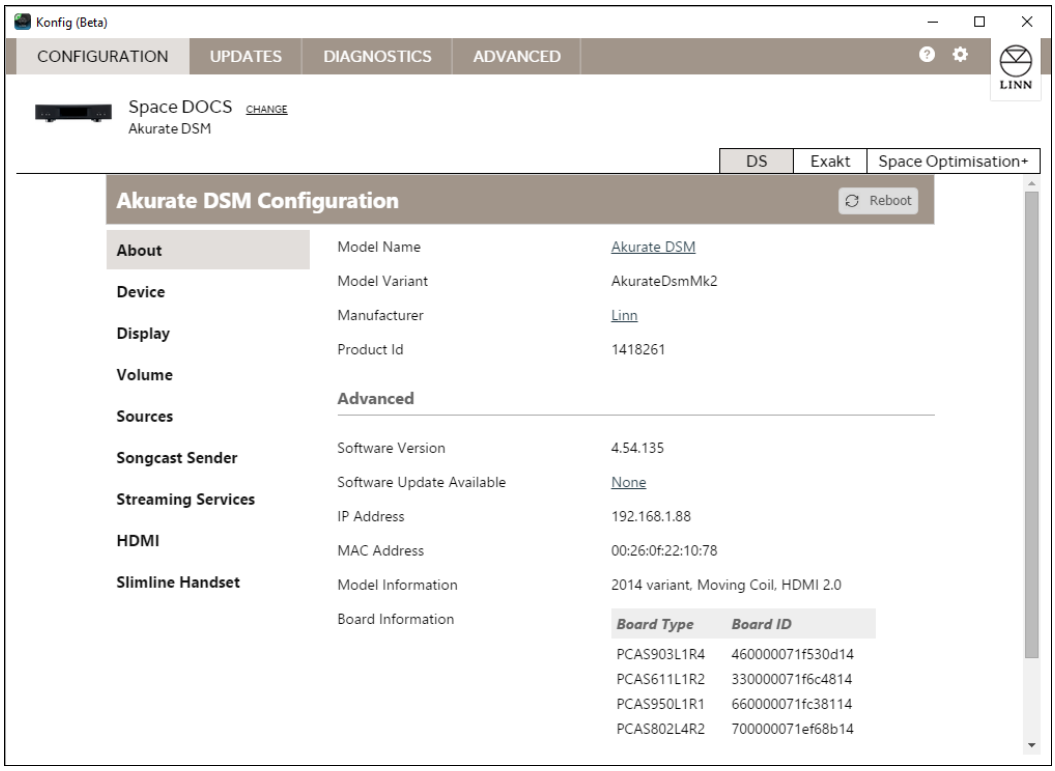
If you selected ‘other’ for either the loudspeaker manufacturer or model you will be requested to tell us about your speaker:



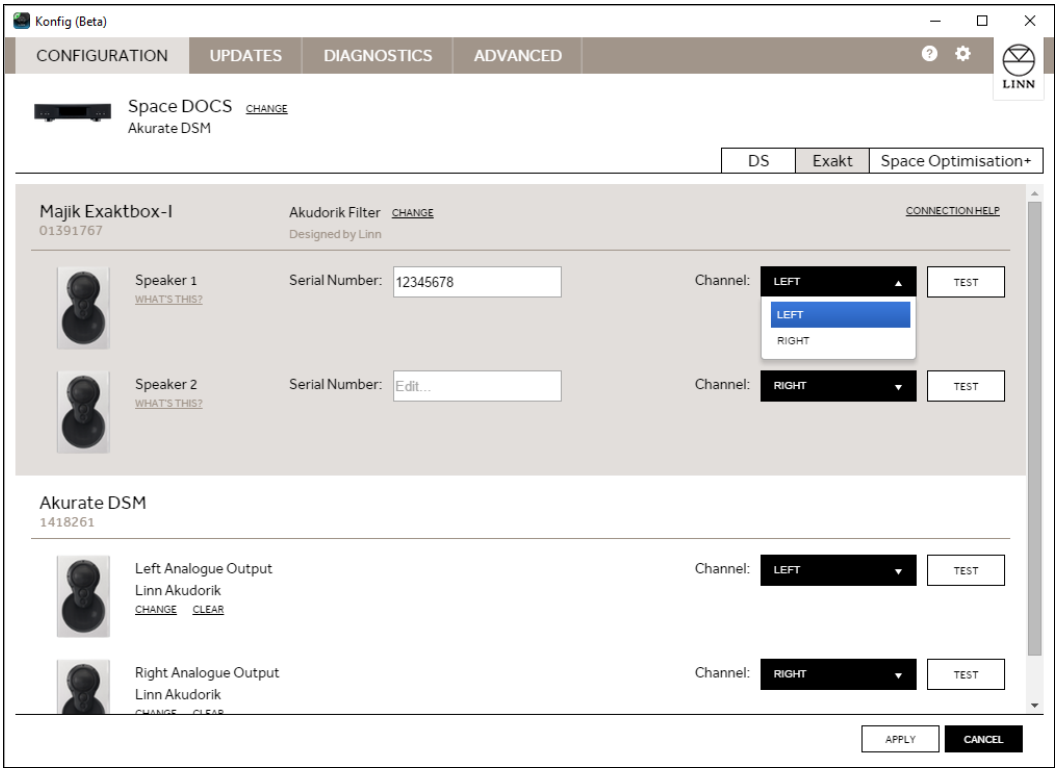
You will need to repeat this operation for both left and right loudspeakers.

2.2.2 Exakt system

A DS, DSM or Exakt DSM connected to an Exakt system will show the tabs DS, Exakt and Space Optimisation+.



Click on the 'EXAKT' tab.



If your loudspeakers contain integrated Exakt amplifier modules this page will automatically populate. You will need to assign the speakers to left and right.

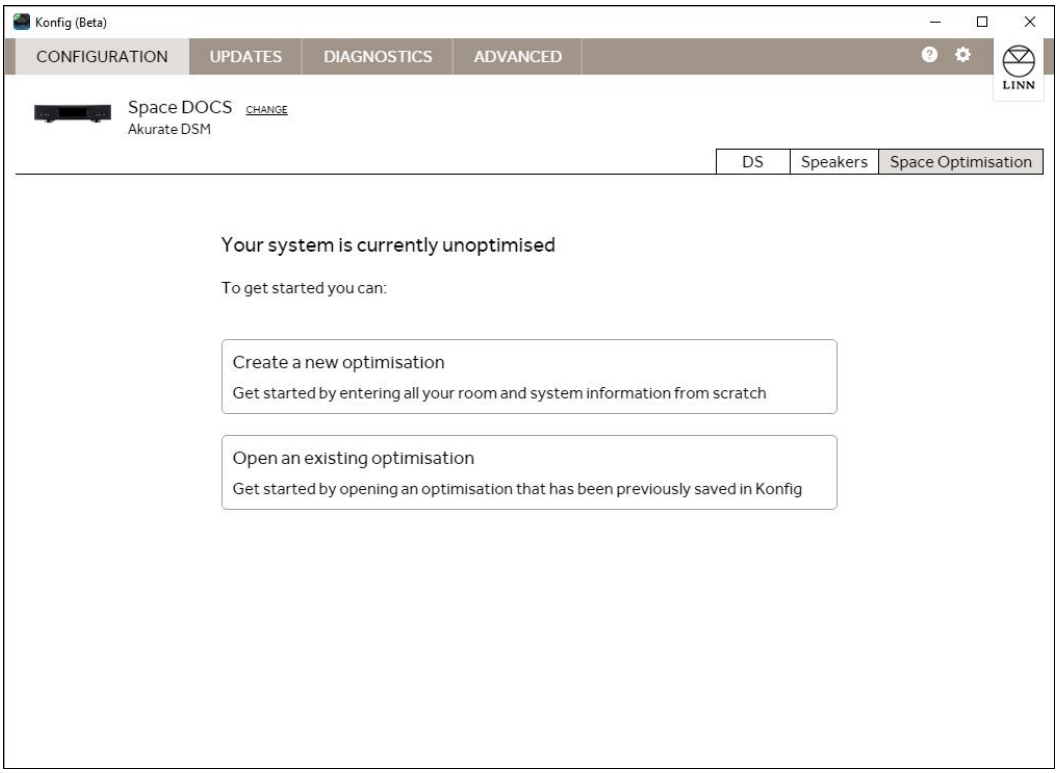
If you are using an Exaktbox based system you will need to select the loudspeakers you have attached, and enter their serial numbers before you can assign the speakers to the appropriate playback channel.

If you are using an Exakt DSM you will see only the Integrated Exakt loudspeakers or Exaktboxes connected to the device over ExaktLink.

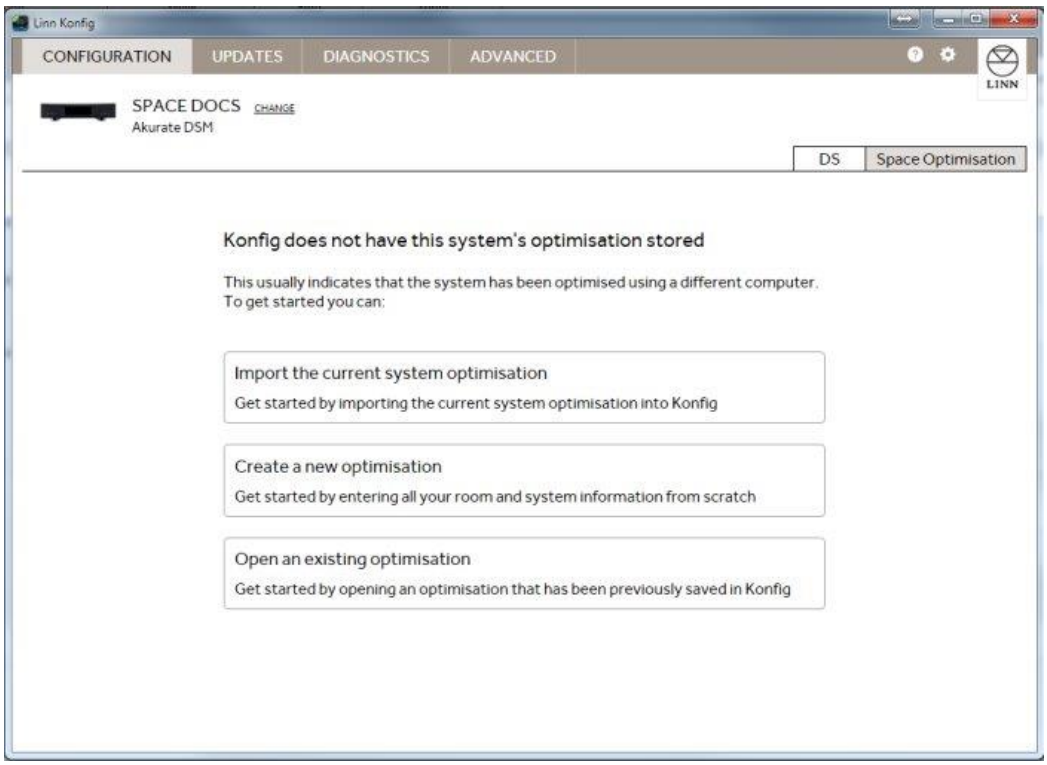
For all other DS or DSM sources you will also see connection options for left and right analogue outputs. For a stereo Exakt system any speakers showing on the left and right analogue outputs should be removed by clicking on 'CLEAR' for each output.

2.3 Turn on Space Optimisation

Click on the 'Space Optimisation' or 'Space Optimisation+' tab. If you DS/DSM has never had Space Optimisation applied you will see the screen below.



If the system has previously been optimised you will see the screen

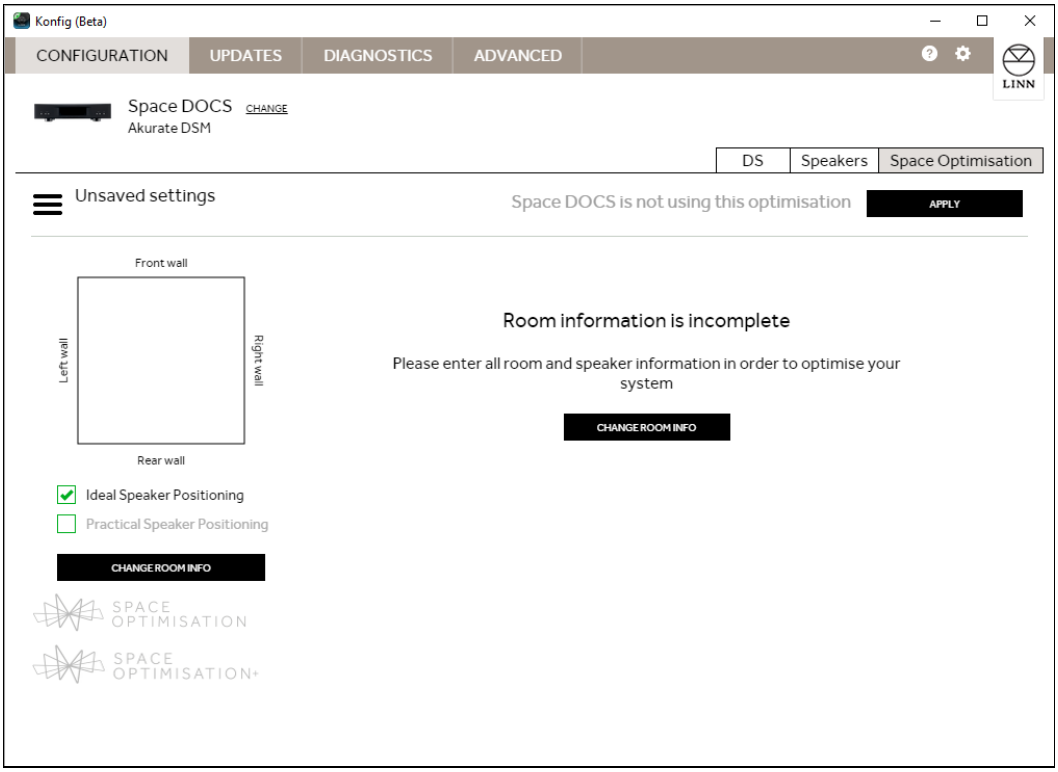


The three possible selections are described below

2.3.1 Create a new Optimisation

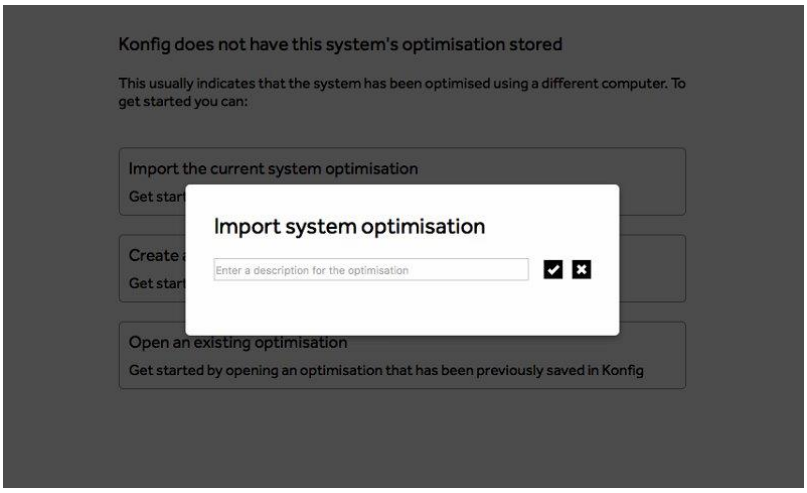
This allows the user to create a new system optimisation from scratch.

Clicking on the 'Create a new optimisation' button will bring up the screen below

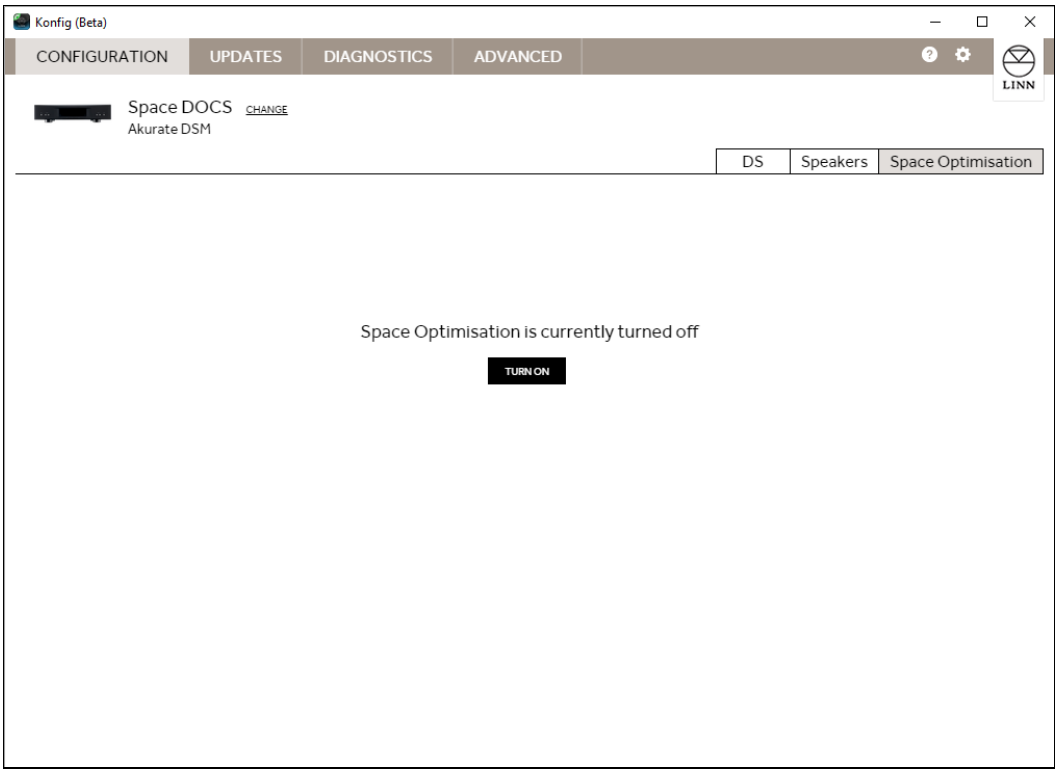


2.3.2 Import the current system optimisation

This will tell you if there is already a Space Optimisation within system that is not turned ON. Select this and Konfig will prompt you to enter a name for this optimisation for saving later.



Once you have named the optimisation you will be prompted to turn on Space Optimisation by clicking the 'TURN ON' button.



2.3.3 Open an existing optimisation

This allow you to recall a system setup that has been saved on that PC/MAC

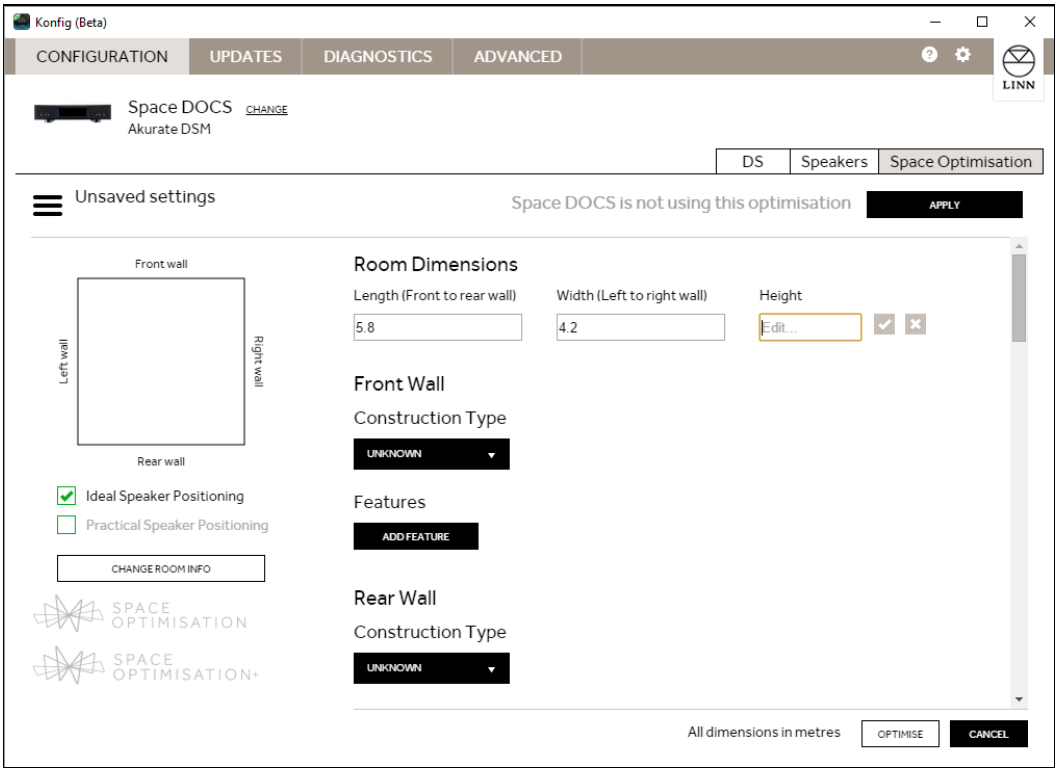
2.4 Entering you room information in Konfig

Click on 'CHANGE ROOM INFO' to enter details about the room, speaker and listener positions. The frequency response graph and the associated filter selection and control buttons will be replaced by a scrolling data entry page as shown below.

2.4.1 Enter room dimensions

Carefully measure your room and enter the dimensions into Konfig. All measurements should be given in metres. As you enter the dimensions Konfig will adjust the room image on the left of the screen to reflect changes.

The room mode algorithm assumes a rectilinear room shape, if your room is not a simple rectangular shape you will need to make some approximations. For advice on how to simplify complex room geometries, see the advance set-up section.



2.4.2 Specify room construction and features

Once the room dimensions are entered you will need to specify the construction type for each surface in the room along with any features such as windows and doors.

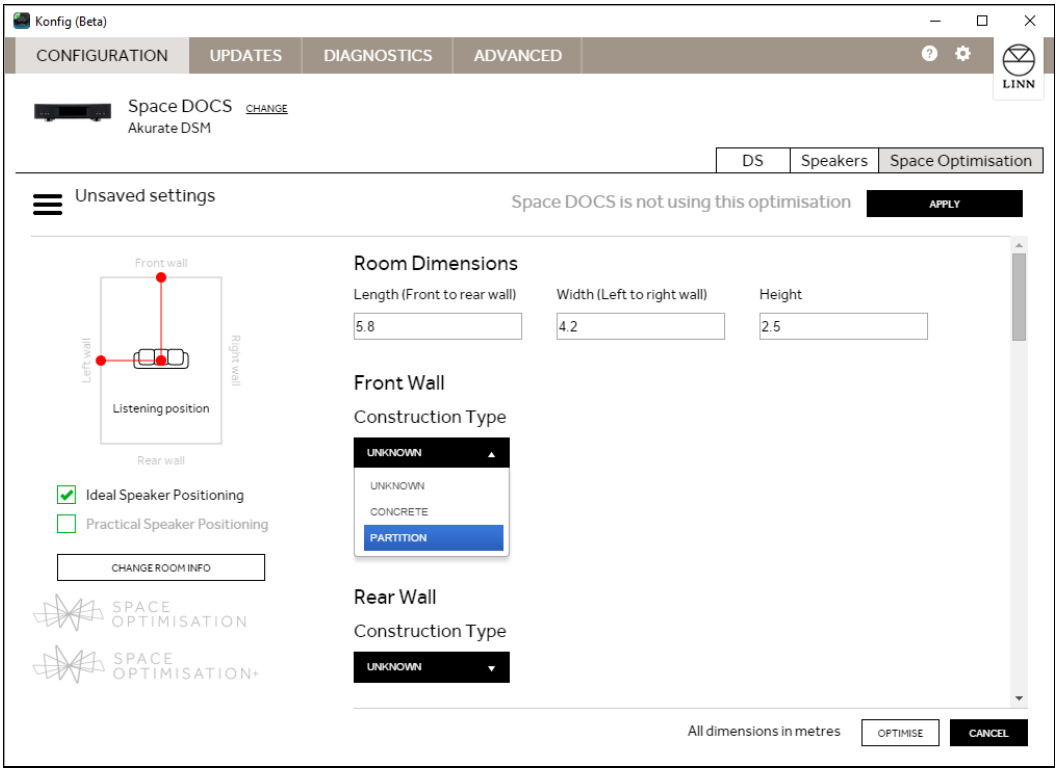
Starting with front wall, click the drop down list adjacent to 'Construction Type'. Select the most appropriate description of the construction of the wall.

'CONCRETE' describes any solid or very heavy wall construction including brick, blockwork or stone.

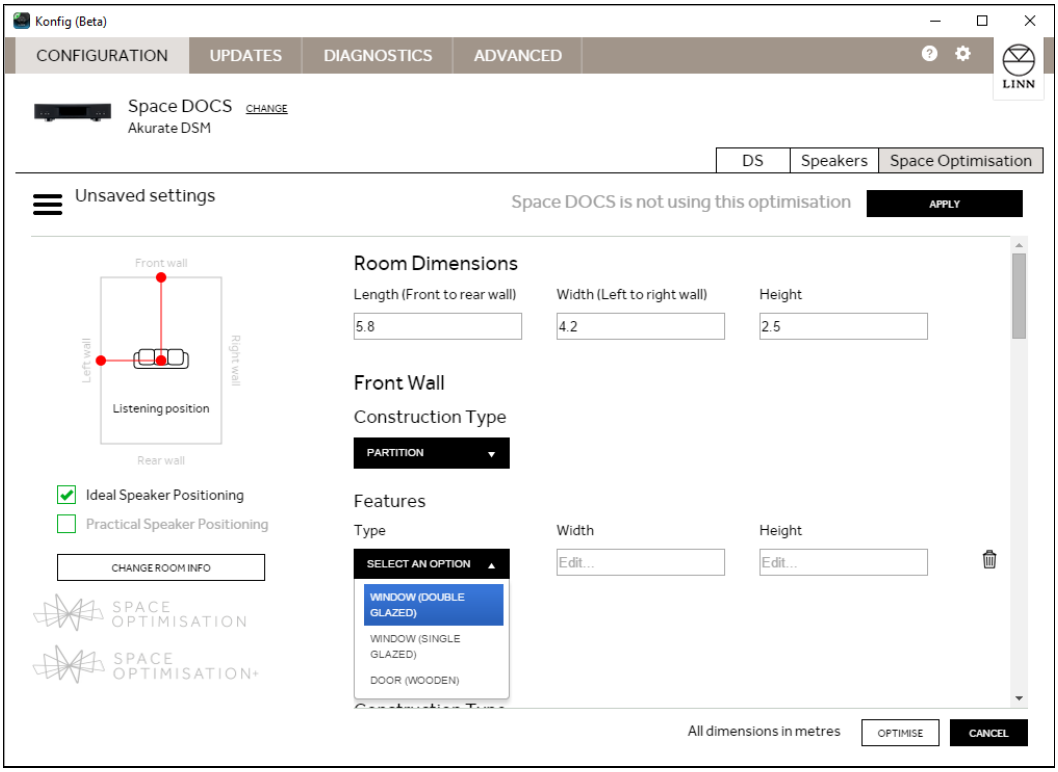
'PARTITION' describes any flexible or lightweight construction such as wooden studwork and plasterboard walls.

'UNKNOWN' provides a coefficient to the room mode algorithm halfway between the 'CONCRETE' and 'PARTITION' settings. Use this selection if the construction is actually unknown. The selection is

also useful where you believe the construction to lie between solid and lightweight construction methods, for example this could be selected for drywall construction (plasterboard cement mounted to a solid wall).



If the wall has any features, such as windows or doors, click the ‘ADD FEATURE’ button

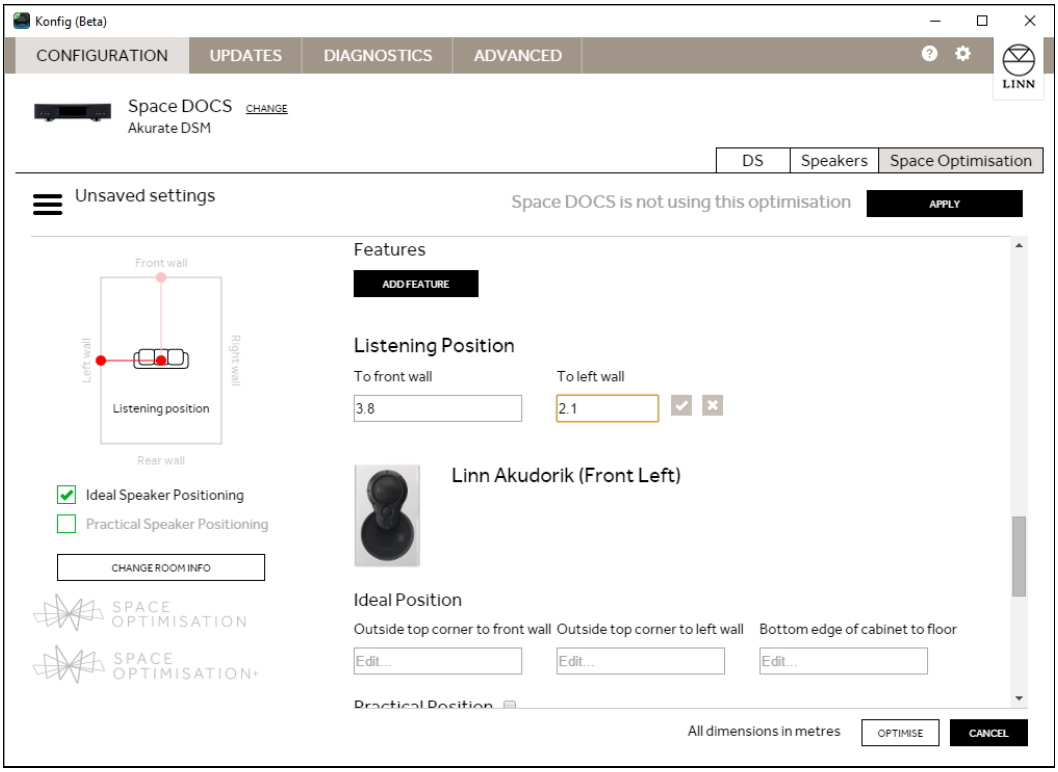


Select the feature type and enter the width and height of the feature. If you need to add more features, click on the ‘ADD FEATURE’ button. To delete a feature click the ‘DELETE’ text adjacent to the feature heading.

Repeat the above steps for each of the six surfaces in the room.

2.5 Enter listening position

Enter the distance of your listening position from the front and left walls. Remember that the distances must be entered in metres.



2.6 Enter loudspeaker positions

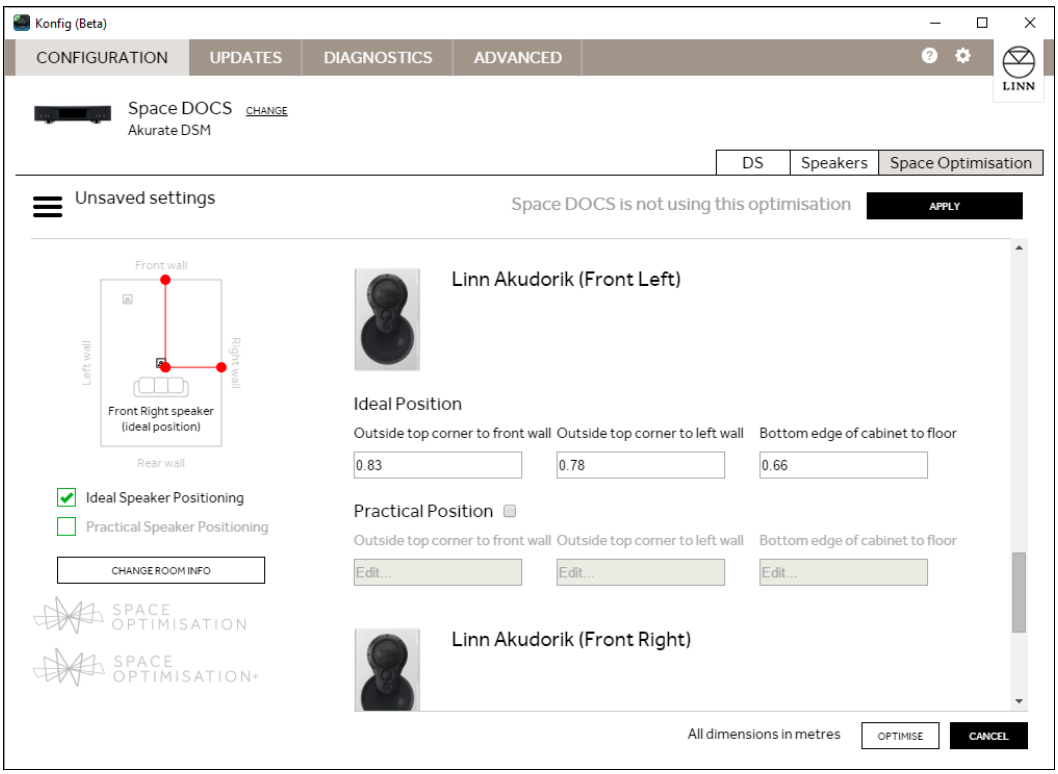
Measure the distance from your loudspeaker to the front and side walls and enter the dimensions into Konfig.

The ‘IDEAL SPEAKER’ position fields MUST be entered otherwise Space Optimisation will not work.

Konfig will provide the position on your loudspeaker from which the distances must be taken.

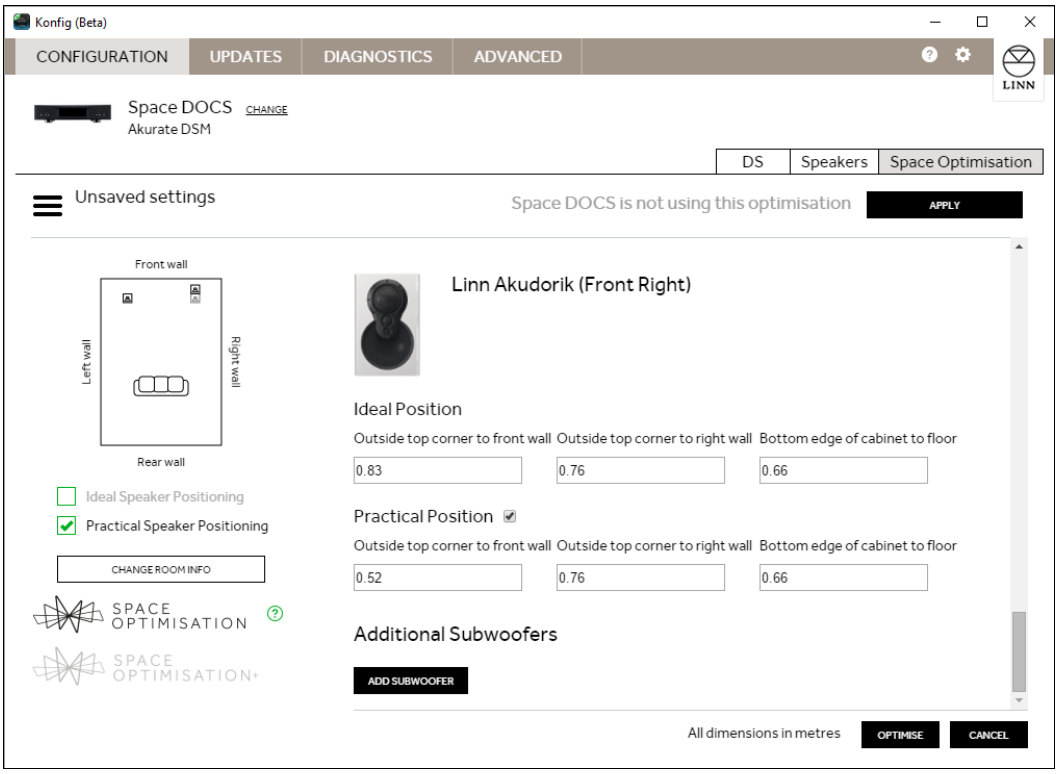
Point source modelling

If your loudspeaker has not been measured by Linn for Space Optimisation you will be prompted to enter the location of the lowest frequency drive unit relative to the front and side walls. If your loudspeaker has multiple low frequency drive units you should take an approximate average position for the drive units.



2.6.1 Practical position

If the 'Ideal position', where the loudspeakers offer their best sonic performance in your listening position, is not suitable due to other domestic constraints then move the loudspeakers to a more practical location and re-measure to the front and side walls.



Check the ‘Practical Position’ tick-box and enter new distances into Konfig. Repeat for the right loudspeaker.

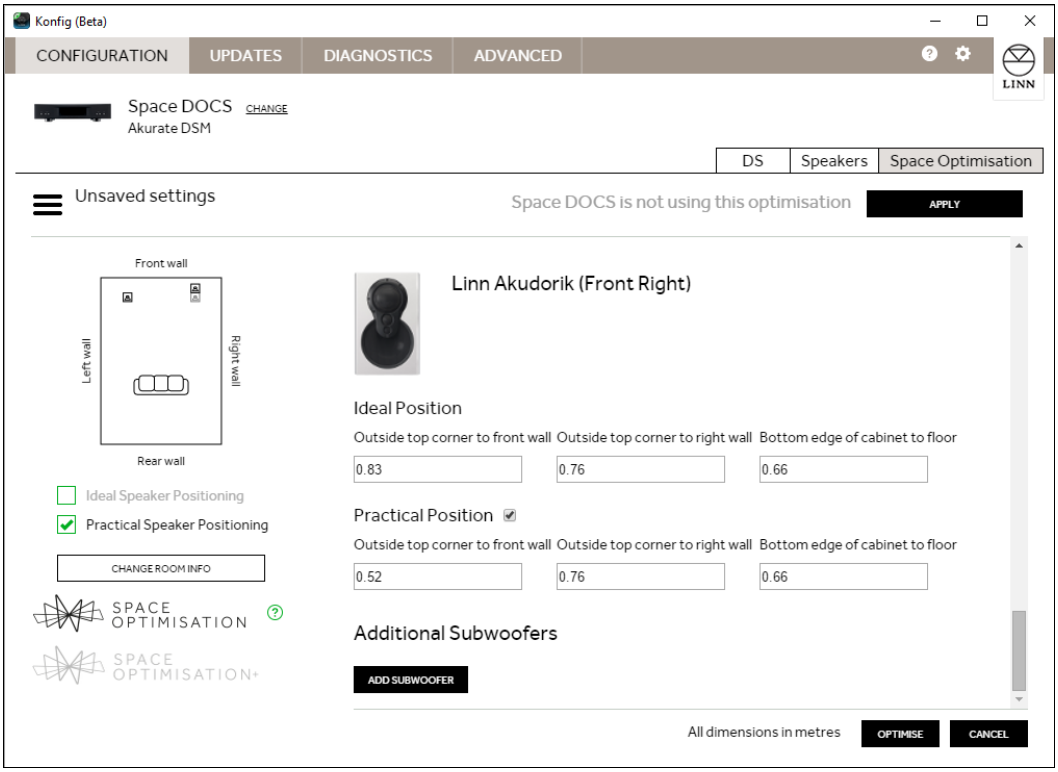
2.6.2 The Virtual Tune-Dem

In some cases, especially for in-wall or in-ceiling speakers and surround systems, it may be impossible or impractical to find the ideal position by physically relocating the speakers. In such cases the placement optimisation feature in Space Optimisation can be utilised to perform a ‘virtual tune-dem’ on the loudspeakers.

To perform a ‘virtual tune-dem’, select the ‘Practical Position’ checkbox and enter the required speaker position into Konfig as the practical position. Adjust the ‘Ideal Position’ settings to reflect the changes you would make if you were physically moving the speakers. Continue to adjust the ideal positions using Tune-dem to establish the ‘virtual’ ideal position.

2.7 Additional Subwoofers

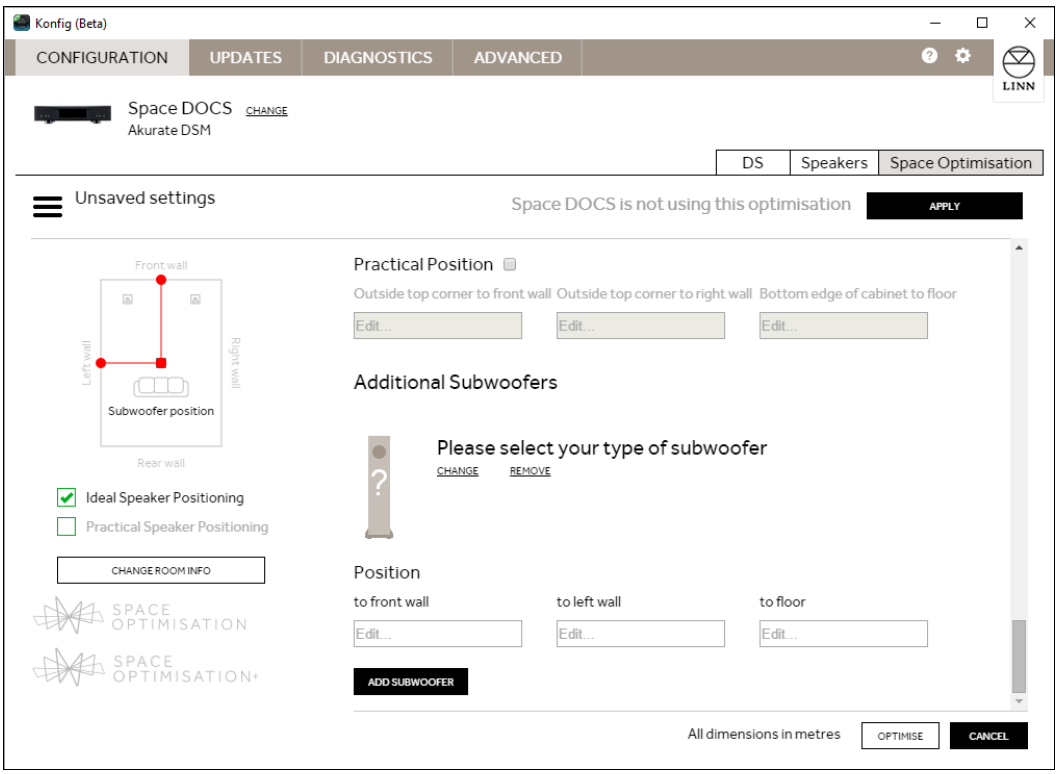
If you have any Subwoofers to add click the ‘ADD SUBWOOFERS’ button.



With conventional analogue front left/right loudspeakers you connect the sub to the Linn DS/DSM front left or right analogue output sockets.

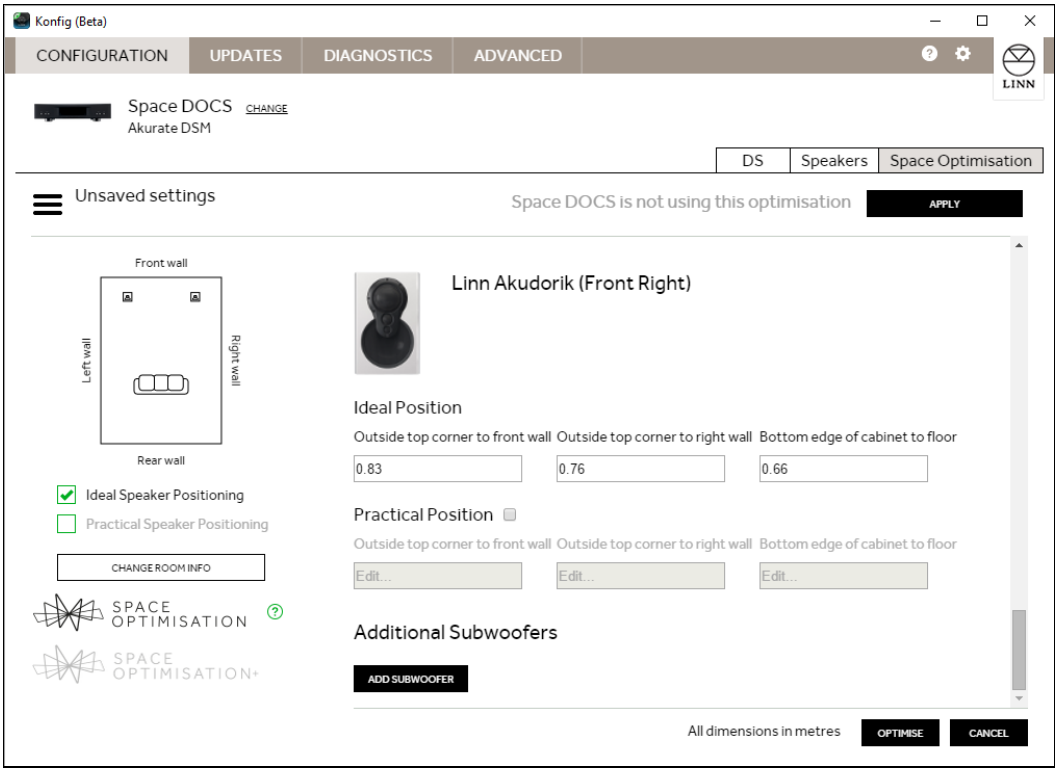
In an Exakt system you should to use an Exaktbox-sub for the sub-woofer connection.

Enter the location of the subwoofer(s).

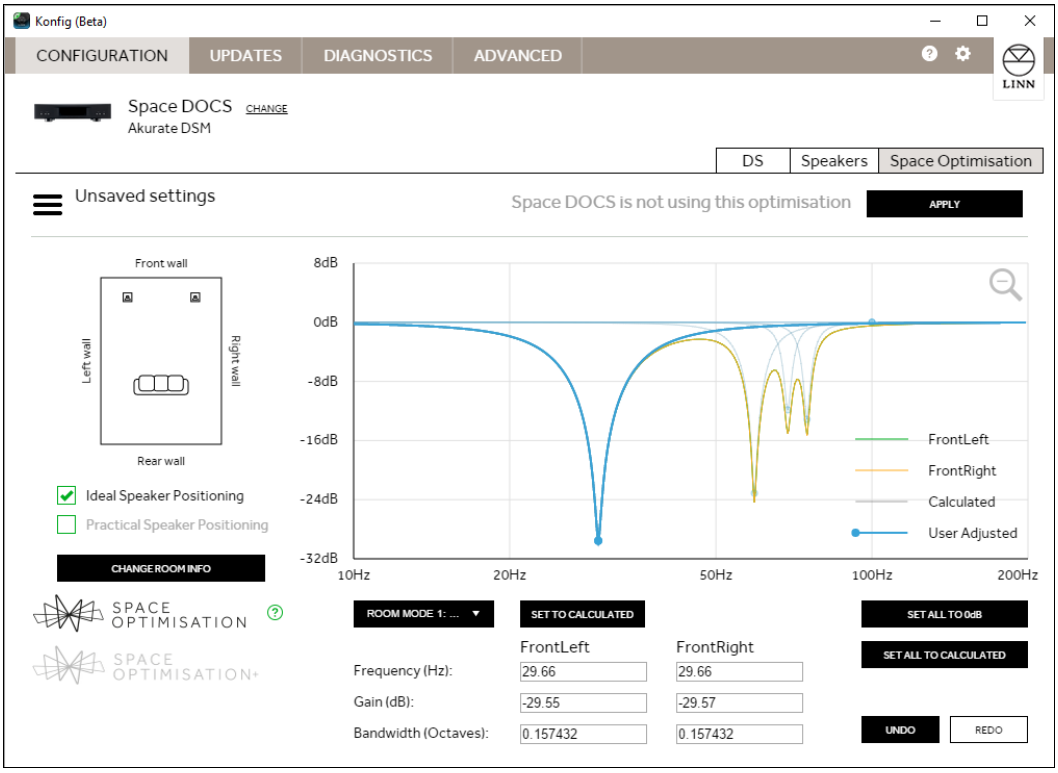


2.8 Optimise and Apply

When all dimensions for the room, loudspeaker position and listener position have been entered, along with any construction and feature data the 'OPTIMISE' button will turn black indicating that Konfig is ready to apply Space Optimisation to your system.

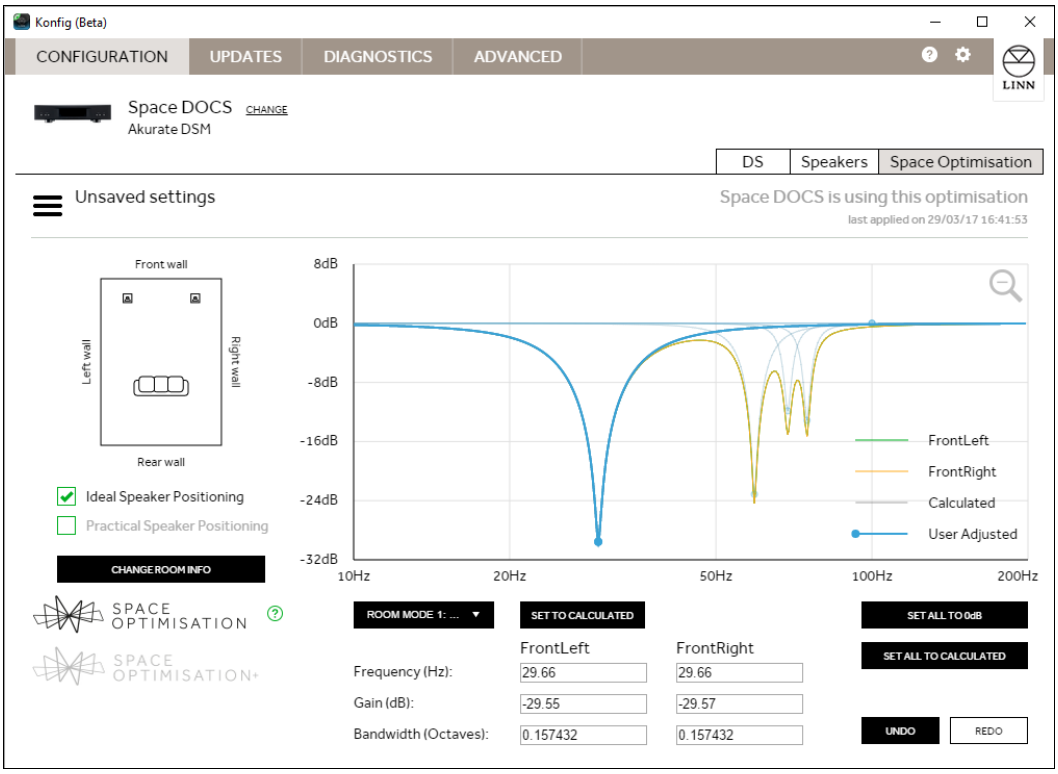


Click on the ‘OPTIMISE’ button.



Konfig will now calculate the optimisation filters for room modes and loudspeaker placement (if practical placement has been entered for the loudspeakers). Once calculated the screen will change to show the result of the room mode optimisation algorithm.

These settings have **NOT** been sent to the Exakt system until you press the ‘APPLY’ button.



The ‘APPLY’ button will disappear and a message will be displayed showing that the DS or DSM system is now using the currently displayed optimisation settings.

For information about further adjustment of the filters produced by Space Optimisation or Space Optimisation+, including setting bass and treble shelves and custom filters see the advanced set-up section.

2.9 Storage of Space Optimisation set-ups

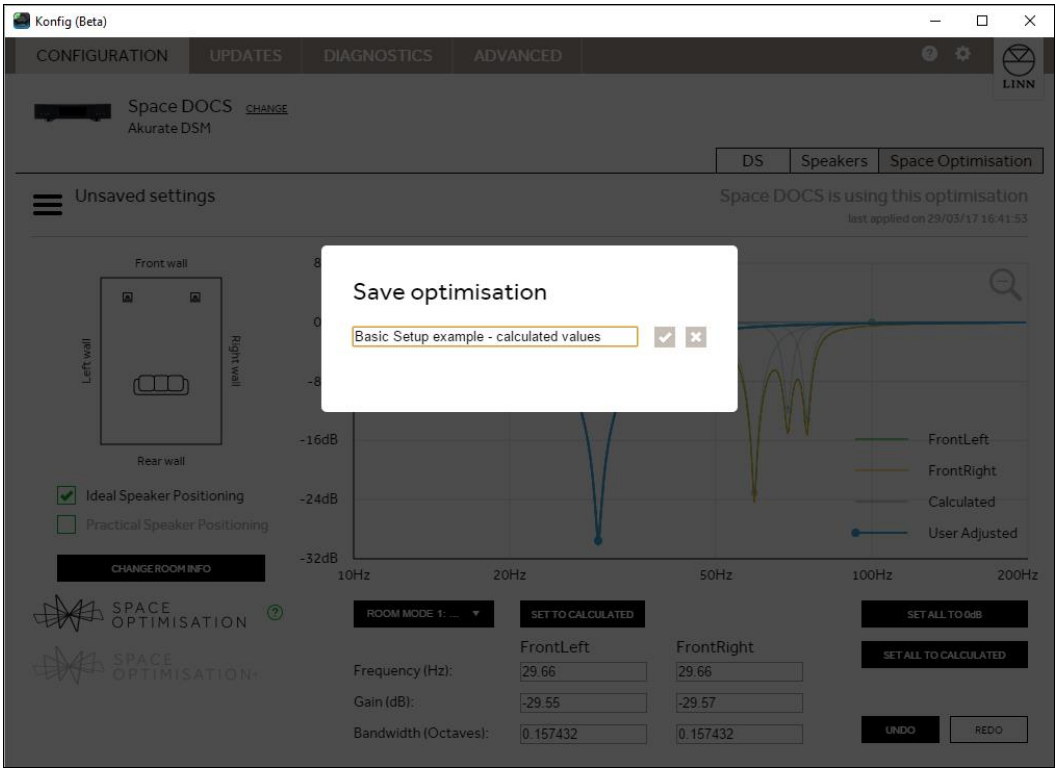
2.9.1 Saving your Space Optimisation

You can save the settings at any time using the ☰ button and select ‘SAVE’.

You will be presented with a dialogue box where you can enter a name for the optimisation setup.

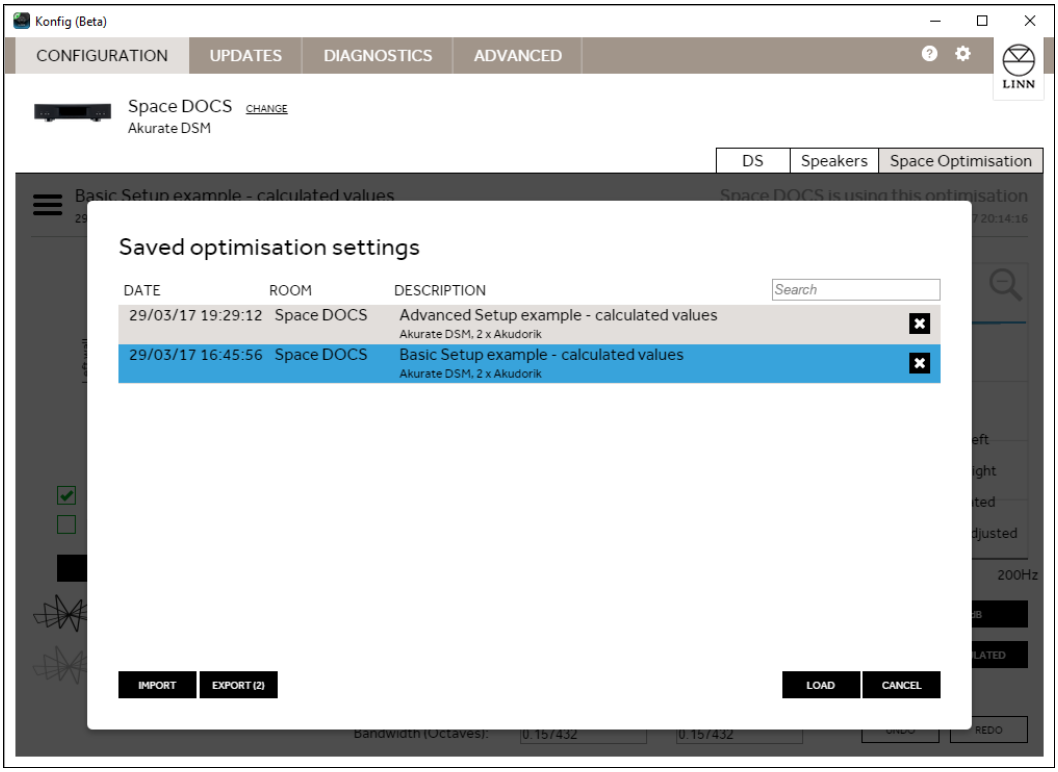
This should normally include the room name and any extra detail about the settings you are storing. Click on the tick symbol to save the setup.

If you make changes to the setup you should use the ‘SAVE AS’ button to avoid overwriting the existing saved room optimisation.



2.9.2 Loading Space Optimisation

The settings can be re-loaded at any time by clicking ☰ button then ‘OPEN’ button and selecting the stored file.

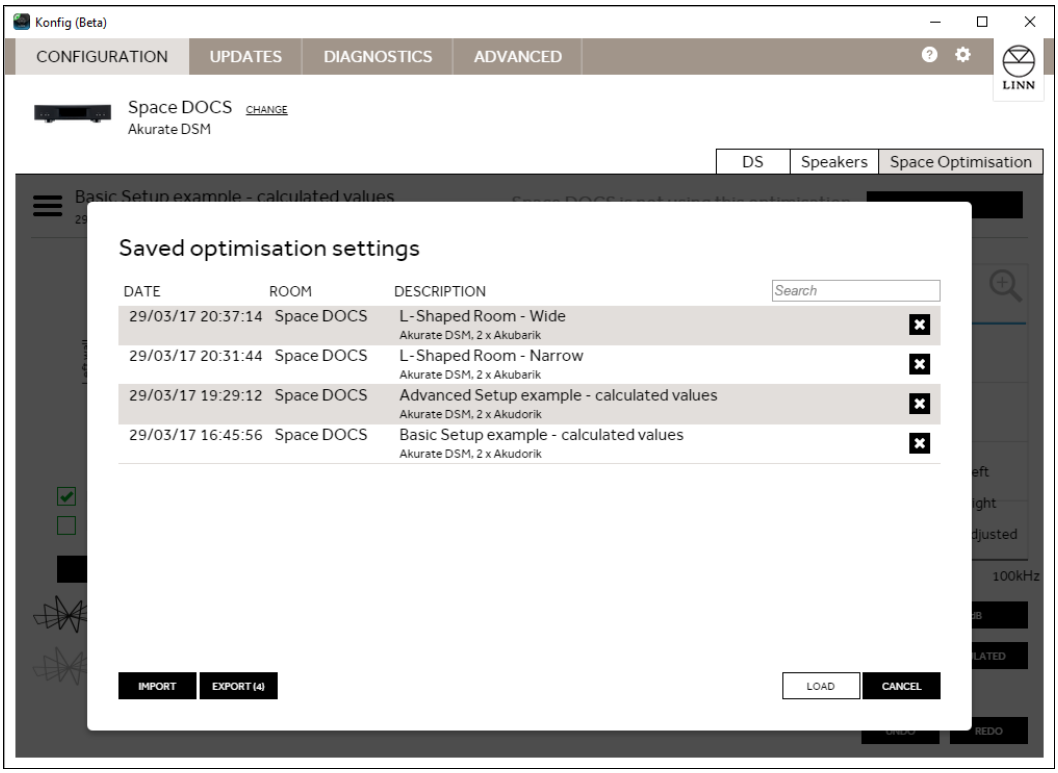


Be aware that clicking the cross box on any saved optimisation will permanently delete that optimisation file.

2.9.3 Import and Export

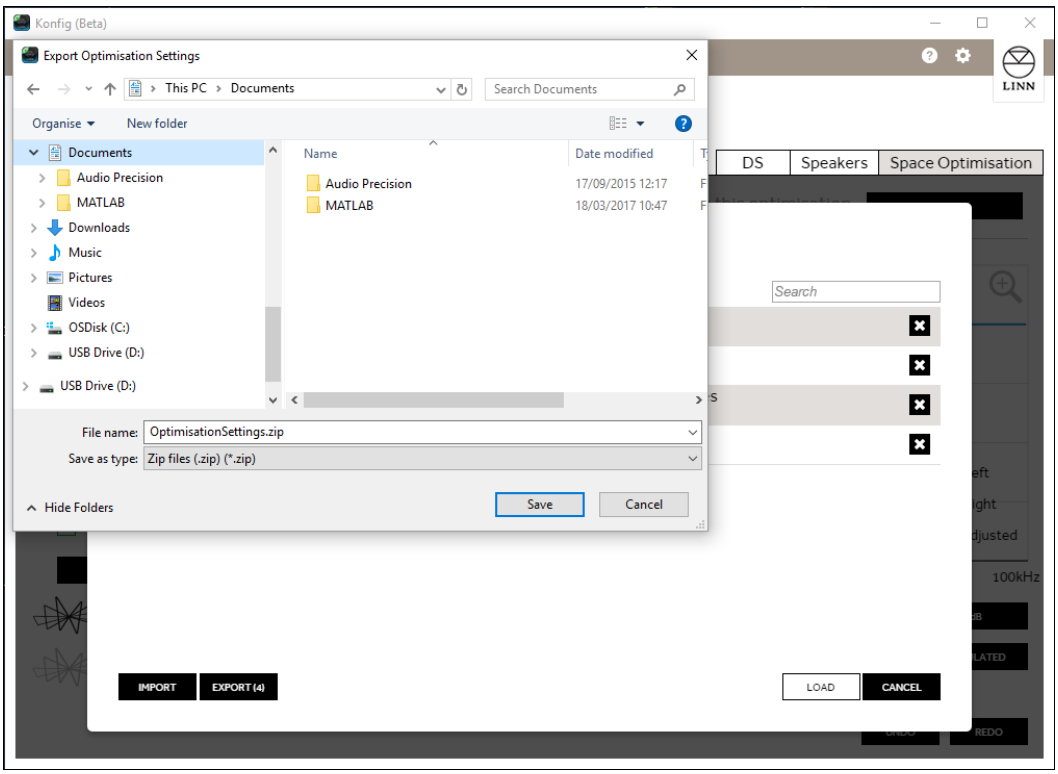
It may be desirable to safeguard your finalised optimisation set-up by storing the saved files in a separate location other than your PC/MAC. Konfig provides the capability to import or export saved setup files.

Within the load setup page on the Konfig optimisation page there are two buttons; ‘IMPORT’ and ‘EXPORT’, these can be used to back-up any saved optimisation set-up files.



If you only wish to EXPORT some files then type in the filter/search box on the top right text that is common to the systems you wish to export, such as "John Smith" will only show systems with John Smith in the ‘ROOM’ or ‘DESCRIPTION’ columns.

Clicking on ‘IMPORT’ or ‘EXPORT’ will open a standard file load/save dialog.


Konfig (Beta)
Export Optimisation Settings
This PC › Documents
Search Documents
Organise
New folder
Documents
Audio Precision
MATLAB
Downloads
Music
Pictures
Videos
OSDisk (C:)
USB Drive (D:)
USB Drive (D:)
Name
Date modified
Audio Precision
17/09/2015 12:17
MATLAB
18/03/2017 10:47
File name:
OptimisationSettings.zip
Save as type:
Zip files (.zip) (*.zip)
Hide Folders
Save
Cancel
DS
Speakers
Space Optimisation
LINN
Search
IMPORT
EXPORT (4)
LOAD
CANCEL
100kHz

3 Advanced set-up for Space Optimisation and Space Optimisation+

Space Optimisation and Space Optimisation+ will produce very accurate models of the low frequency interaction between the loudspeakers, room and listening position in a regular rectangular shaped room. There are often cases, however, where some adjustment of the predicted room mode solution is required. For example, if the room does not closely conform to a rectangular floorplan the mode estimates are likely to be in error. Also if the method of construction does not closely match the options provided in Konfig the amount of cut applied for room modes may be in error.

This advanced set-up guide presents further information about the calculation and manipulation of room mode filters.

The correct methodology for adjusting the room mode optimisation filters is presented in section 3.2.

Guidelines for simplifying non-rectangular room layouts to better fit to the idealised model are presented in section 3.3.

Additional filters are available in Space Optimisation and Space Optimisation+ which may also prove useful in some applications. These include bass and treble shelving filters, and user defined custom filters. Examples are given where these filters could be of benefit in odd shaped rooms

3.1 Room modes

Konfig provides information which will benefit an experienced installer and allow him to more quickly identify which mode filters will need to be adjusted, and in what way. To make use of this information it is useful to understand the limitations of the Konfig room mode calculation resulting from the assumptions made by the algorithms.

Presented in this section are the fundamental assumptions employed by the room mode optimisation algorithms. Also recommendations for when to adjust the room mode filter centre frequency and bandwidth are presented.

3.1.1 Basic assumptions used for calculations of room modes

The optimisation algorithm assumes that the room is of essentially rectangular layout. This is often not the case. For Konfig to provide a meaningful room mode optimisation more complicated room shapes must be simplified to approximate rectangular dimensions. How the room is simplified will dictate the adjustment required to the Konfig optimisation.

All reflections at room boundaries are considered to be specular. This implies that the reflective characteristics are ideal and are the same at all frequencies. Most real surfaces do not provide specular reflections, instead the magnitude and phase response of any reflected wave is dependent on the incident angle of the acoustic wave. This has significant implications for any non-axial mode (a mode which operates between more than two parallel surfaces).

3.1.2 How room mode filters are displayed and adjusted

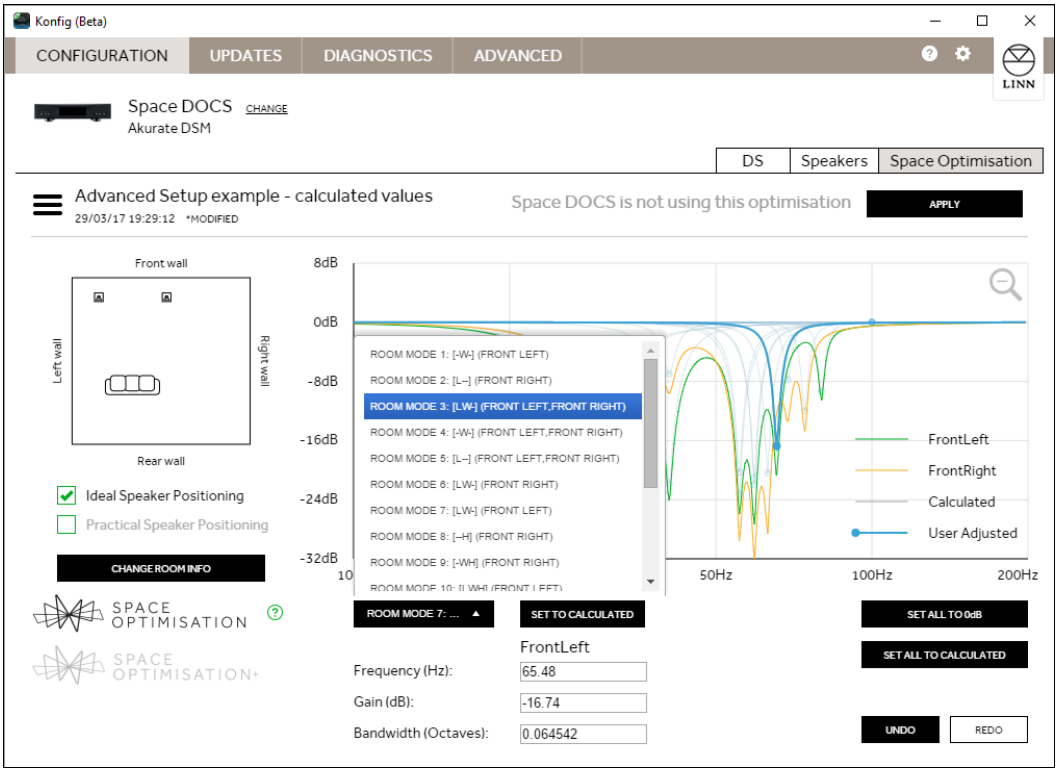
Go to the Space Optimisation tab within Konfig. Below the room mode filter graph you will see a popup list-box showing the room mode optimisation filters. The popup list also allows access to bass and treble shelves and custom filters.

Selecting an individual optimisation filter allows you to modify its behaviour.

Room modes and their optimisation filters are calculated on a single speaker basis and are listed in ascending frequency; the lowest frequency room mode will be optimised by 'ROOM MODE 1'.

Each room mode will be active across one or more dimensions of the room, indicated by the square bracket notation in the popup list. This information will be of great use to an experienced installer, further comment is made below.

Some room modes will be unique to a single loudspeaker; some will be common across a pair of loudspeakers. This is also indicated in the popup list.

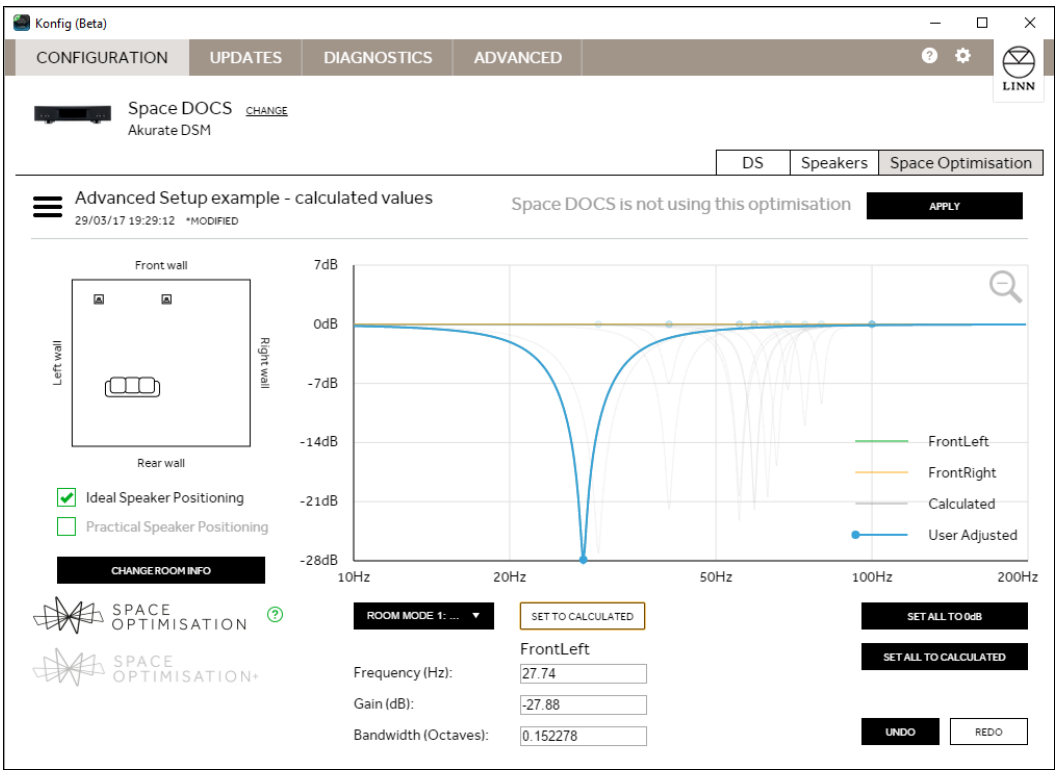


Adjustment of room modes in Konfig

When a room mode filter is selected from the drop down list the user is provided with the full specification of the parametric equalising filter applied to optimise for the room mode.

For mode filters which are unique to one speaker (left or right) a set of three parameters will be displayed, centre frequency, gain and bandwidth. These parameters fully describe the room mode optimisation filter being applied and each may be adjusted to better optimise for a given room mode.

The user is permitted to vary the filter gain by ±100%, the centre frequency by ±2 Hz and the bandwidth of the filter by ±10%.

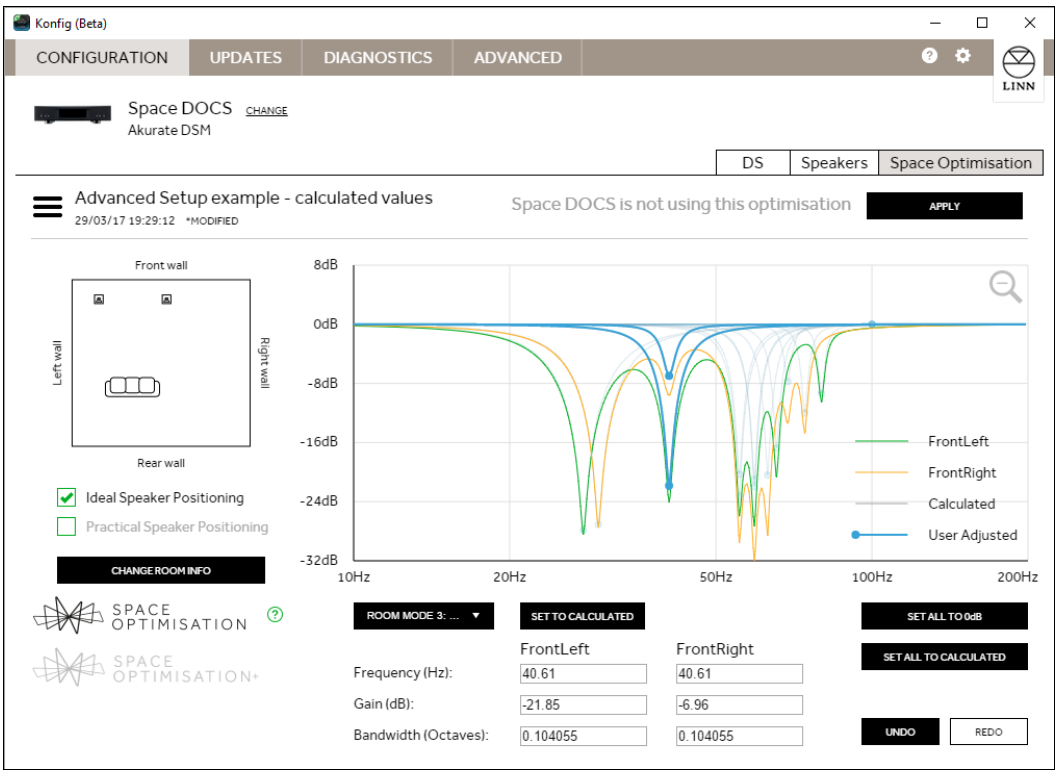


For room mode optimisation filters that are ‘common’ across a pair of loudspeakers the three parameters will be displayed for both loudspeakers. Any adjustments made to the filter will be applied to both loudspeakers.

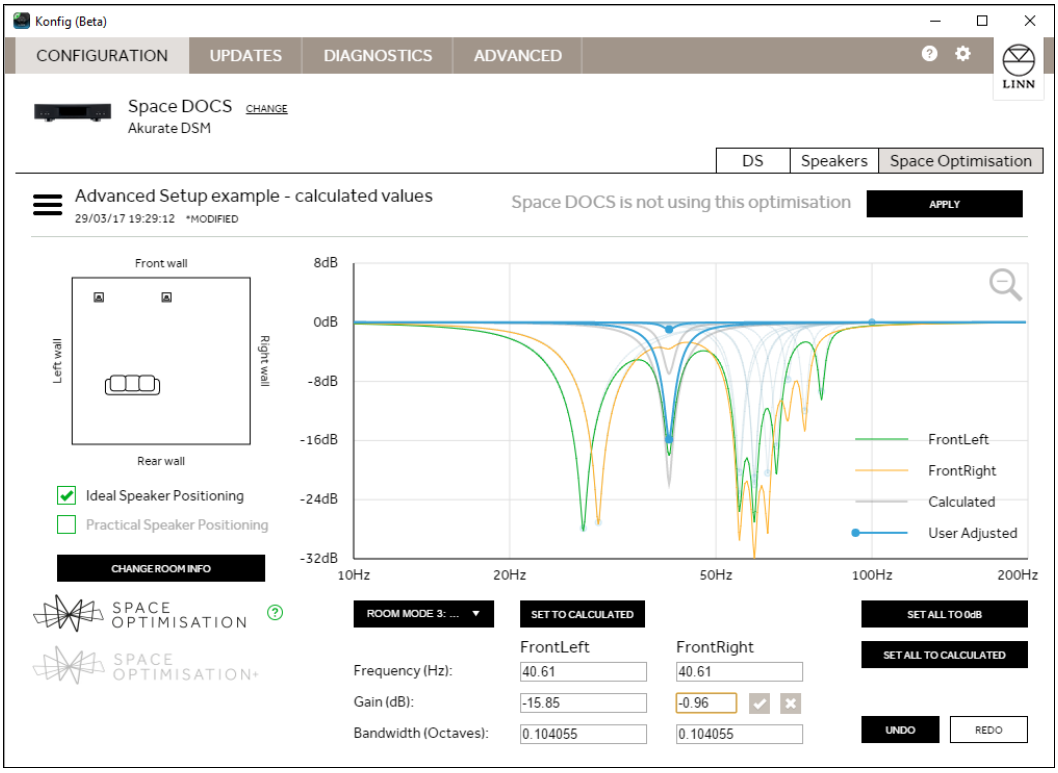
For ‘common’ filters the bandwidth and frequency of the left and right filters will always be identical, any change to bandwidth or frequency on one speaker will be reflected across the pair.

The gain of ‘common’ filters will often be different. Konfig will attempt to maintain the gain difference between the left and right room mode optimisation filters for ‘common’ filters. In this case adjusting one speaker by 1 dB will also change the paired speaker’s filter by 1 dB. Neither of the optimisation filters can be extended to provide positive gain, when one filter reaches 0 dB Konfig will no longer maintain the gain difference.

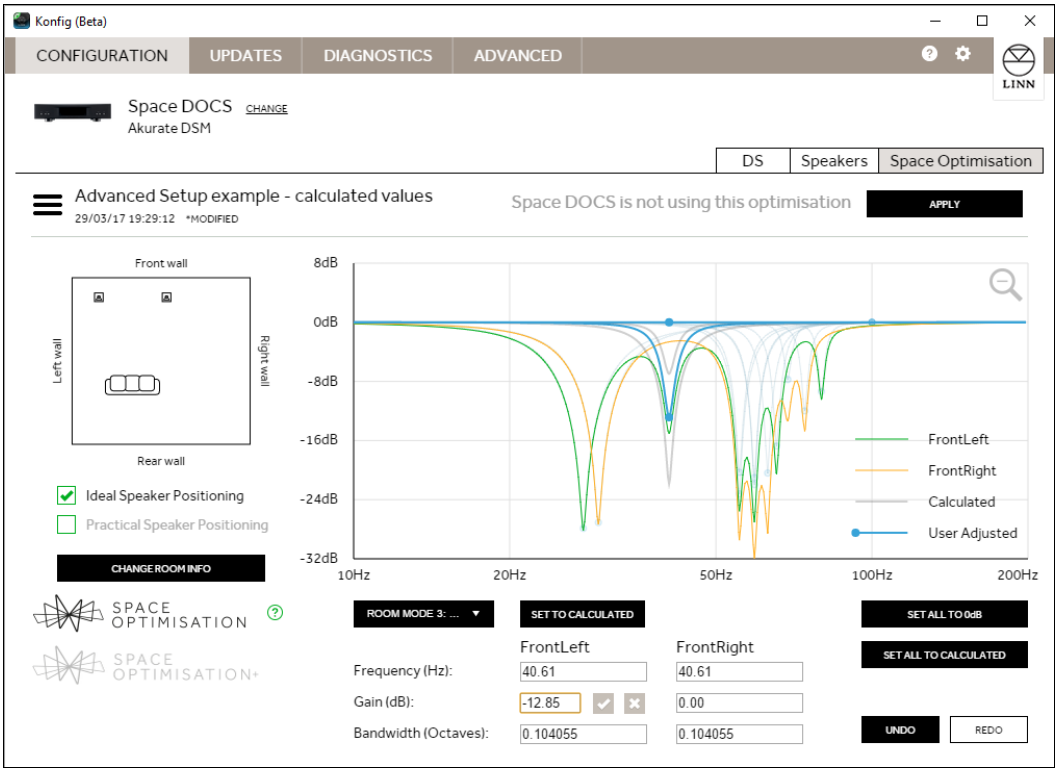
This is indicated well by examining ‘ROOM MODE 3’ in the example below:



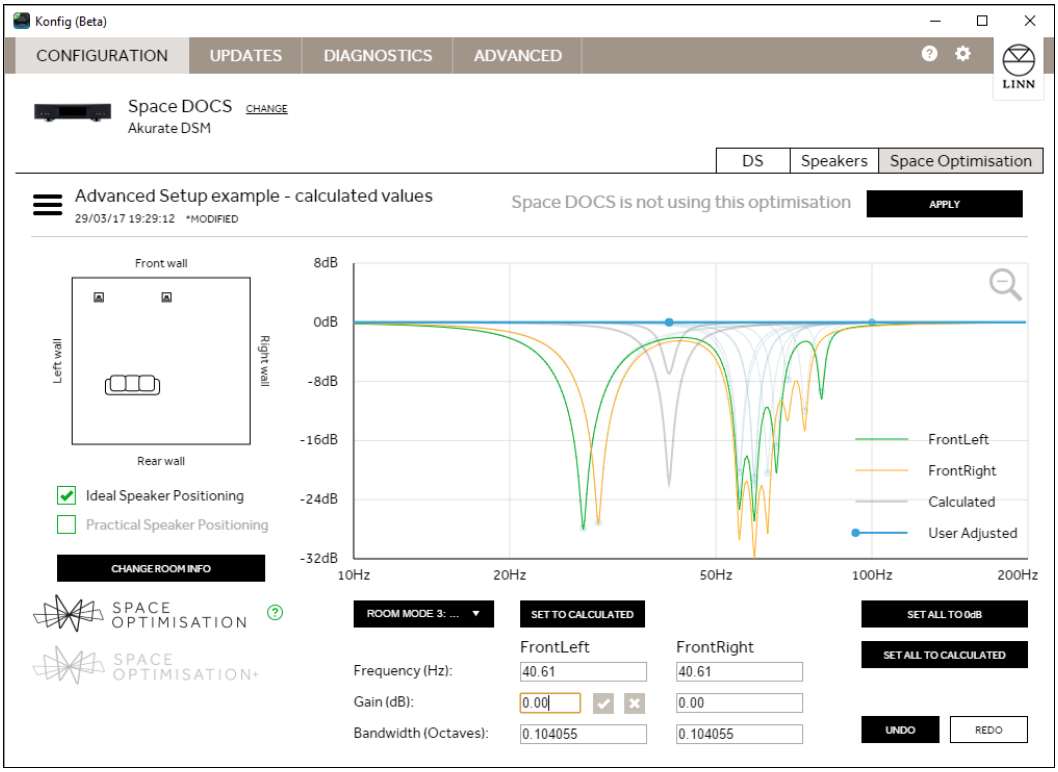
For ‘ROOM MODE 3’ the left and right filters show a gain difference on 14.89 dB. Increasing the gain of either speaker by 6 dB results in a left filter gain of -15.85 dB and a right filter gain of -0.96 dB. The 14.89 dB difference is maintained.



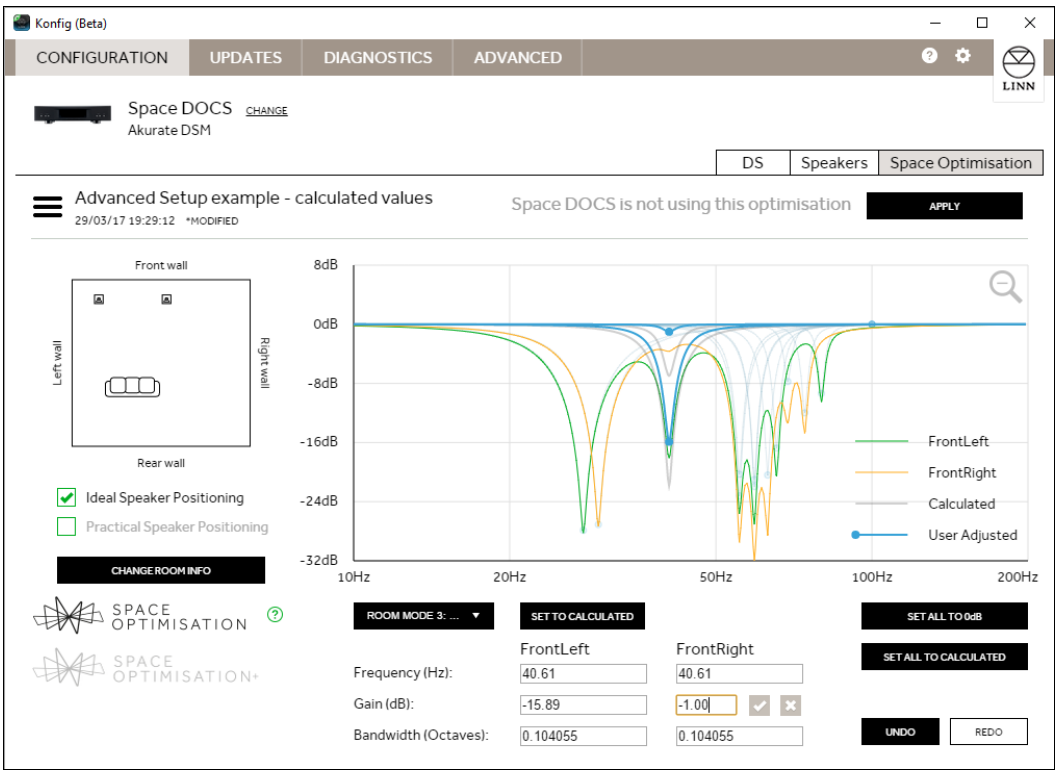
Adjusting the left speaker by a further 3 dB now gives a left filter gain of -12.85 dB, but a right filter gain of 0 dB.



The left filter gain can continue being increased until it also reaches 0 dB with no further effect on the right filter gain.



With both filter gains set to 0 dB, a decrease of 1 dB to the right filter gain results in the left speaker gain setting itself to -15.89 dB. Konfig has re-applied the gain difference of 14.89 dB.



Additional information provided by Konfig

Konfig provides dimensional information about the room modes. The room mode filter titles shown in the drop down list also include a set of three characters in square brackets. This describes the axis of the room along which the standing waves of the room mode occur.

Modes active along the length axis of the room are shown as **[L--]**.

Those active across the width or height are shown as **[-W-]** and **[--H]** respectively.

The mode descriptor will inform the installer whether a mode is a simple axial mode (operating along a single room dimension) or if the mode is tangential or oblique (operating between four or six room surfaces).

This is very useful information for the experienced installer. A length mode will be controlled by the characteristics of the front and rear walls. Say, for example, the room has a pitched roof; any height mode will need to be adjusted.

Due to the non-ideal reflective characteristics of real surfaces any non-axial mode is likely to be over-optimised by Konfig. The installer will know that any mode described by more than one letter (e.g. [L-H] or [LW-]) is likely to require adjustment, typically an increase in filter gain (less cut).

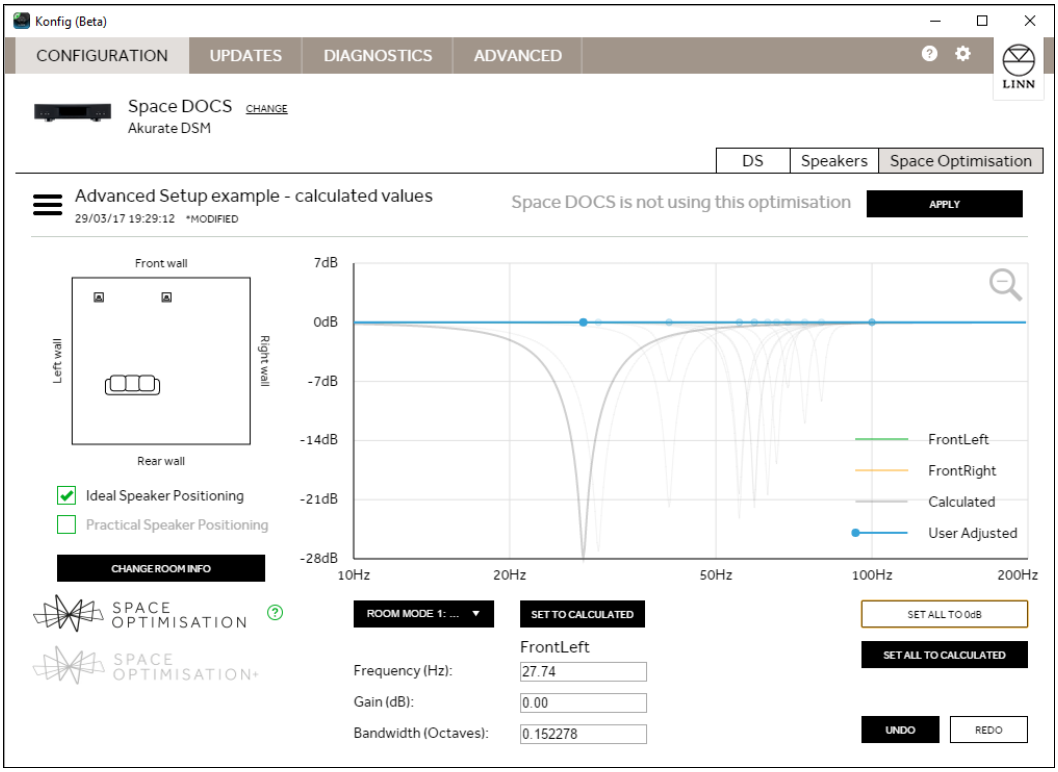
3.2 Improving the estimated room mode optimisation using tune-dem

Due to assumptions made in the room mode algorithms there will be scope for further optimisation of the filters applied by SPACE optimisation. The process that should be adopted is detailed below.

3.2.1 Room mode filter validity

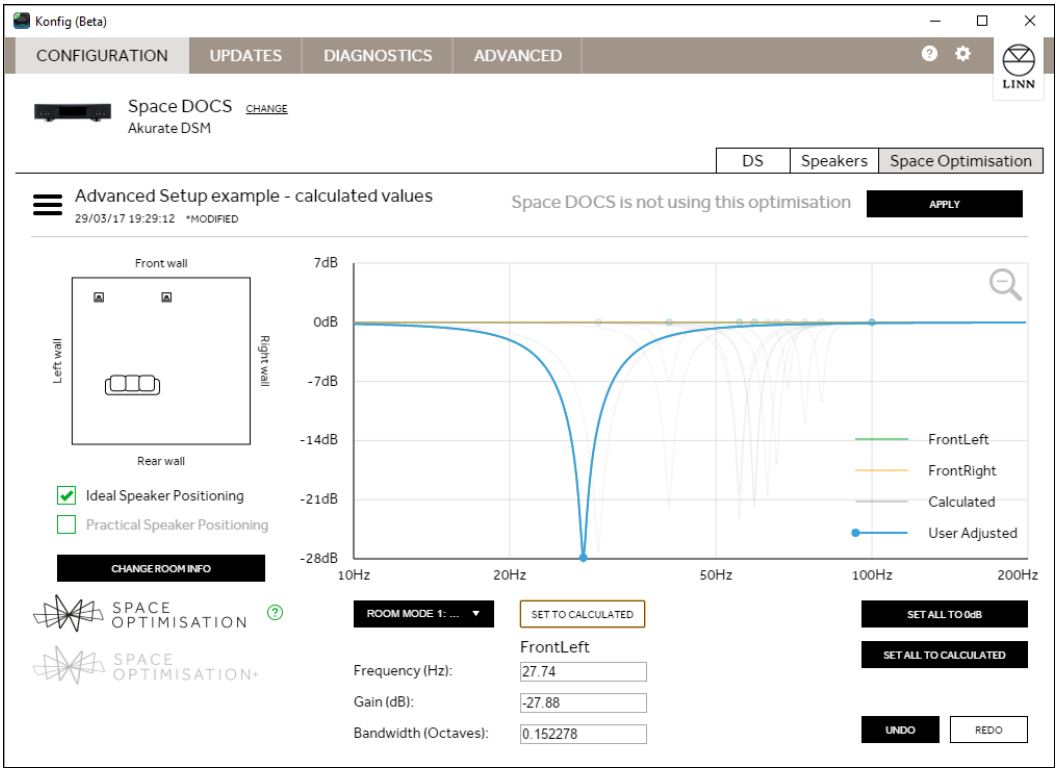
As a first step it is recommended that the installer check the validity of each room mode filter. Filter redundancy may occur if a room surface is particularly irregular, for example a pitched roof. In this instance no strong standing waves will occur between the floor and ceiling and unnecessary optimisation filters may be produced.

Once the optimisation has been performed and the graph of all room modes is showing, click on the 'SET ALL TO 0dB' button, followed by the 'APPLY' button.



Using the tune-dem listen to a piece of music, ideally with an even melodic bass line, a couple of times to familiarise yourself with the music.

Select room mode 1 from the drop down list on the right. Click on the 'SET TO CALCULATED' button followed by the 'APPLY' button



Listen to the piece of music again.

- Is it more musical with the mode filter set?
- If the filter has improved the musicality of the system then move on to room mode filter 2.
- If the system musicality is no better, or has got worse, then set the room mode filter back to 0dB.

Using the tune-dem re-instate each filter in turn, always starting with the lowest frequency, and ensure that each optimisation filter improves the musicality of the system. If re-instating a filter has no audible effect then return the filter's gain to zero and move to the next filter

3.2.2 Adjusting room mode filters for best sonic performance

Once all required room mode optimisation filters have been established some further optimisation may be achieved by altering the gain of the room mode filters (examples of when to adjust frequency and bandwidth are covered in next section).

- Use a piece of music with an even, melodic bass line.
- Starting with the lowest frequency room mode filter, increase the gain by 6dB (towards 0 dB) and listen again.
- Using tune-dem decide if the result is an improvement.
- If the bass line sounds more even, try increasing the gain again.
- If the bass line sounds less even, then reduce the gain.
- Increase and decrease the gain in progressively smaller steps until the best result is achieved.

- Move on to the next valid room mode and repeat.

Always start with the lowest frequency room mode filter. Low frequencies mask higher frequencies so it will be easier to judge the accuracy of the higher frequency mode filters if the lower frequency filters are correct.

3.3 Simplifying room dimensions

The room optimisation algorithm in Space Optimisation is based on the assumption of a largely rectangular room. If the room is slightly non-rectangular (e.g. it has a chimney breast or a bay window) you must decide upon the pertinent dimensions. In general the room dimension should be taken as the distance corresponding to the largest surface area on any given wall. Taking the examples cited above; in the case of the bay window, if the window covers more than half of the wall then measure into the bay window. For the case of the chimney breast, if the chimney covers less than half of the wall surface then measure to the wall either side of the chimney.

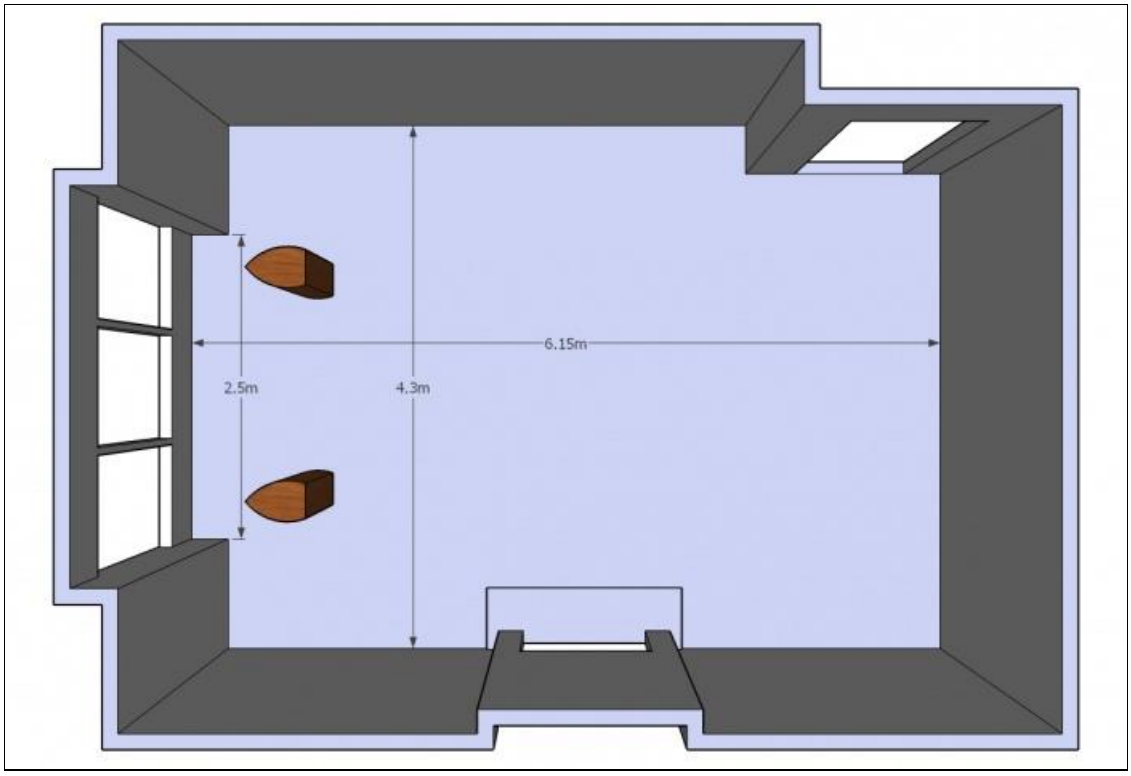
If a room is rectangular but has one corner taken up by a partitioned corridor or small anteroom then the larger dimensions should be used.

3.3.1 Simplifying a room to rectangular dimensions

Presented below are some examples of non-ideal rooms and how they should be simplified to fit the rectangular model employed by Konfig. In addition some recommendations are given for each room likely to improve the optimisation produced by the simplified rectangular model.

Example room 1, chimney breast and bay window.

In general when measuring a room the dimension should be taken which corresponds to the largest parallel surface area of opposite walls. In the example above, the inset door and chimney breast (fireplace) account for *less than 50%* of the side walls so they are ignored and the measurement taken is to the most distant surfaces (4.3m). The bay window covers *more than 50%* of the end wall so the length of the room is measured into the window (6.15m).

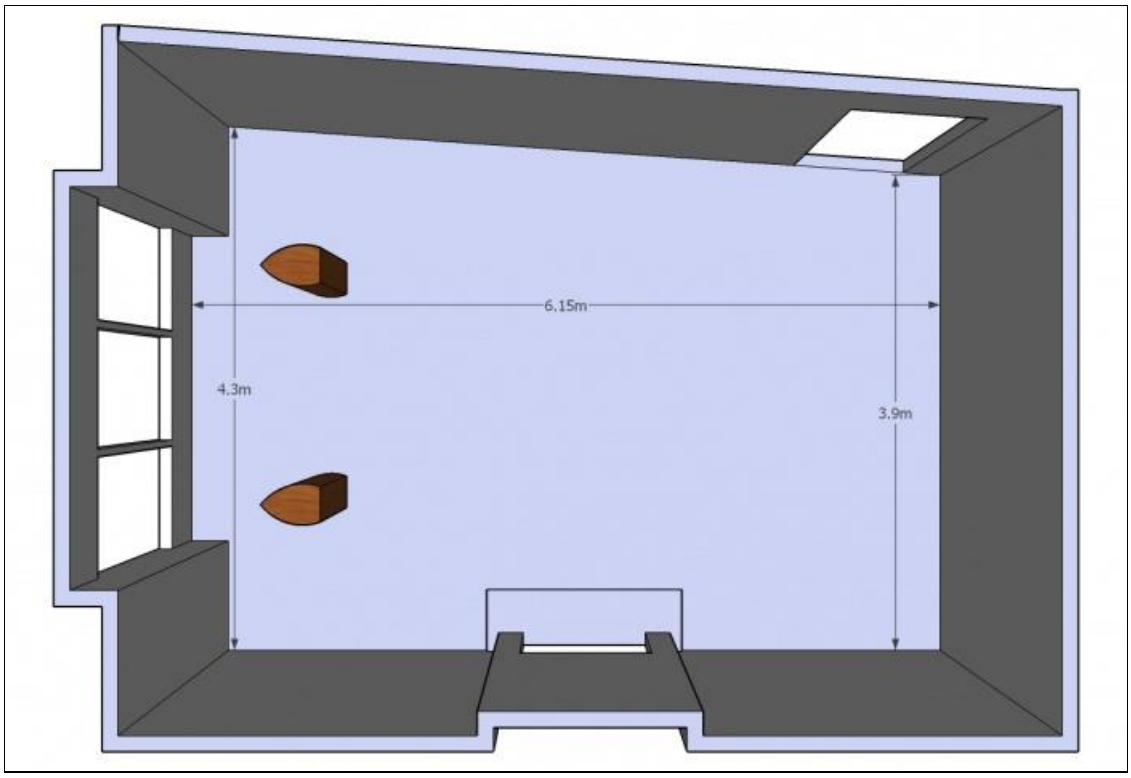


As the bay window along with the remainder of the front wall forms a staggered surface some smearing of room modes relating to the length of the room may occur. This can be countered by slightly increasing the bandwidth of any length modes.

Example room 2, room with one angled wall

Where walls are angled it is recommended to take an average measurement. For the room below the length remains at 6.15, measured into the bay window. The width would be taken as 4.1m, the average width.

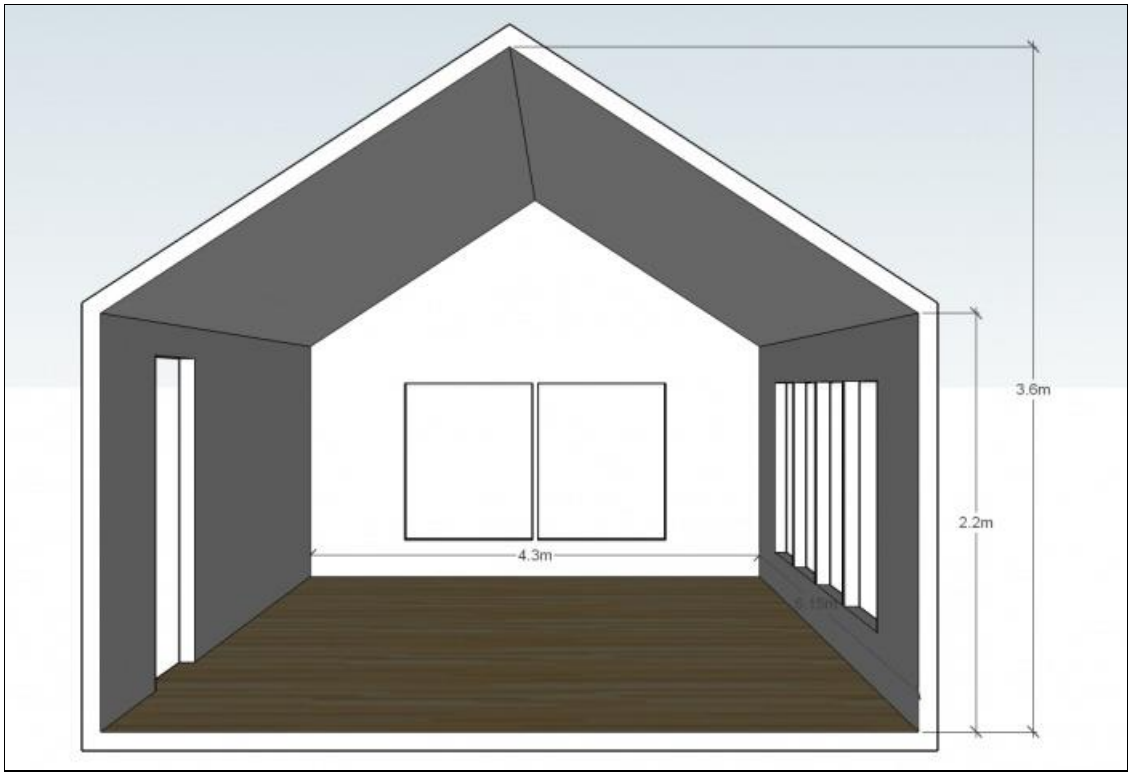
Modes relating to the width of the room will need further attention. It is likely that the optimisation filter gain for width modes will need to be reduced as non-parallel walls will reduce the strength of any modal behaviour. It may also be beneficial to increase the bandwidth of any width modes to capture the spread of modal frequencies resulting from the non-parallel surfaces.



Example room 3, room with pitched roof

For a room with a pitched roof careful attention to any room modes operating in the vertical axis is required. The most reliable approach for optimising room modes where a pitched roof is present is to take the height measurement to approximately one third of the way up the pitched roof. Run through the modal validity checks (detailed in section 3.2.1) to ensure that any calculated height modes are providing benefit. If benefit is found the calculated mode filter may be improved by increasing the bandwidth (5% to 10%) and gain (less cut).

For the example room below this corresponds to a height of 2.7m, an increase in bandwidth of any height modes of between 5% and 10%.



As the floor plan of the room is a pure rectangle the width and length of the room are as given (4.3m and 6.15m).

3.4 Approach for rooms which may not be simplified

In many cases the floorplan of a room may be too complicated to reduce to a simplified rectangular shape. Often, if the room is highly irregular, this may not be too much of a problem as there will be few parallel surfaces between which strong room modes will occur. In other cases where parallel surfaces are evident but the room is impractical to simplify the use of custom filters may prove useful.

This section introduces several such spaces and provides guidance on how to tackle the room mode solution through both the room mode optimisation algorithm as well as the application of custom filters.

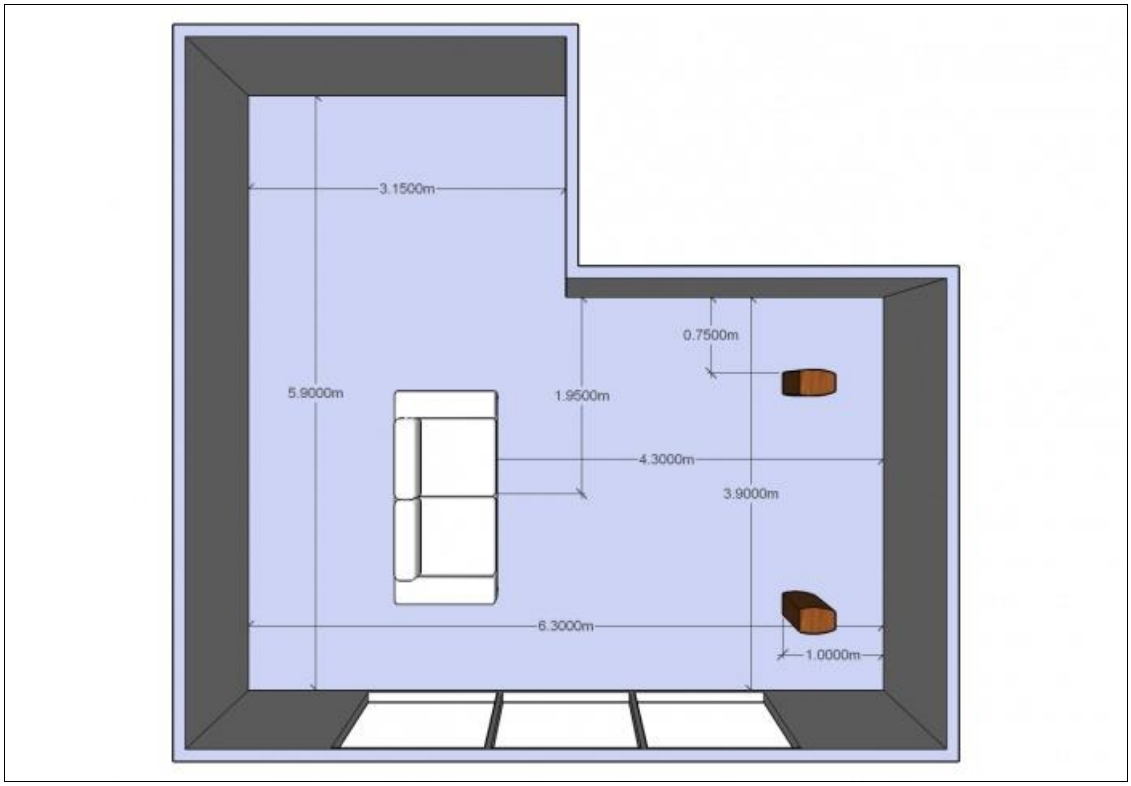
3.4.1 Example room 4, L-shaped

A more challenging room shape to configure for room mode optimisation is an L-shaped room. The approach adopted will often depend on the location of the loudspeakers and listening position within the room.

The layout presented below presents quite a dilemma with regard to simplifying the room to a rectangular form. In this case the L-shape splits the room in half along the longest dimension. This makes it impossible to apply the approach where a dimension is dictated by the largest parallel surface of opposite walls (remember the bay window example). If the L-shape had split the room off-centre the choice of room dimensions would be simplified.

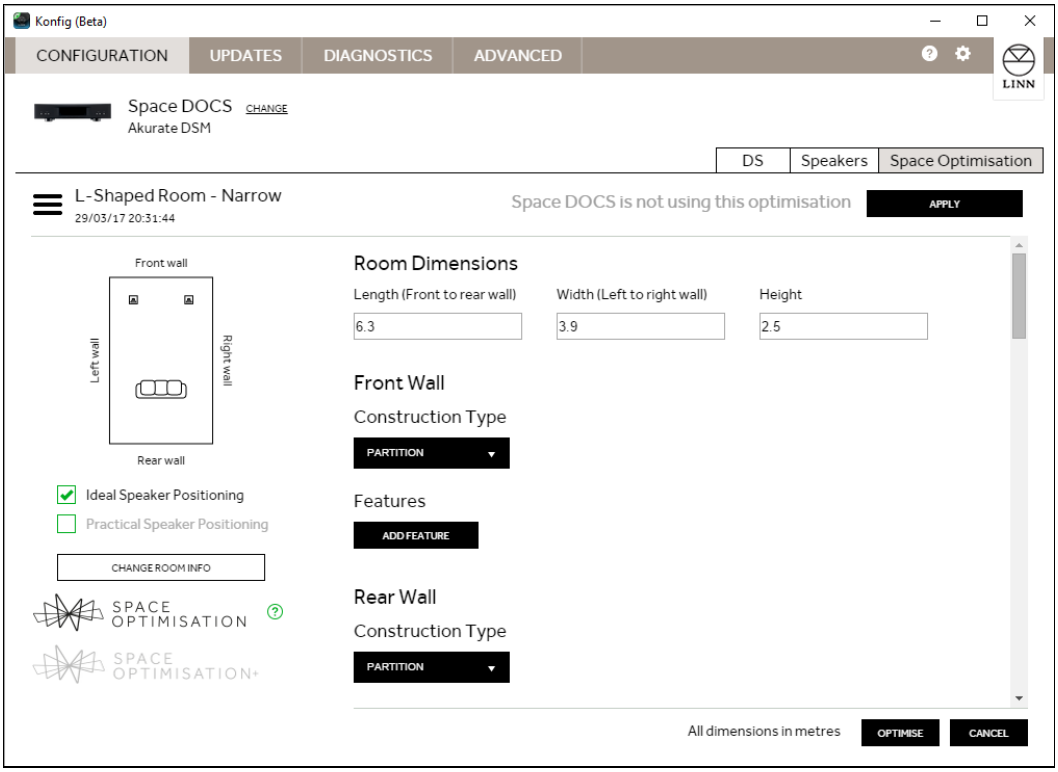
Taking the layout presented below, depending on the location of the loudspeakers and listening position there exist three sets of dimensions which could be appropriate for specifying the room in Konfig, namely; 6.3m by 5.9m, 3.9m by 6.3m, or 3.15m by 5.9m.

It may be that the best solution to the problem would be a combination of the mode solutions from two of these possible sets of dimensions. This was a principle reason for the addition of custom filters in Space Optimisation.



For this example, the loudspeakers are placed on the right side across the 3.9m width firing along the 6.3m length of the room. The initial rectangular layout would have a length of 6.3m and a width of 3.9m.

Let us set the listening position at 4.3m from the front wall, central with regard to the loudspeakers. The loudspeakers, a pair of Akubariks, are placed 1m from the front wall and 0.75m from the side walls.

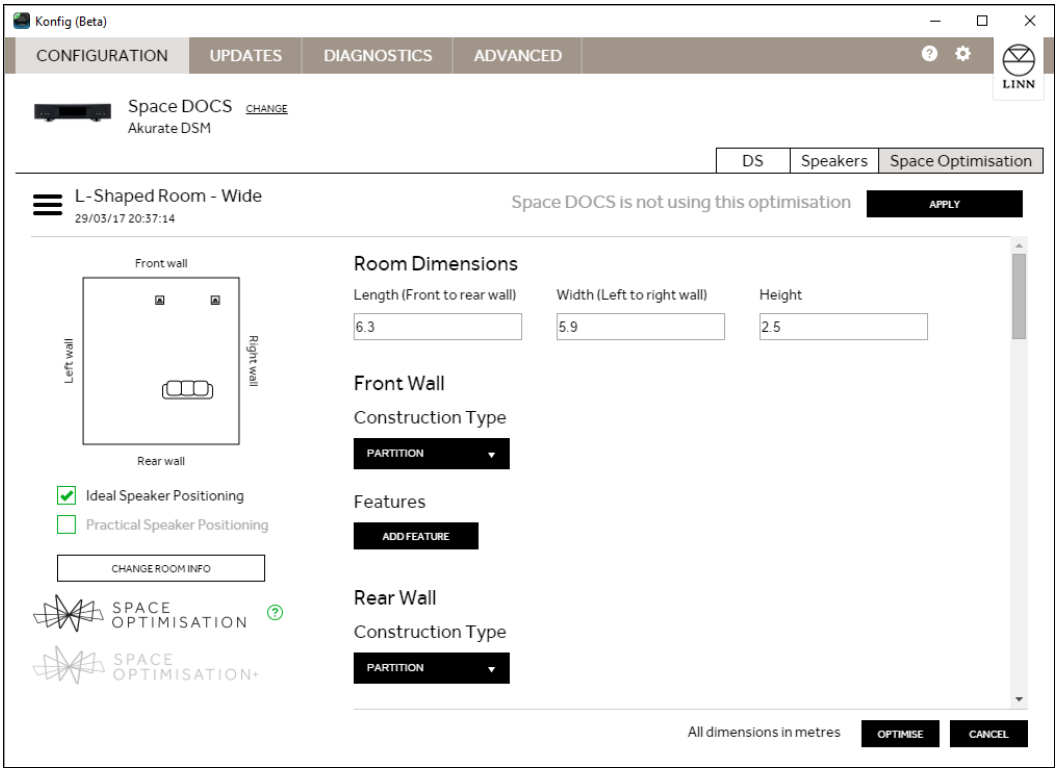


The first model room mode algorithm predicts the following four modes:

Calculated Mode	***Channel***	***Frequency (Hz)***	***Gain (dB) L/R***	***Bandwidth (Octaves)***
ROOM MODE 1 [L--]	L/R	27.30	-27.59/-27.59	0.196209
ROOM MODE 2 [L--]	L/R	54.60	-16.50/-16.50	0.098161
ROOM MODE 3 [--H]	L/R	68.80	-12.31/-12.31	0.077911
ROOM MODE 4 [L-H]	L/R	74.02	-13.11/-13.11	0.072419

All four modes are common to both speakers, a result which is unsurprising due to the symmetry of the set-up within the model. Following the tune-dem process outlined in section 3.2, all modes are found to be valid but the room still sounds modal.

A second model is then produced extending the left wall to the full extent of the L-shaped room. The rectangular layout now has a length of 6.3m and a width of 5.9m. The listening position and left hand speaker move 2m further from the left wall.



The room mode algorithm predicts 9 room modes:

Calculated Mode	***Channel***	***Frequency (Hz)***	***Gain (dB) L/R***	***Bandwidth (Octaves)***
ROOM MODE 1 [L--]	L/R	27.30	-24.91/-23.06	0.173860
ROOM MODE 2 [LW-]	R	39.94	0.0/-19.91	0.118881
ROOM MODE 3 [L--]	L/R	54.60	-13.22/-14.87	0.086969
ROOM MODE 4 [-W-]	L/R	58.31	-16.86/-15.31	0.081449
ROOM MODE 5 [LW-]	R	61.90	0.0/-13.91	0.076722
ROOM MODE 6 [LW-]	L	64.38	-15.97/0.0	0.073765
ROOM MODE 7 [--H]	L/R	68.80	-7.71/-9.61	0.069027
ROOM MODE 8 [L-H]	L	74.02	-11.38/0.0	0.064161
ROOM MODE 9 [LW-]	L	79.88	-10.27/0.0	0.059453

The large number of modes is principally due to the off-centre set-up within the room, a situation which is characterised by the prevalence of single speaker modes.

Using the room mode validation process detailed in section 3.2 modes 2, 6 and 9 are found to offer no improvement so can be set to zero.

All four room modes identified in the first model are present in the second, confirming the result of the tune-dem evaluation already conducted, though the second model omits the right hand speaker from the mode optimisation at 74.02 Hz.

It should also be noted that all four room mode filters common to both models show reduced gain in the second model. This is due to the increase in absorptive surface area and increased room volume in the second room model. Since we know that the total absorptive surface area of the actual room is larger than that of the initial room model it is likely that all mode filters produced in the first model will benefit from a reduction in their impact (reduced cut).

Following the process detailed in section 3.2.2 each of the remaining room mode filters was adjusted using tune dem. A custom filter is added to provide some filtering for the right speaker for the room mode at 74.02 Hz. The filter is applied using the bandwidth calculated from the initial model. The gain of ROOM MODE 8 is reduced such that, when added to the custom filter, the amount of cut applied to the left speaker is equal to that calculated by the second model.

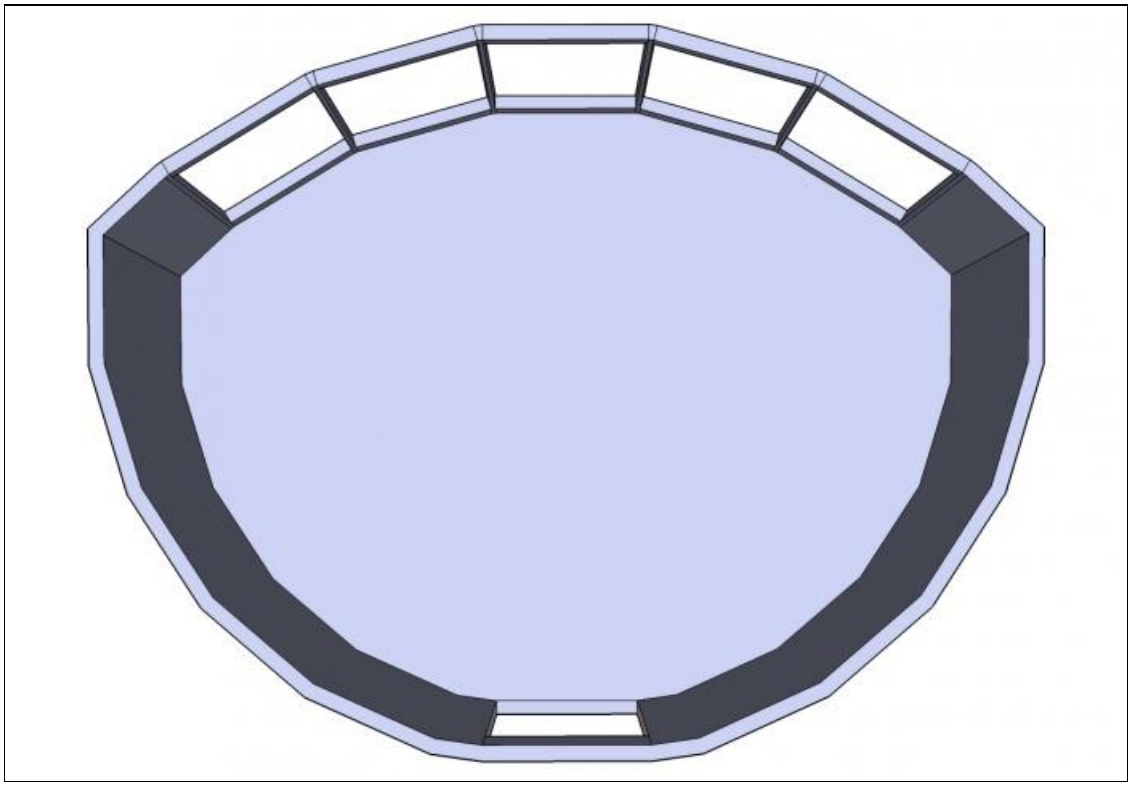
Calculated Mode	*Channel*	*Frequency (Hz)*	*Gain (dB) L/R*	*Bandwidth (Octaves)*
ROOM MODE 1 [L--]	L/R	27.30	-24.91/-23.06	0.196209
ROOM MODE 2 [LW-]	R	39.94	0.0/0.0 (OFF)	0.118881
ROOM MODE 3 [L--]	L/R	54.60	-13.22/-14.87	0.086969
ROOM MODE 4 [-W-]	L/R	58.31	-6.86/-5.31	0.081449
ROOM MODE 5 [LW-]	R	61.90	0.0/-9.91	0.076722
ROOM MODE 6 [LW-]	L	64.38	0.0/0.0 (OFF)	0.073765
ROOM MODE 7 [--H]	L/R	68.80	-4.71/-6.61	0.069027
ROOM MODE 8 [L-H]	L	74.02	-5.38/0.0	0.064161
Custom Filter	L/R	74.02	-6.0/-6.0	0.072419
ROOM MODE 9 [LW-]	L	79.88	0.0/0.0 (OFF)	0.059453

3.4.2 Example rooms 5, 6 and 7, non-modal rooms

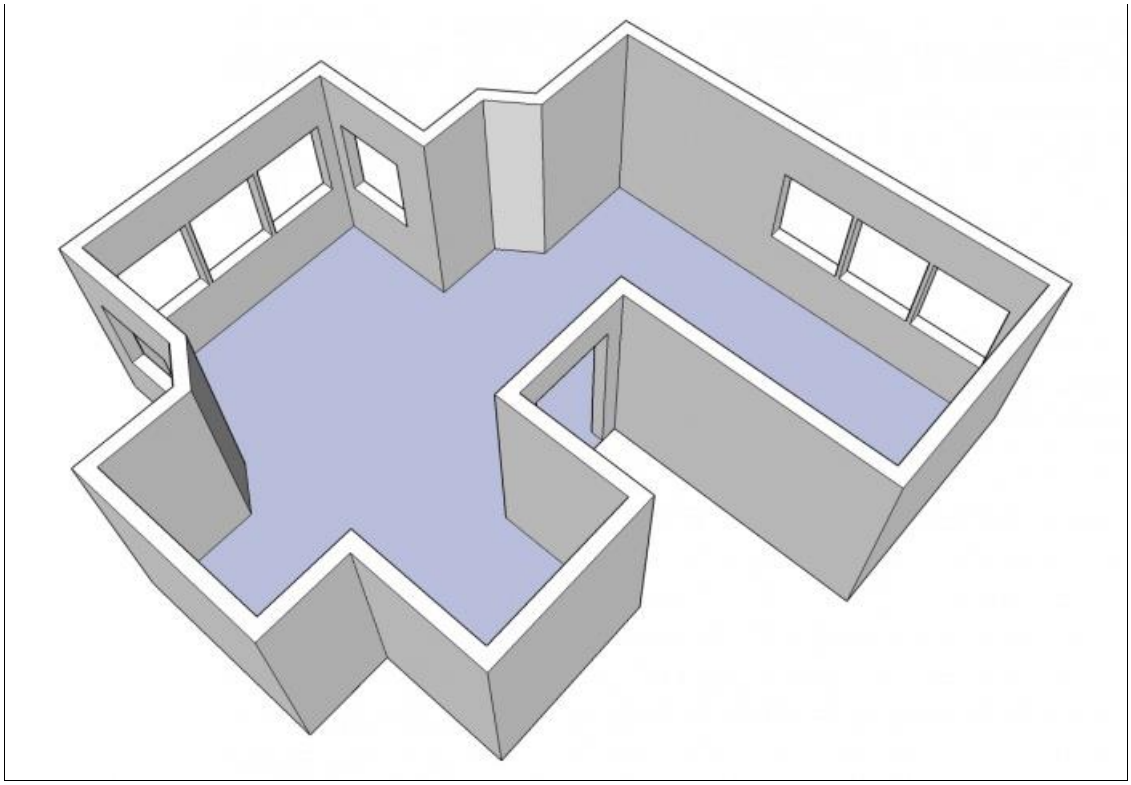
A room mode is set up when a sound-wave whose half-wavelength coincides with the distance between parallel walls. As a result, rooms of highly irregular floorplan, those with significant curved walls or those with predominantly non-parallel surfaces will often exhibit very few room modes.

In such cases it is necessary to identify any large parallel surfaces in the room (often the floor and ceiling) and target the room model to focus on these surfaces.

Example room 5: Curved walls



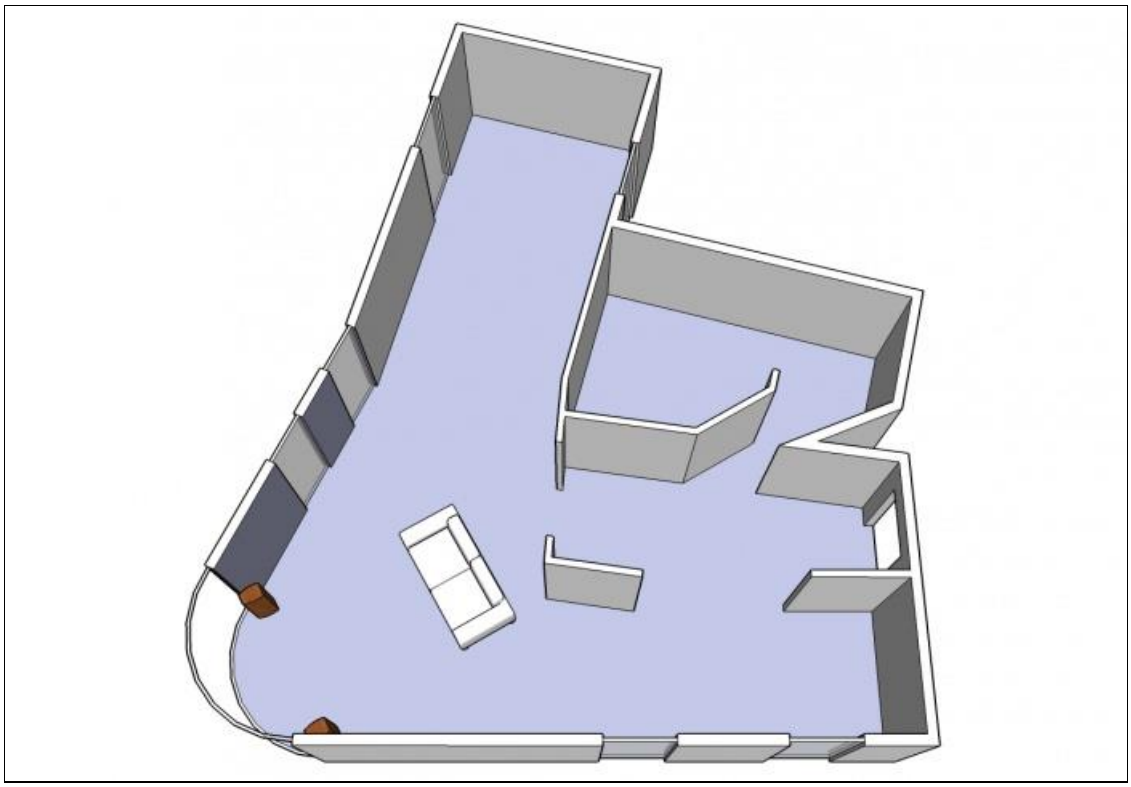
Example room 6: Irregular floorplan



In the two room examples above it is highly unlikely that any room modes relating to the length or width of the room will dominate the sound-field at the listening position. But both cases, assuming the floor and ceiling are parallel may exhibit height modes. In such cases it is useful to describe the room with an arbitrary floorplan large enough to encompass the loudspeakers and listening position, but to accurately specify the ceiling height.

When Konfig produces its room mode optimisation filter estimate set all mode filters to zero gain, except the height modes (those with the suffix **[--H]**). Use the tune dem approach detailed in section 3.2 to assess the validity of the height modes.

Example room 7: Non-parallel walls



The final example room (example 7), one with essentially non-parallel walls should be treated in the same way as the curved wall and irregular floorplan rooms. Two additional features of this example installation may benefit from the application of custom filters.

The first likely issue is the anteroom adjoining the listening space with an open doorway. This may exhibit a resonance separate from the principle listening space. Little can be done to model this room and its impact on the room mode solution, but a custom filter may be applied to reduce its impact on the performance of the system. Setting the custom filter could be done by analysing the anteroom issue with a third party acoustic measurement acoustic system, though it is likely that a good result could be found tuning the filter by ear. Set the custom filter a reasonably wide bandwidth and a gain of -10 dB, adjust the frequency until the impact of the anteroom resonance on

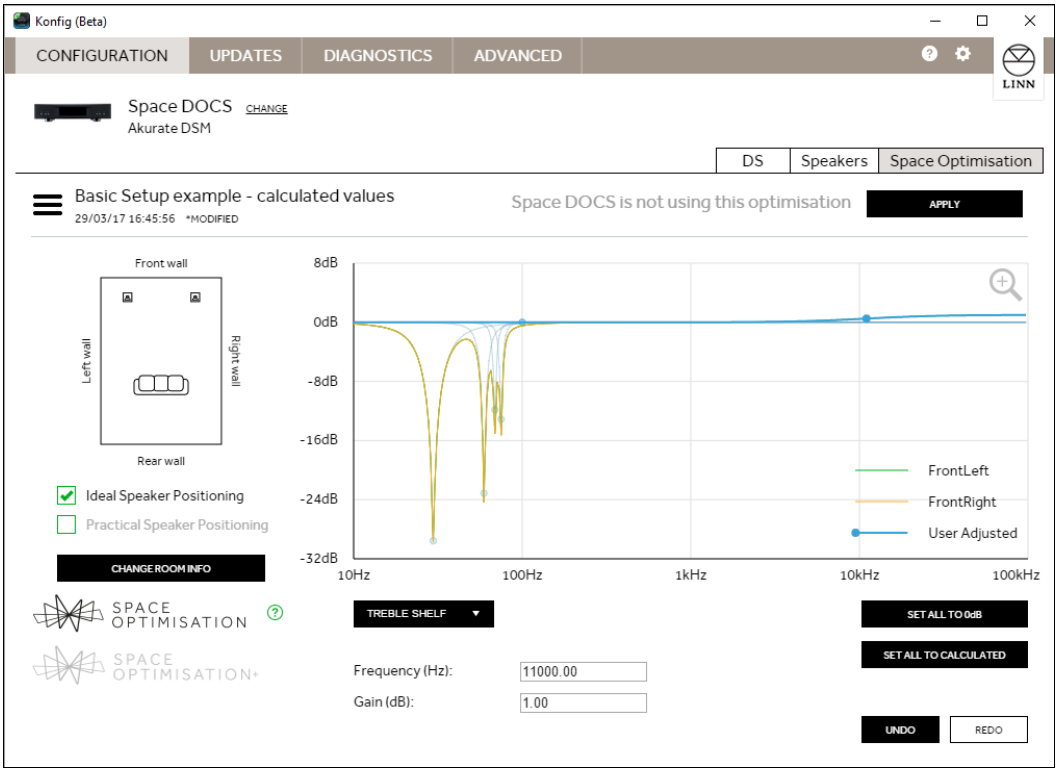
the music is reduced. Now the filter is roughly centred apply the tune-dem to gradually fine tune the bandwidth, gain and frequency.

A second likely problem with the installation is the close proximity of the speakers to the sidewalls. This may well result in excess boundary support in the upper bass and lower midrange. Placement optimisation is designed to function when the loudspeaker is bounded by two perpendicular planes, in other words the speaker should be located near the corner of a room. In the example above neither speaker is located in a true corner so placement optimisation will be unable to accurately resolve the tonal issues due to this loudspeaker placement. A custom filter should be applied. Set the frequency to lie in the problem range, around 140 Hz. Give the filter a wide bandwidth, ~ 3 octaves and a gentle cut of about 2dB. Use the Tune-dem to adjust the filter.

3.5 Bass and Treble shelves

An additional pair of filters is available in Space Optimisation and Space Optimisation+, namely the bass and treble shelves. These may be considered as a highly flexible and customisable equivalent to a classic tone control.

The treble shelf can be varied between + 2dB and -2dB with a corner frequency between 8 kHz and 12 kHz. For rooms with a large amount of soft furnishings, or for installations where the listening position is further from the loudspeakers than is typical the high frequency shelf can be employed to add lift to the treble. Conversely if the room contains mainly hard reflective surfaces some cut may be required to calm to top end of the music spectrum. When applying a treble shelf ensure you click on the magnifying glass symbol on the plot area to ensure you get a visual representation of the filter being applied.



The low frequency shelf can apply cut or boost to low frequencies with a corner between 20Hz and 200Hz. The limits of cut and boost are specific to each model of speaker but typically cover the range -6dB to + 3dB. It is generally advisable when applying boost to set the corner frequency at 65Hz or lower to avoid disrupting the vocal presentation of the system.

Both treble and bass shelves are user configurable and the tune-dem should be utilised when making adjustments

4 Significant changes to Space Optimisation within Konfig

This section details the more significant changes to the application of Space Optimisation and Space Optimisation+ within Konfig.

In instances where a DS or DSM was previously running an analogue system and the customer has upgraded to Exakt there is a requirement to de-select the original speakers from the analogue output channels. This is detailed in section 4.1.1.

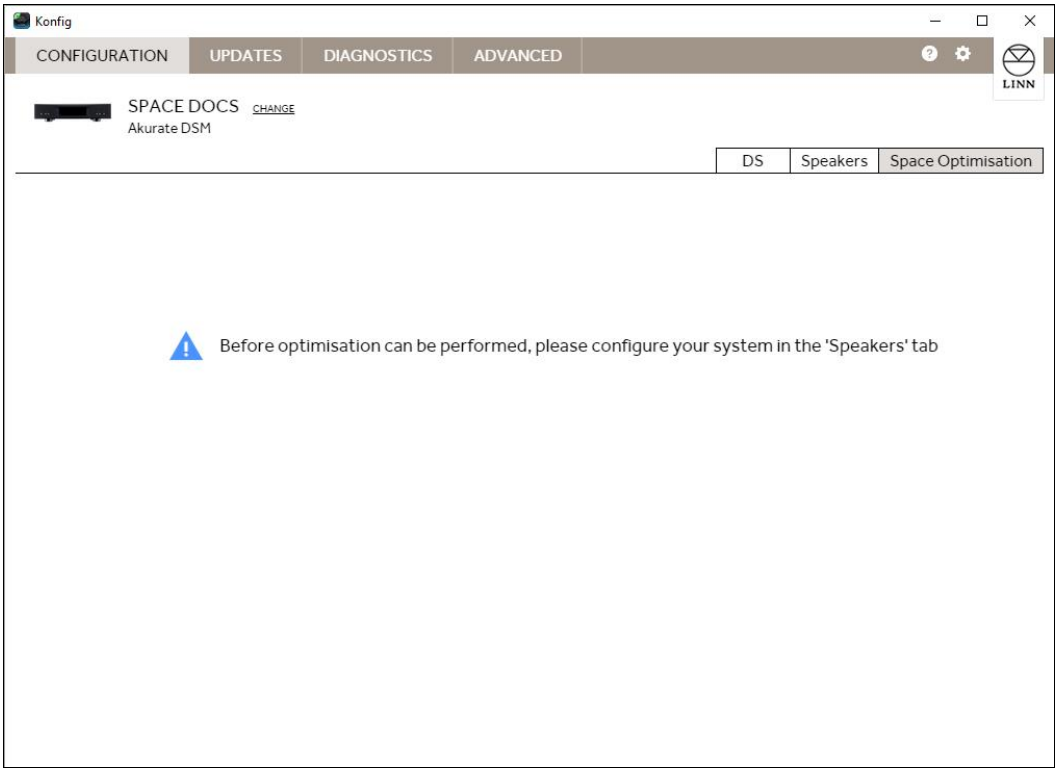
In instances where a system has previously been optimised and the original optimisation is imported some confusion may arise, details are presented in section 4.2.

The new room mode optimisation algorithm will often produce more optimisation filters for a given room that was seen from earlier versions of Space Optimisation. This is to be expected, the reasons are detailed in section 4.3.

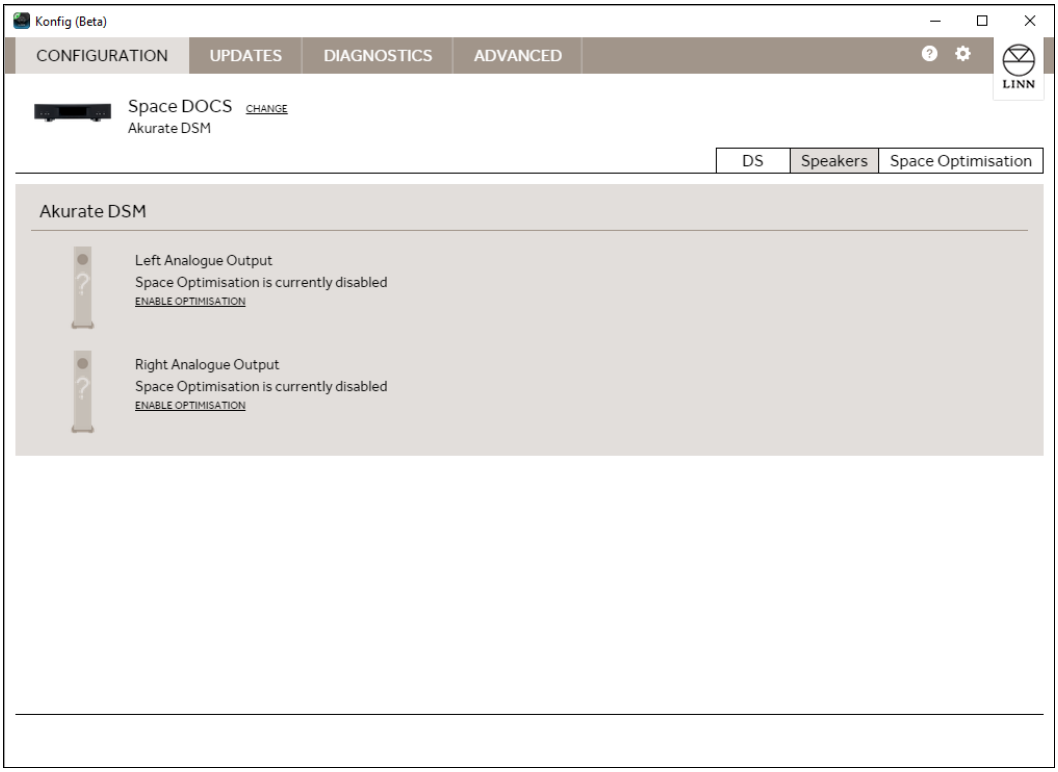
4.1 Speaker selection

In previous versions of Space Optimisation the selection of connected analogue speakers was performed as part of the room definition stage ('CHANGE ROOM INFO' within Space Optimisation). Speaker selection is now performed in a separate tab and must be completed before Space Optimisation can be accessed.

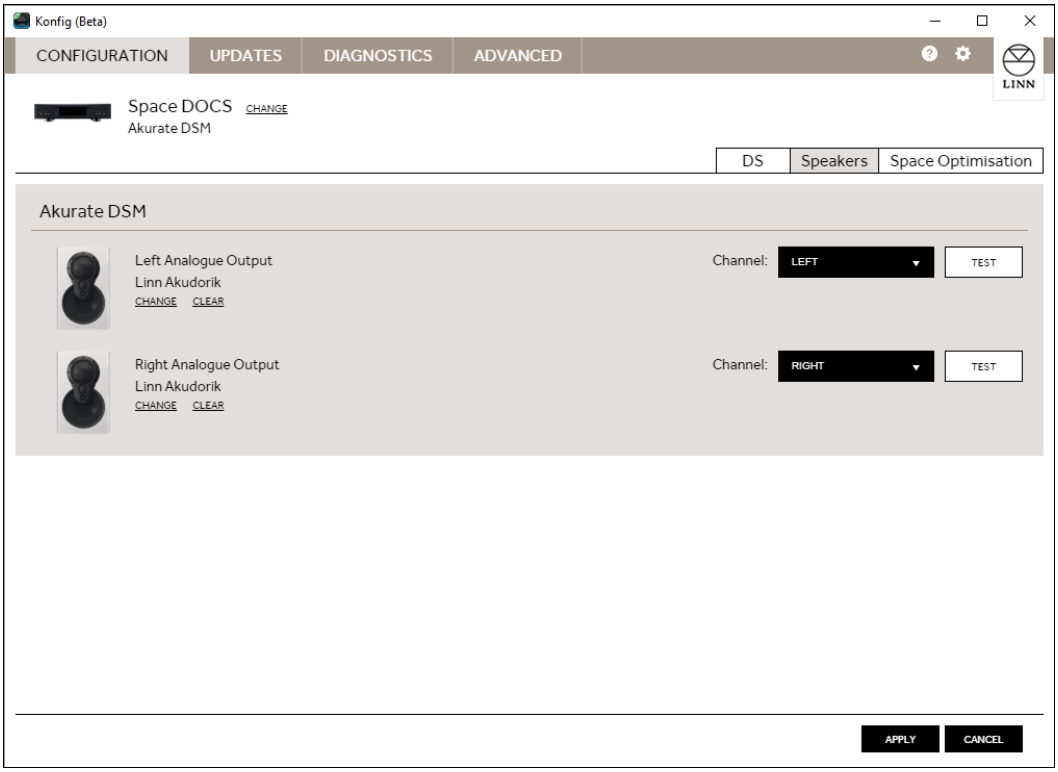
If you select the Space Optimisation tab with no speakers selected you will see the message:



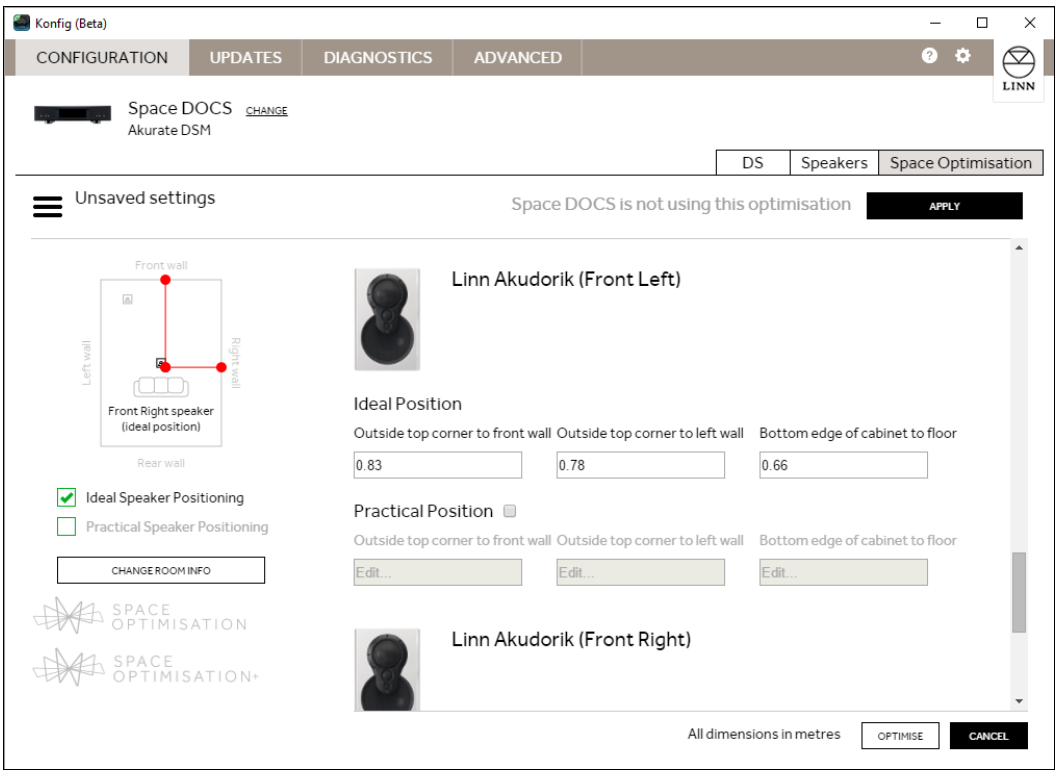
Go to the 'Speakers' tab and for each speaker click on 'ENABLE OPTIMISATION', you will then be prompted to selected the manufacturer and model of your loudspeakers.



The speakers will automatically assign channels ‘LEFT’ and ‘RIGHT’, click ‘APPLY’ and after a moment you will see the message ‘Updates successfully applied’.



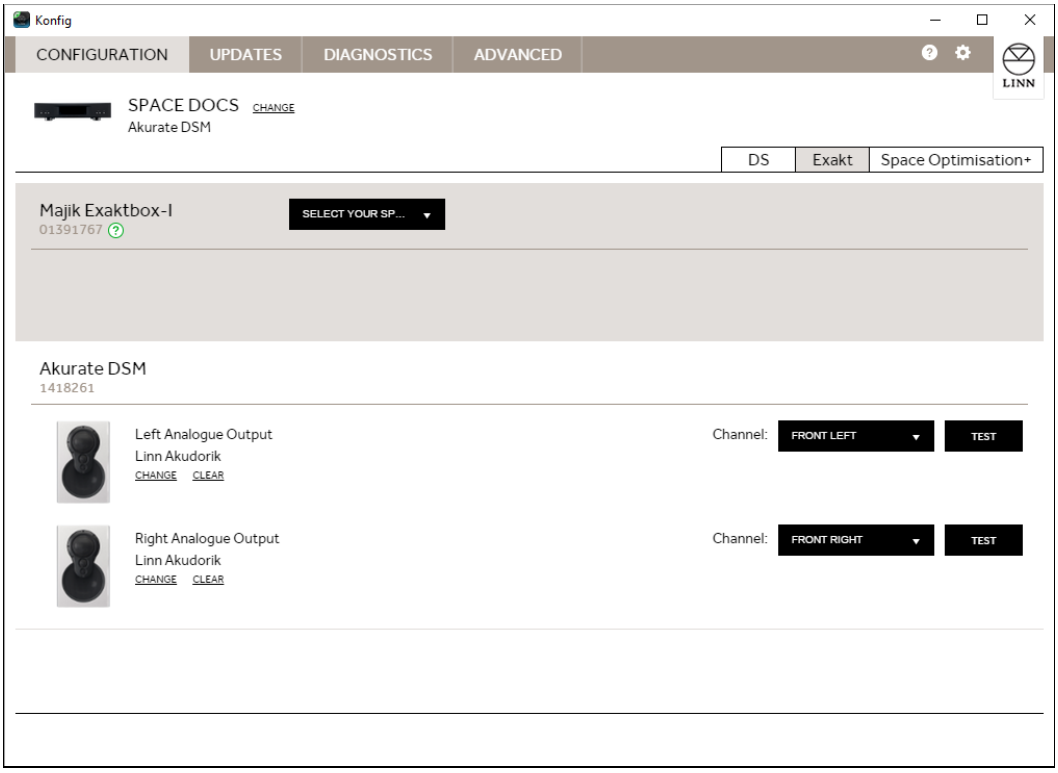
Once the analogue speakers have been selected they will automatically appear in the Space Optimisation set-up.



4.1.1 Disable analogue speakers for stereo Exakt systems

If a system is being upgraded to Exakt, either with integrated Exakt speakers or an Exaktbox, you will need to de-select the previously assigned speakers for the analogue outputs. If this operation is not performed two sets of loudspeakers will be introduced to the Space Optimisation model.

Click on the 'Exakt' tab as normal when assigning Exakt integrated loudspeakers or Exaktboxes.



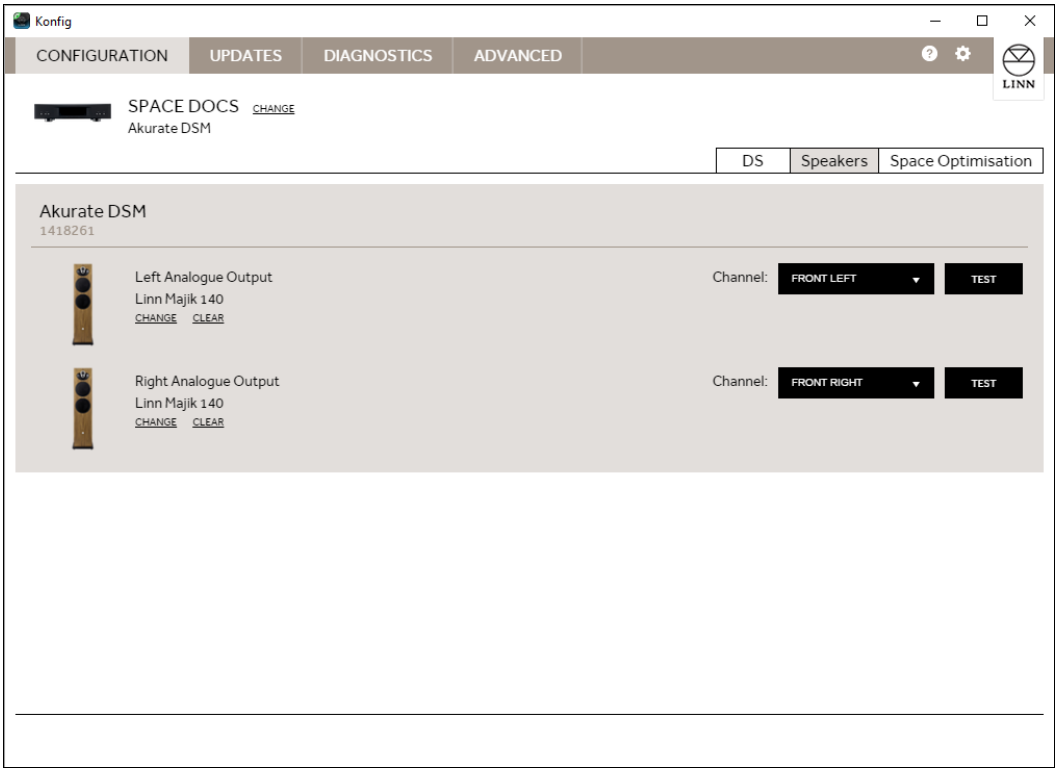
De-select the speakers assigned to the analogue channels by clicking on ‘CLEAR’ for both left and right speakers.

If using an Exaktbox, assign the speakers as normal. Integrated Exakt speakers will automatically populate. Assign the Exakt speakers as left and right and click on ‘APPLY’. Space Optimisation+ will now show a single pair of speakers.

4.2 Importing a previous optimisation

Optimisations made previously can be imported into the new Space Optimisation and can be made to function as expected but care must be taken to ensure they do.

First, for analogue playback systems, ensure the correct speakers are assigned to the analogue outputs.



Click on the ‘Space Optimisation’ tab and select load from the menu, select the optimisation you wish to import and click ‘LOAD’.

You should see the original optimisation presented on the graph area. All mode filters will be common to, and equal for, both loudspeakers. The mode filters will also include any user adjustments previously made and any custom filters or bass/treble shelves will be present.

Click ‘APPLY’ to apply these settings.

DO NOT enter the room set-up ('CHANGE ROOM INFO'), DO NOT press 'OPTIMISE'. Doing so will replace the imported mode filters with a newly calculated set of optimisation filters based on the new optimisation algorithm.

4.3 Why do I get more room mode filters than before?

In earlier versions of Space Optimisation low frequencies were assumed to be mono. As a result both loudspeakers (the stereo pair) were included in a single room mode optimisation calculation. The new algorithm does not apply this assumption; each speaker is now treated independently by the room mode optimisation algorithm.

When a room is acoustically energised at multiple locations with the same signal, depending on the location of the energising sources many modes will effectively cancel themselves out. A stereo system, supplied with a mono bass signal, which is set-up symmetrically within a room, will produce relatively few room modes. Axial width modes (those relating only to the width of the room) will often cancel, tangential and oblique modes which include the width of the room may also be significantly reduced in their intensity.

As the new algorithm now calculates the modal optimisation for each individual loudspeaker you will see more correction filters being applied. Whilst the apparent complexity of the solution may seem daunting, the benefit of this approach is quite audible, and the amount of post optimisation modification of the room mode filters is significantly reduced. As the output of each individual speaker is now pre-optimised to account for the room interaction the perceived stereo balance will be better, especially for non-symmetrical set-ups.