

## Space Optimisation

Revision 3.0, September 24, 2018

Space Optimisation is a toolset available to all Linn DS/DSM system owners which uses highly sophisticated acoustic modelling to build up a complete picture of how your speakers, their placement, and the unique characteristics of your room interact to affect the sound you hear. Space Optimisation takes account of the characteristics of your speakers, such as the position of each drive unit and the response of bass reflex ports, and of the characteristics of your room, such as room dimensions, construction materials, and features like doors and windows, to accurately model these interactions. It then precisely identifies frequencies that are artificially distorted by your environment, and reduces their energy, to reveal the music that would otherwise be hidden. It also applies a delay to each speaker to ensure the content from each speaker reaches your ears at the same time.

Given any and all external inputs to a Linn DS/DSM system, Space Optimisation is applied to all analogue outputs. However, note that the SPDIF/TOSLINK, HDMI, and headphone outputs will not output optimised audio, as these outputs pass the unprocessed audio feed.

Significant changes have been made to the application of Space Optimisation through your Linn account. If you have a Linn DS/DSM system optimised through Linn Konfig guidance on importing and applying these optimisations through your Linn account, along with clarification of the general changes, is presented in §1.

The procedure for basic setup of Space Optimisation on Linn DS/DSM systems is then presented in §2.

Finally, the procedure for advanced setup of Space Optimisation on Linn DS/DSM systems is presented in §3.

Note that the application of Space Optimisation<sup>+</sup> to Linn Exakt systems and Linn Exakt/analogue surround systems is currently unsupported through your Linn account; Space Optimisation<sup>+</sup> must still be applied through Linn Konfig.

# Contents

<b>1</b>	<b>Significant changes</b>	<b>4</b>
1.1	Adding your music system to your Linn account . . . . .	4
1.2	Optimisation algorithm updates . . . . .	7
1.2.1	Support for non-rectangular rooms . . . . .	7
1.2.2	Optimisation based on psychoacoustic research . . . . .	8
1.2.3	Optimisation calculation time . . . . .	8
1.3	Importing a previous optimisation . . . . .	8
<b>2</b>	<b>Basic setup</b>	<b>11</b>
2.1	Installing your speakers using Tune Dem . . . . .	11
2.2	Adding your speakers to your music system . . . . .	11
2.3	Optimising your music system for the first time . . . . .	14
2.3.1	Entering your room information . . . . .	14
2.3.2	Entering your speaker and listening locations . . . . .	21
2.3.3	Calculating the optimisation . . . . .	24
2.3.4	Applying the optimisation . . . . .	26
2.3.5	Resuming an incomplete optimisation . . . . .	27
2.4	Re-optimising your music system . . . . .	28
2.4.1	Adding an optimisation . . . . .	28
2.4.2	Adjusting an optimisation . . . . .	29
2.5	Optimisation history . . . . .	30
2.6	Rooms . . . . .	31
<b>3</b>	<b>Advanced setup</b>	<b>33</b>
3.1	Environmental . . . . .	33
3.2	Absorption . . . . .	34
3.2.1	Approximating Floor and Ceiling Features . . . . .	35
3.3	Optimisation preference . . . . .	36

3.4	Simplifying room dimensions . . . . .	37
3.4.1	Rooms with a sloped or pitched ceiling . . . . .	37
3.4.2	Rooms with a stepped floor . . . . .	38
3.5	Virtual Tune Dem . . . . .	40

# 1 Significant changes

In this section the most significant changes to the application of Space Optimisation are detailed.

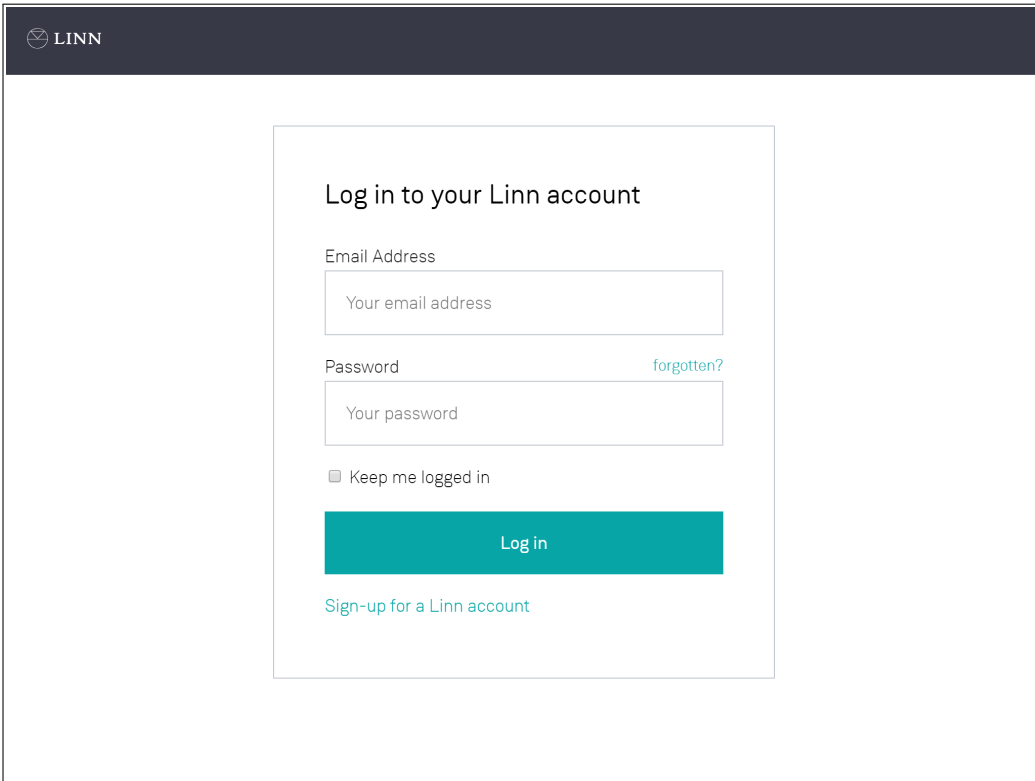
In order to utilise Space Optimisation your music system must be added to your Linn account; this procedure is detailed in §1.1.

The optimisation algorithm has been updated to deliver an improved optimisation; these updates are detailed in §1.2.

Guidance on importing and applying previous optimisations from Linn Konfig through your Linn account are detailed in §1.3.

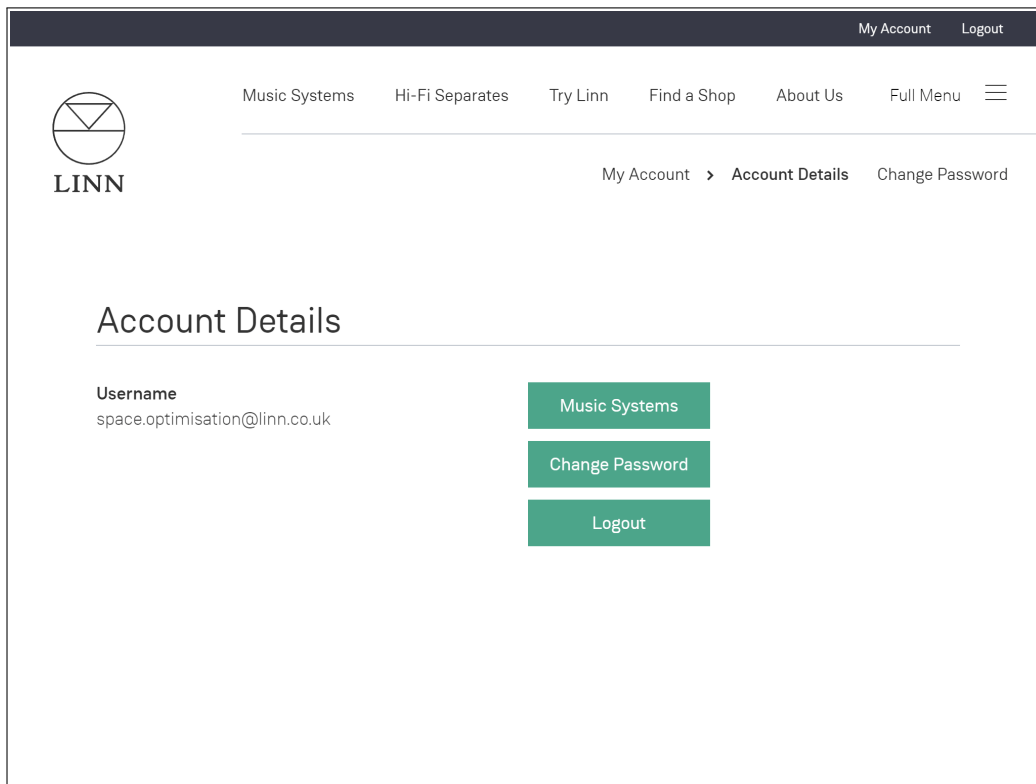
## 1.1 Adding your music system to your Linn account

Navigate to the [Linn account](#) webpage, as shown below, in your browser of choice. If you have already created a Linn account, enter your credentials and click on the **Log in** button; otherwise, click on the **Sign-up for a Linn account** link and follow the instructions to create a Linn account.

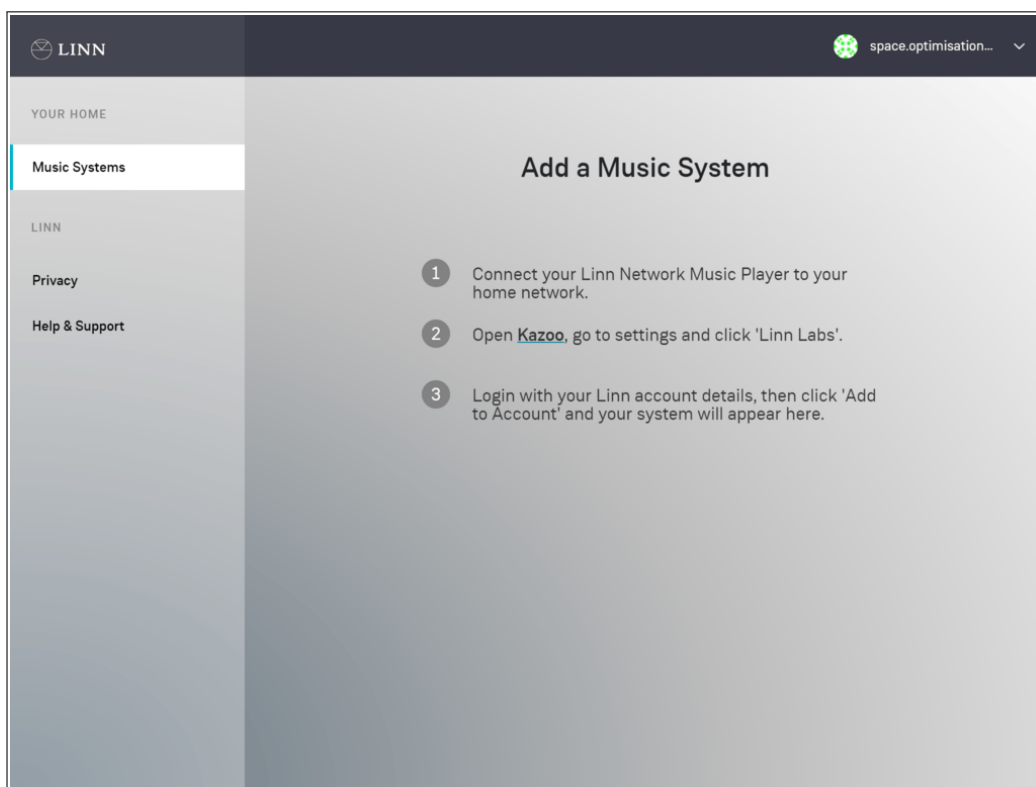


The screenshot shows the Linn account login page. At the top left, there is a dark header with the Linn logo and the word "LINN". The main content area is white and contains a central login form. The form is titled "Log in to your Linn account". It has two input fields: "Email Address" with the placeholder text "Your email address" and "Password" with the placeholder text "Your password". To the right of the password field is a link that says "forgotten?". Below the password field is a checkbox labeled "Keep me logged in". At the bottom of the form is a teal "Log in" button. Below the button is a link that says "Sign-up for a Linn account".

Within your Linn account, as shown below, you can edit your account details or manage your music systems. Click on the **Music Systems** button; you will be taken to the **Music Systems** page.

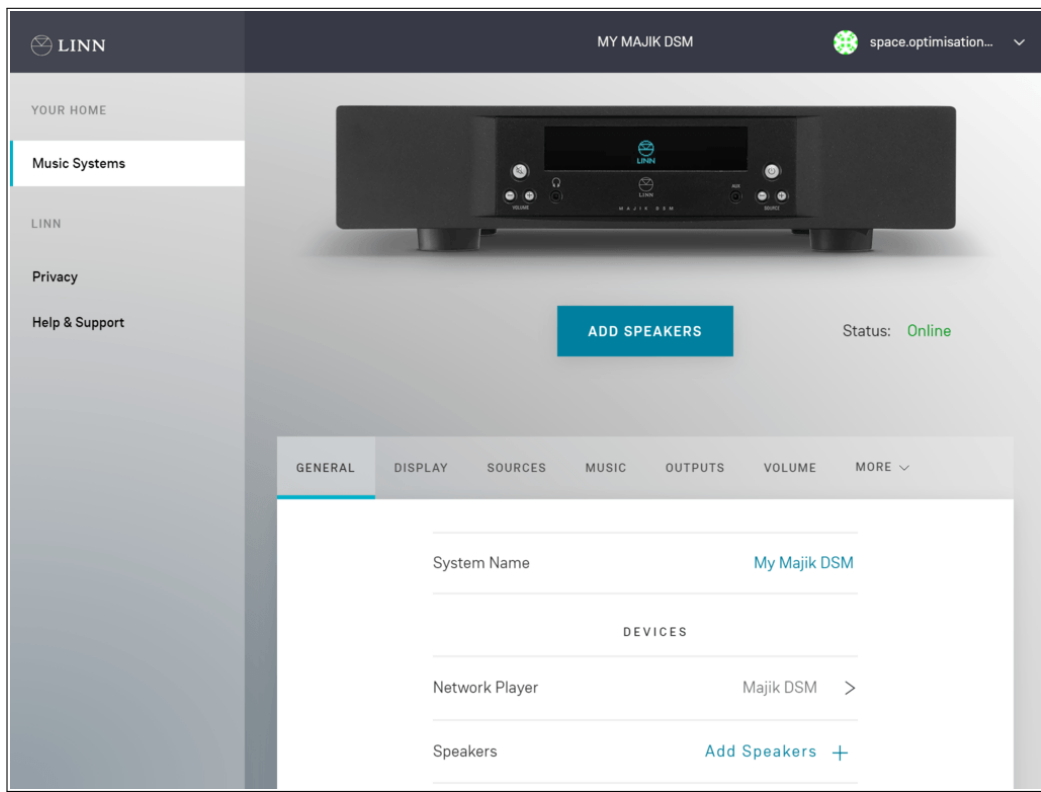


If no music systems have previously been added to your Linn account you will see instructions for adding a music system, as shown below; follow these instructions to add your music system to your Linn account.

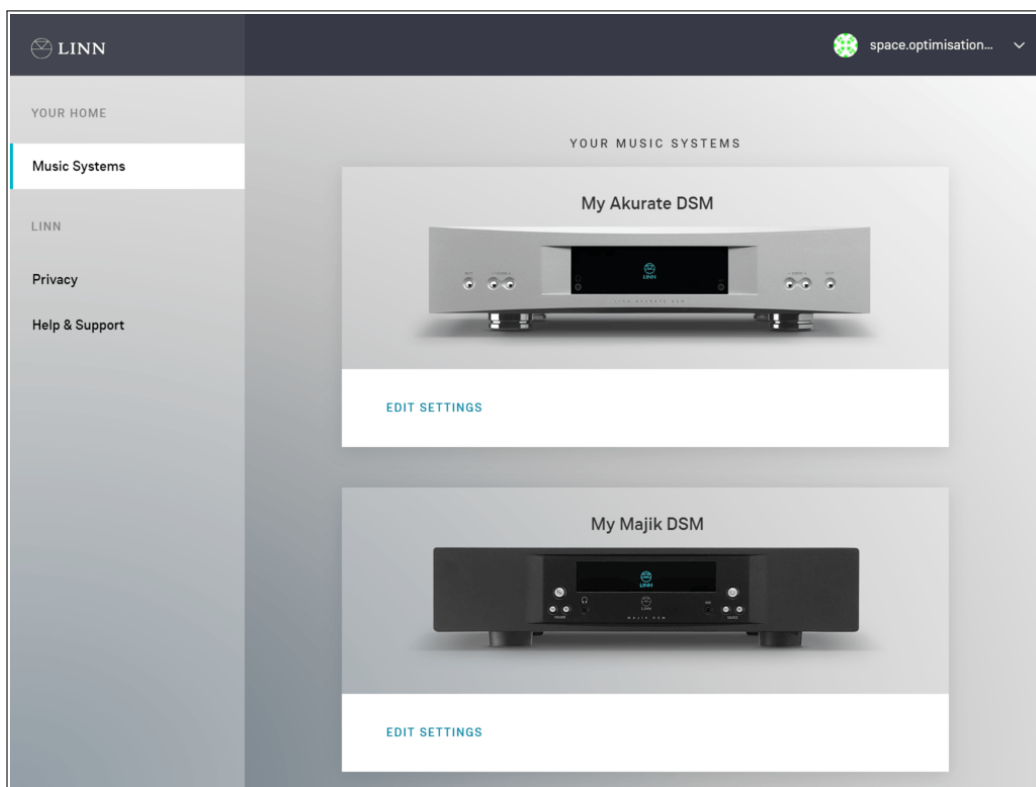


Once your music system has been added to your Linn account it will appear on the **Music Systems** page, as shown below. You can rename your music system at any time by clicking on the system name under

the **General** tab; note that music systems and rooms are now considered as separate entities within your Linn account, therefore when renaming your music system avoid names such as 'Living Room' or 'Kitchen', instead opting for names such as 'My Majik DSM' or 'My Akurate DSM'.



You may also add multiple music systems to your Linn account; each music system will then be listed on the **Music Systems** page, as shown below.



Note that you can remove a music system from your Linn account at any time by clicking on the **Remove Music System** button under the **Advanced** tab on the **Music Systems** page for that system, or through [Linn Kazoo](#).

## 1.2 Optimisation algorithm updates

In this section the most significant updates to the Space Optimisation algorithm are detailed.

The optimisation algorithm has been updated to support non-rectangular rooms; this update is detailed in §1.2.1.

The optimisation algorithm has also been updated based on psychoacoustic research; this update is detailed in §1.2.2.

Finally, the updates to the optimisation algorithm have resulted in a longer calculation time; this issue is detailed in §1.2.3.

### 1.2.1 Support for non-rectangular rooms

In earlier versions of Space Optimisation, previously available through Linn Konfig, all rooms were assumed to be rectangular. This assumption allowed for the use of analytical acoustic modelling of the interactions between your speakers and room; while sufficiently valid for minimally non-rectangular rooms, this assumption was invalid for general non-rectangular rooms. To account for this sometimes invalid assumption users were given the ability to adjust individual room modes and add custom filters in order to arrive at a valid optimisation.

In the new version of Space Optimisation, available through your Linn account, non-rectangular rooms may now be modelled. This new capability is allowed for by the use of highly sophisticated acoustic modelling of the interactions between your speakers and room; validity is thus assured for all rooms. Due to this assured validity the ability to adjust individual room modes and add custom filters has been removed; any adjustments will now be dictated by either refinements of the model inputs or user preference, and may be made through the advanced settings, as outlined in §3.

Note that rooms with non-flat ceilings or floors are currently unsupported, and so a room simplification procedure must be adopted, as outlined in §3.4.

### 1.2.2 Optimisation based on psychoacoustic research

Psychoacoustic research has shown that listeners have a preference not only to a flat frequency response, but also to a uniform decay time. A non-flat frequency response may be associated with the perception of 'one note bass', where a particular bass note masks other notes around it, leading to a monochromatic bass line. A non-uniform decay time may be associated with the perception of 'boominess', where a particular bass note rings out for longer than other notes around it, leading to a booming bass line.

In earlier versions of Space Optimisation, previously available through Linn Konfig, the optimisation precisely identified frequencies that were artificially distorted by the environment, and reduced their energy to give a flat frequency response.

In the new version of Space Optimisation, available through your Linn account, the optimisation can also identify how these artificial distortions change over time, and reduce their decay times to give a uniform decay time. Furthermore, the optimisation has been updated to give a better balance of low- and mid-frequency energy. The user is also able to adjust the optimisation according to their preference, as outlined in §3.3.

### 1.2.3 Optimisation calculation time

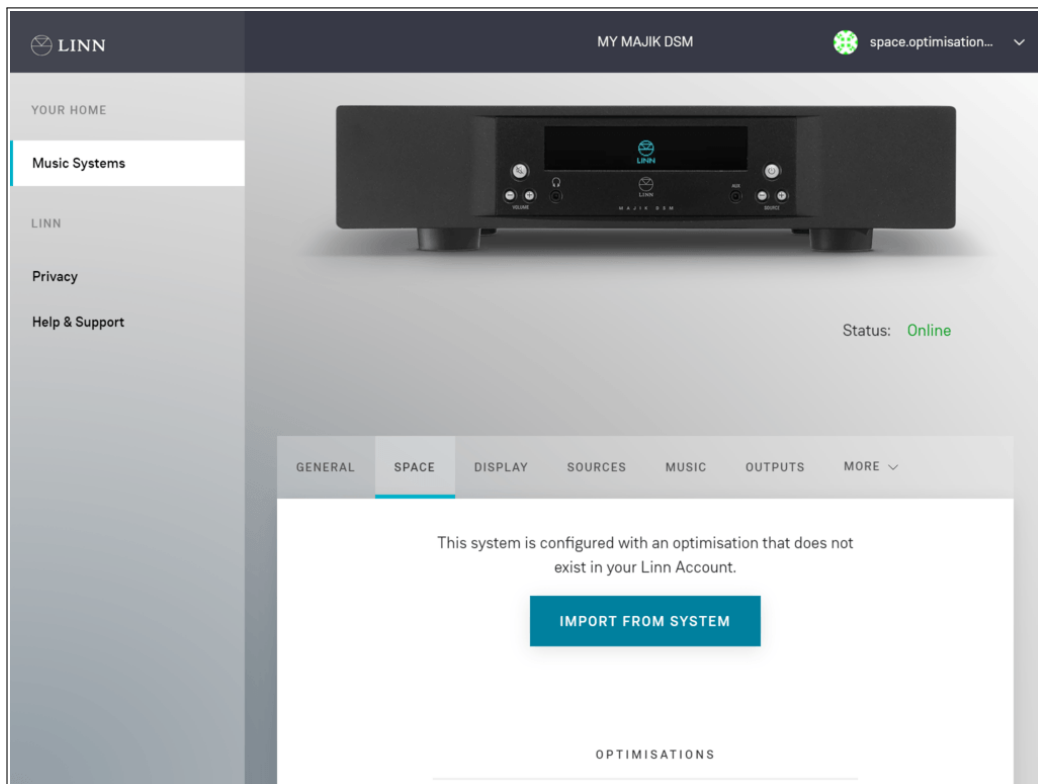
Due to the use of highly sophisticated acoustic modelling in the new version of Space Optimisation, available through your Linn account, optimisations may take slightly longer to calculate than earlier versions of Space Optimisation, previously available through Linn Konfig; this calculation time will depend on your room and speakers, with large rooms containing multiple speakers taking longer to calculate than small rooms containing few speakers.

However, the benefits of the new version of Space Optimisation, outlined in §1.2.1 and §1.2.2, massively outweigh this slight increase in calculation time.

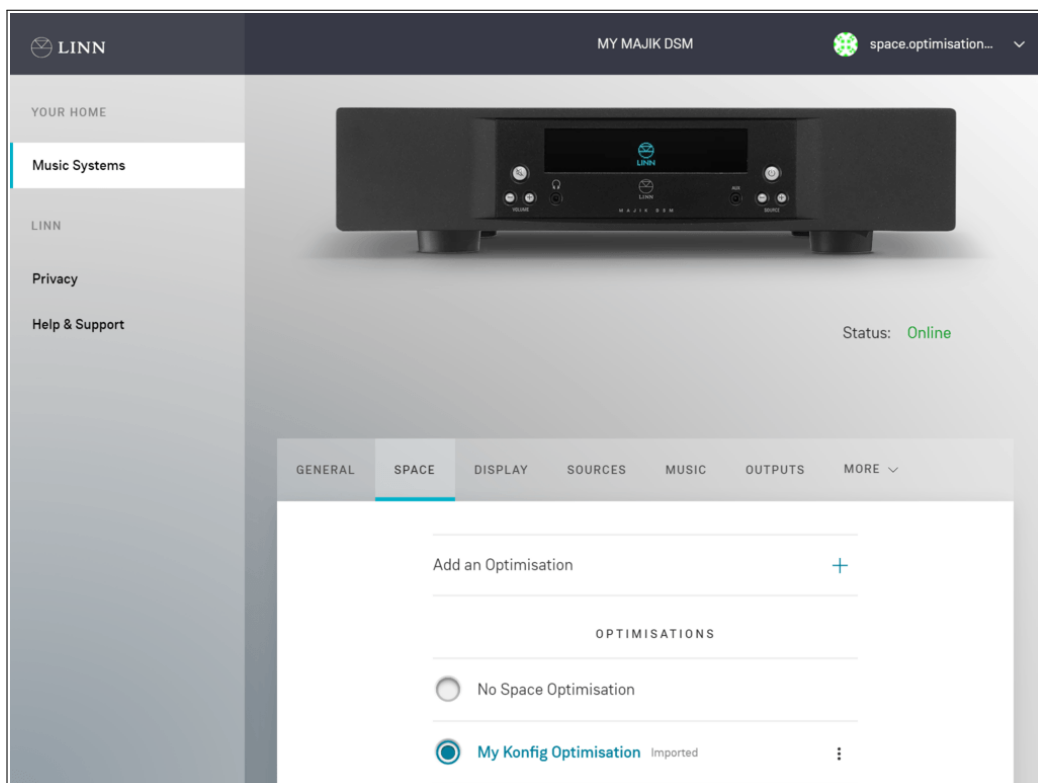
## 1.3 Importing a previous optimisation

In the case that your Linn DS/DSM system has already been optimised, through either Linn Konfig or a different Linn account, a **Space** tab will be visible on the **Music Systems** page for that system, as shown below.





Click on the **Import from System** button to extract the optimisation from your Linn DS/DSM system. The optimisation will be added to a list of optimisations below the **Optimisations** heading; this optimisation will be flagged as being imported, as shown below. Note that this optimisation contains only the resultant data of the optimisation, and not the optimisation inputs such as room information or speaker and listening locations.



Should you wish to import further Linn Konfig optimisations, you may apply these through Linn Konfig whilst logged in to your Linn account, then follow the procedure outlined above to extract them from your Linn DS/DSM system and add them to the list of optimisations. However, it is recommended that you redefine any previous optimisations through your Linn account, in order to take advantage of the improvements in the new version of Space Optimisation over earlier versions.

## 2 Basic setup

Before commencing optimisation please ensure that your music system has been added to your Linn account, as outlined in §1.1.

### 2.1 Installing your speakers using Tune Dem

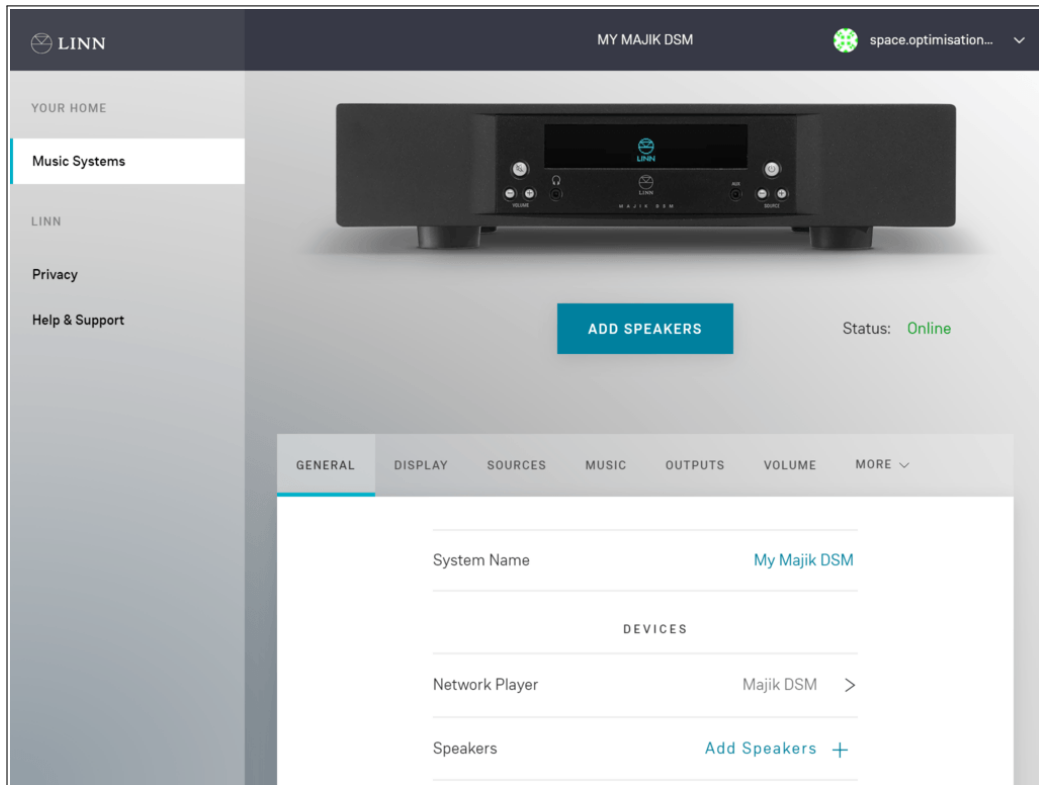
When installing your speakers you should first decide along which axis of the room the speakers should be installed; for example, in a rectangular room the speakers will usually sound best along the short axis of the room. The [Tune Dem](#) method should then be used to find the ideal locations for your speakers; these are the locations where it is easiest to follow the tune. Correct identification of the ideal locations for your speakers is essential if you wish to achieve the full potential of both your music system and Space Optimisation; Space Optimisation is able to recreate the sound of your speakers in their ideal locations, even if you have been forced to move them to a more practical location due to domestic constraints, to give you the best of both worlds.

If you are unsure of how to find the ideal locations for your speakers please contact your expert Linn retailer.

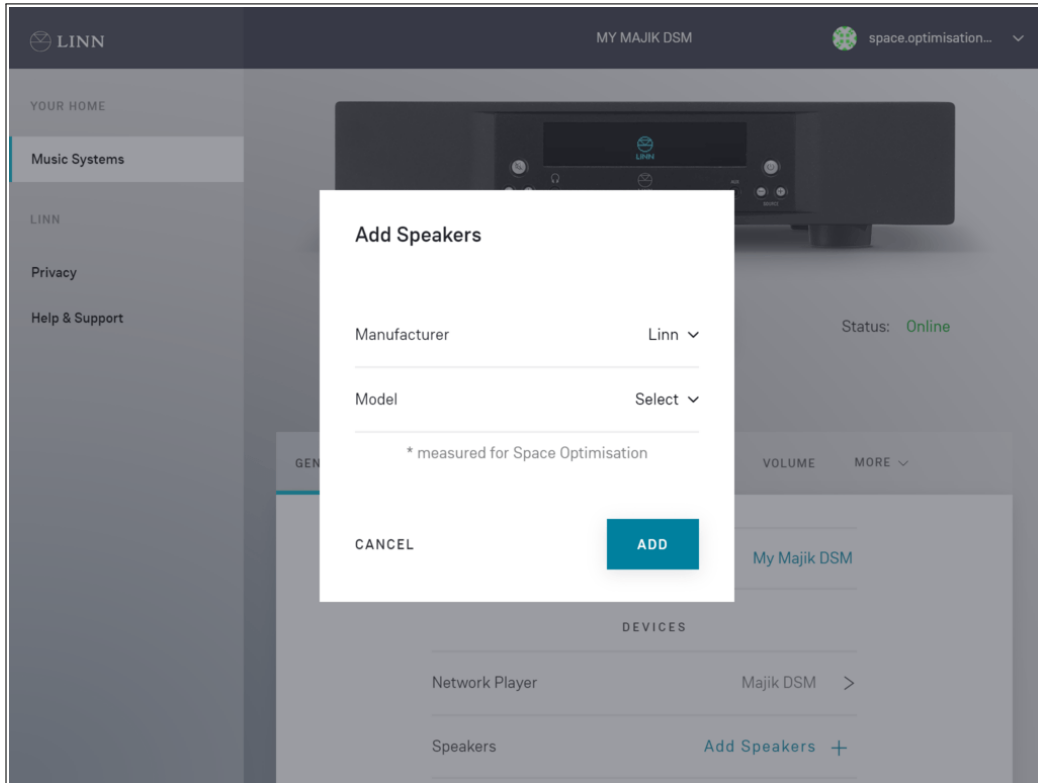
### 2.2 Adding your speakers to your music system

Space Optimisation takes account of the characteristics of your speakers, such as the position of each drive unit and the response of bass reflex ports. You must therefore inform your Linn account of the speakers being used with your music system before Space Optimisation can be applied.

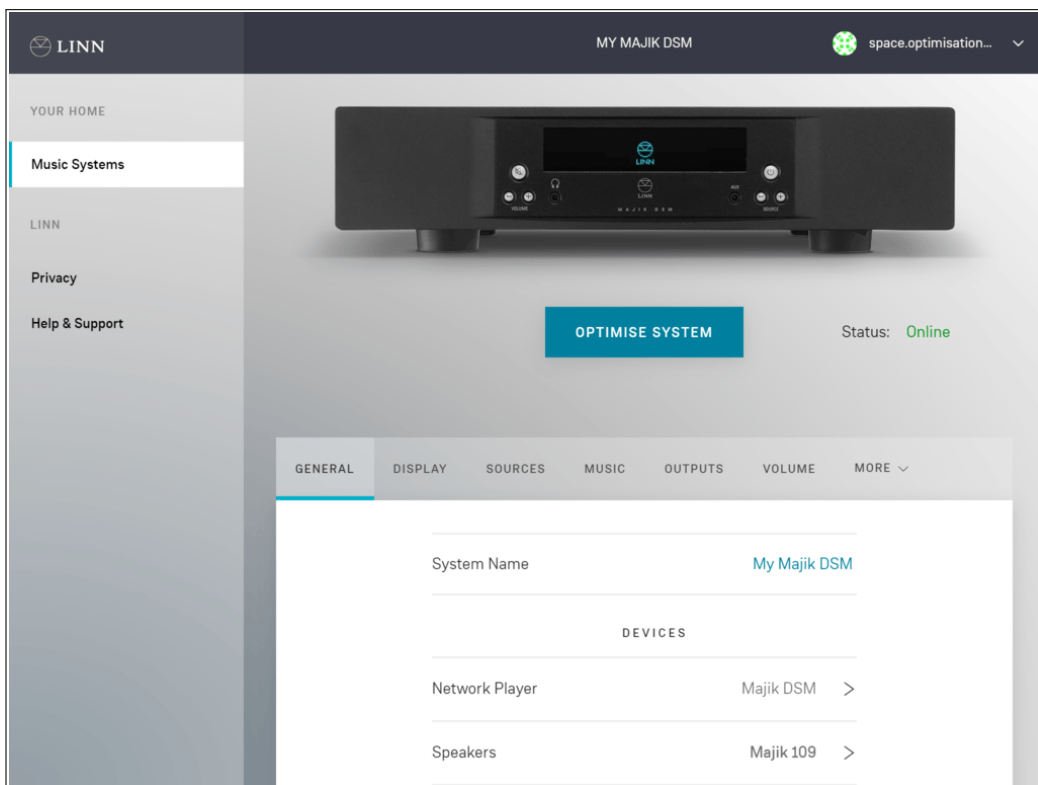
Navigate to the **General** tab on the **Music Systems** page for the system you wish to optimise. If no speakers have previously been added to your music system you will see an **Add Speakers** button below the graphic of your music system, and a similar link under the **General** tab, as shown below.



Click on either the **Add Speakers** button or link; a dialog prompting you to provide the make and model of your speakers will appear, as shown below. Select the make and model of your speakers using the drop-down menus, then click on the **Add** button; if your speakers' make or model does not appear in the drop-down menu, select **Other**. If your speakers have been measured for Space Optimisation an asterisk will appear next to your speakers' model; this means that Space Optimisation can take account of the characteristics of your speakers, such as the position of each drive unit and the response of bass reflex ports. Otherwise, your speakers will be modelled as point sources; this means that you can still benefit from the room and placement optimisation functionality of Space Optimisation.

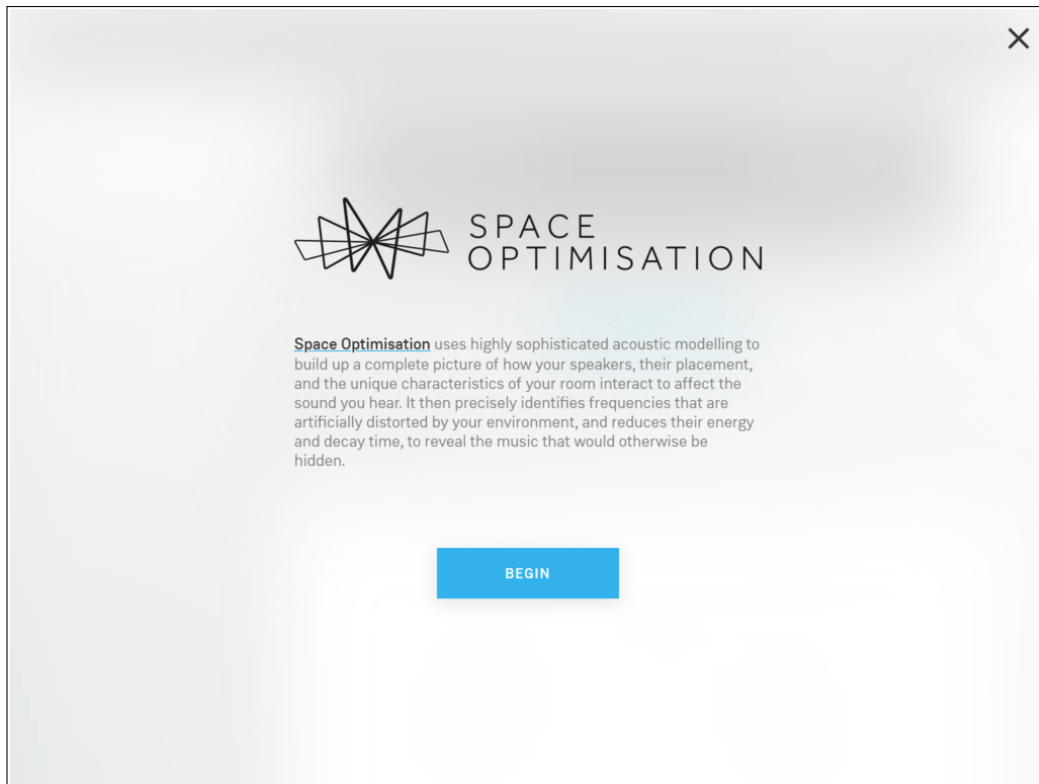


Once your speakers have been added to your music system they will appear under the **General** tab, as shown below; note that you can remove your speakers at any time by clicking on the speakers' name under the **General** tab and clicking on the **Remove Speakers** button.



## 2.3 Optimising your music system for the first time

If you are optimising your music system for the first time you will see an **Optimise System** button below the graphic of your music system, as shown above. Click on the **Optimise System** button; a dialog with a brief explanation of Space Optimisation will appear, as shown below.



### 2.3.1 Entering your room information

Space Optimisation takes account of the characteristics of your room, such as room dimensions, construction materials, and features like doors and windows. You must therefore inform your Linn account of your room information. Your Linn account then stores your room information separately from your music system; this makes it quick and easy to upgrade your music system, or move your music system to a new room.

#### Room name

Click on the **Begin** button; a dialog prompting you to provide a name for your room will appear, as shown below.

✕

## Room Name

Choose a meaningful name for the room where this music system is located, for example **Main Room** or **Kitchen**

Name Main Room

NEXT

Enter an appropriate name for your room, such as 'Living Room' or 'Kitchen', and click on the **Next** button; the Space Optimisation user interface will appear, as shown below. The Space Optimisation user interface has three key stages; **Room Dimensions**, **Room Features**, and **Speaker Locations**.

SPACE OPTIMISATION

MAIN ROOM
✕

ROOM STEPS

Room Dimensions

- Floor Plan ✓
- Height

Room Features

SPEAKER STEPS

Speaker Locations

OPTIONAL STEPS

Environmental

Absorption

Optimisation Preference

5 m

5 m

5 m

5 m

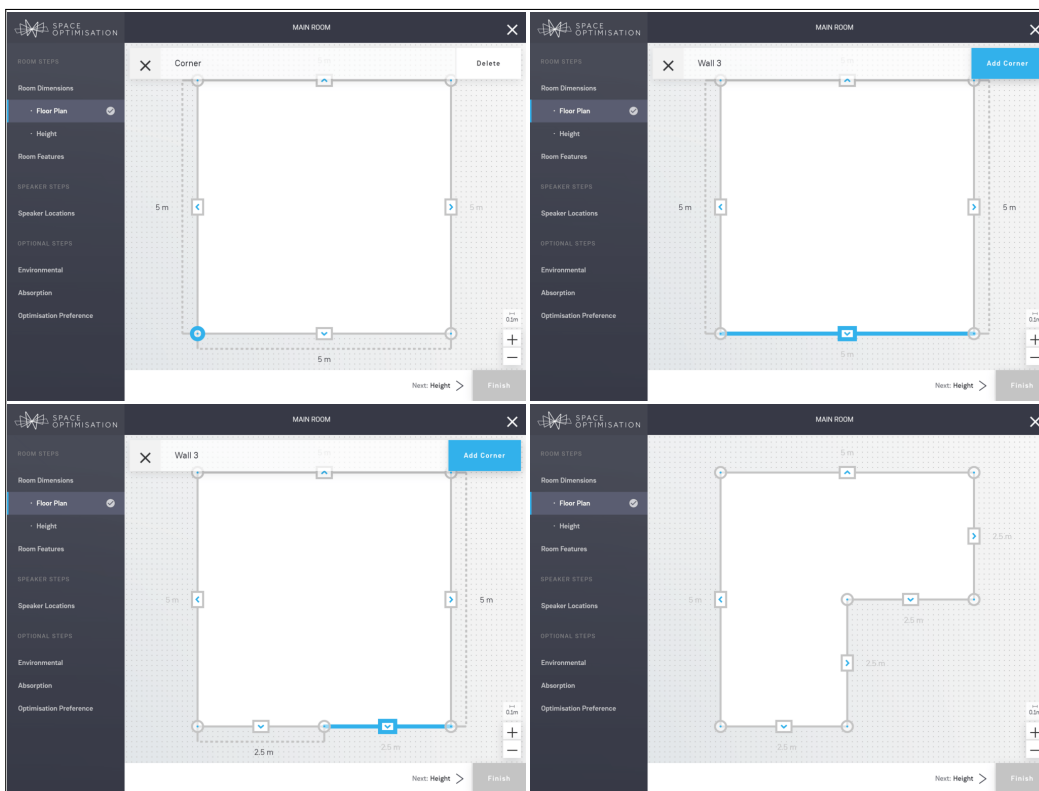
0.1m  
+  
-

Next: Height >
Finish

## Room dimensions

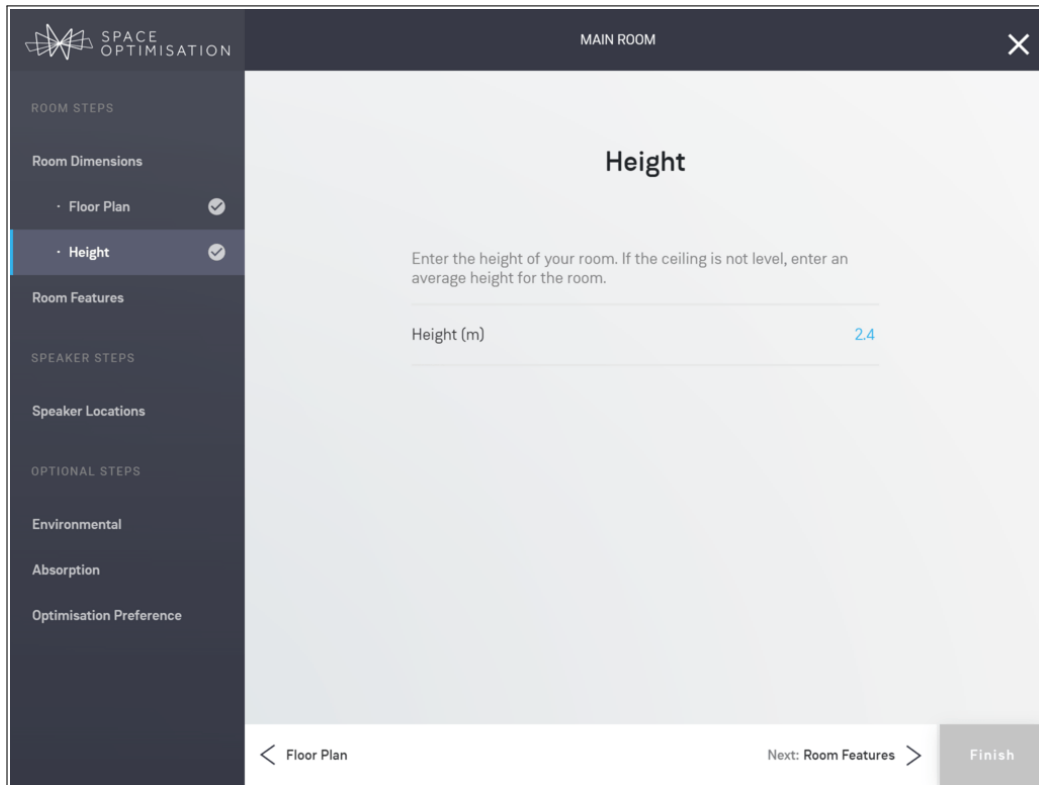
In order for Space Optimisation to give you an accurate optimisation you must ensure that you have carefully measured your room; note that small geometrical features, such as support struts and window casements, with dimensions less than around 10 cm should be ignored, as their inclusion can actually result in a less accurate optimisation. All measurements are given in metres.

The **Room Dimensions** stage is split into the **Floor Plan** and **Height** stages. In the **Floor Plan** stage you can define your floor plan using three simple mechanisms, as shown below: you may select any corner with a click, drag it to any desired location, or delete it by clicking on the **Delete** button in the contextual control bar at the top; similarly, you may select any wall with a click and drag it to any desired location; and finally, you may add corners to a selected wall by clicking on the **Add Corner** button in the contextual control bar at the top. These mechanisms give you complete control over the floor plan. Note that you can also zoom in and out using the  $+/-$  zoom buttons in the bottom right-hand corner; the grid size is clearly stated above these buttons. When dragging corners and walls they will snap to the current grid size; adjacent walls will also prefer to snap to a 90 degree angle.



Once your floor plan has been defined click on the **Next: Height >** link in the bottom navigation pane to enter the **Height** stage, as shown below; note that rooms with non-flat ceilings or floors are currently unsupported, and so a room simplification procedure must be adopted, as outlined in §3.4. Enter the height of your room and click on the **Next: Room Features >** link in the bottom navigation pane.

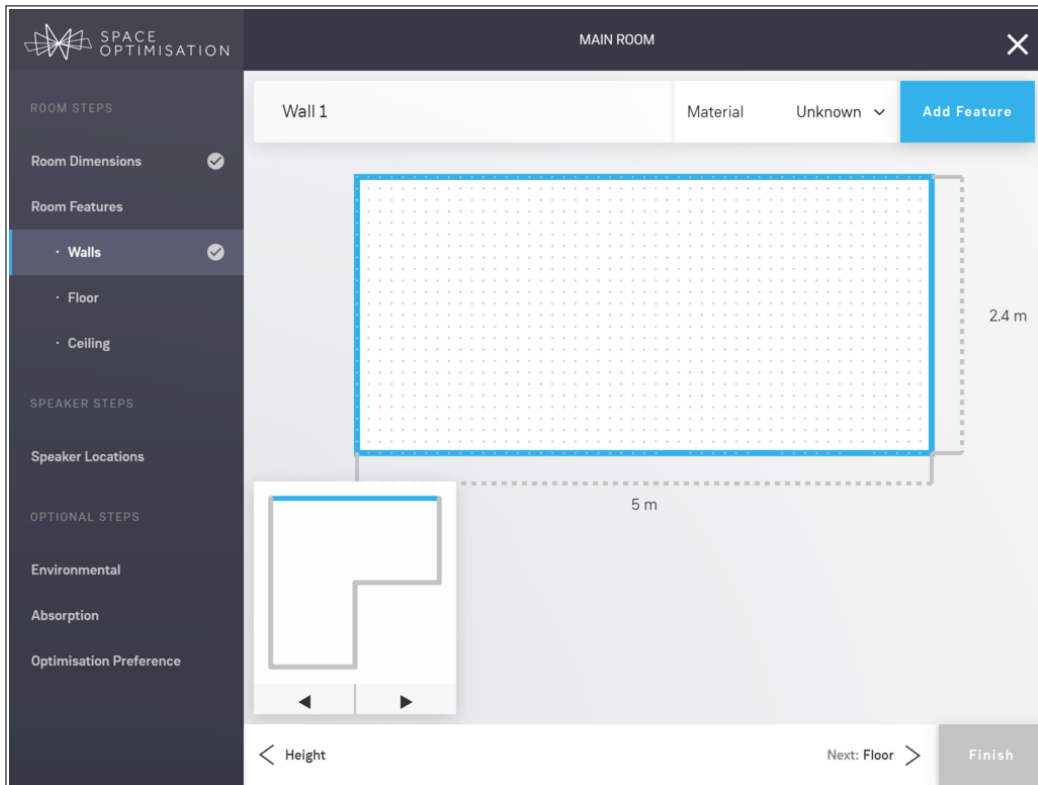




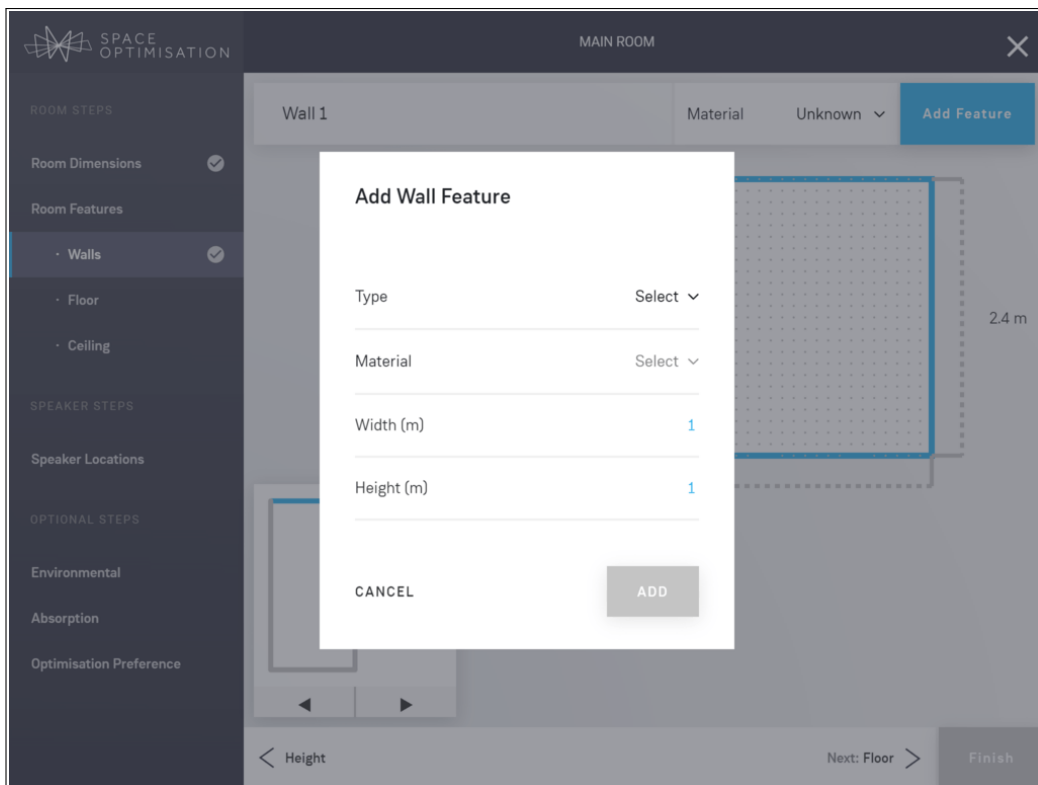
## Room features

In the **Room Features** stage you can define the construction materials of your room's surfaces and the features on each surface. You now have the ability to correctly place the features on each surface; the new version of Space Optimisation now correctly considers the effects of the placement of features on the interaction between your room and your speakers.

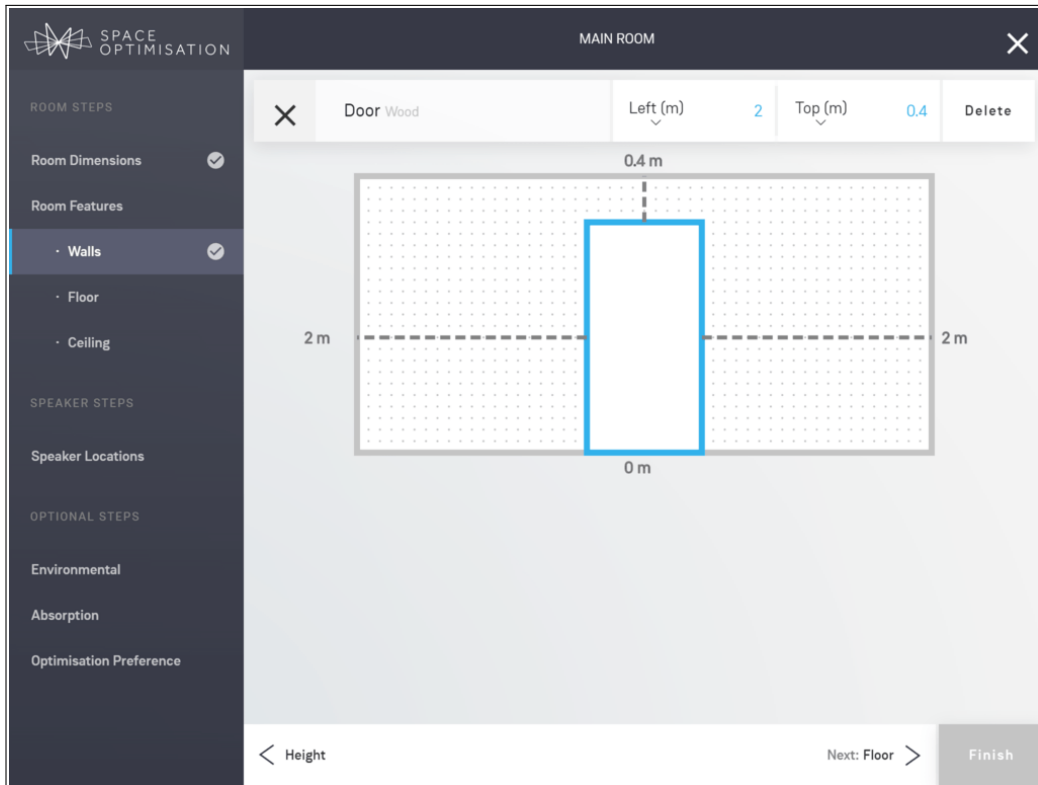
The **Room Features** stage is split into the **Walls**, **Floor** and **Ceiling** stages. In the **Walls** stage, as shown below, you can move between walls by either clicking on the desired wall in the mini-map in the bottom left-hand corner, or by clicking on the ◀/▶ buttons below the mini-map. Once the desired wall is selected, you can select the construction material using the **Material** drop-down menu in the contextual control bar at the top: **Concrete** describes any solid or heavy construction, including brick, blockwork or stone; **Drywall** describes any mid-weight construction, including plaster on brick; **Partition** describes any flexible or lightweight construction, including wooden studwork or plasterboard walls; and **Unknown** provides an averaged absorption coefficient which should be used when the construction material is unknown.



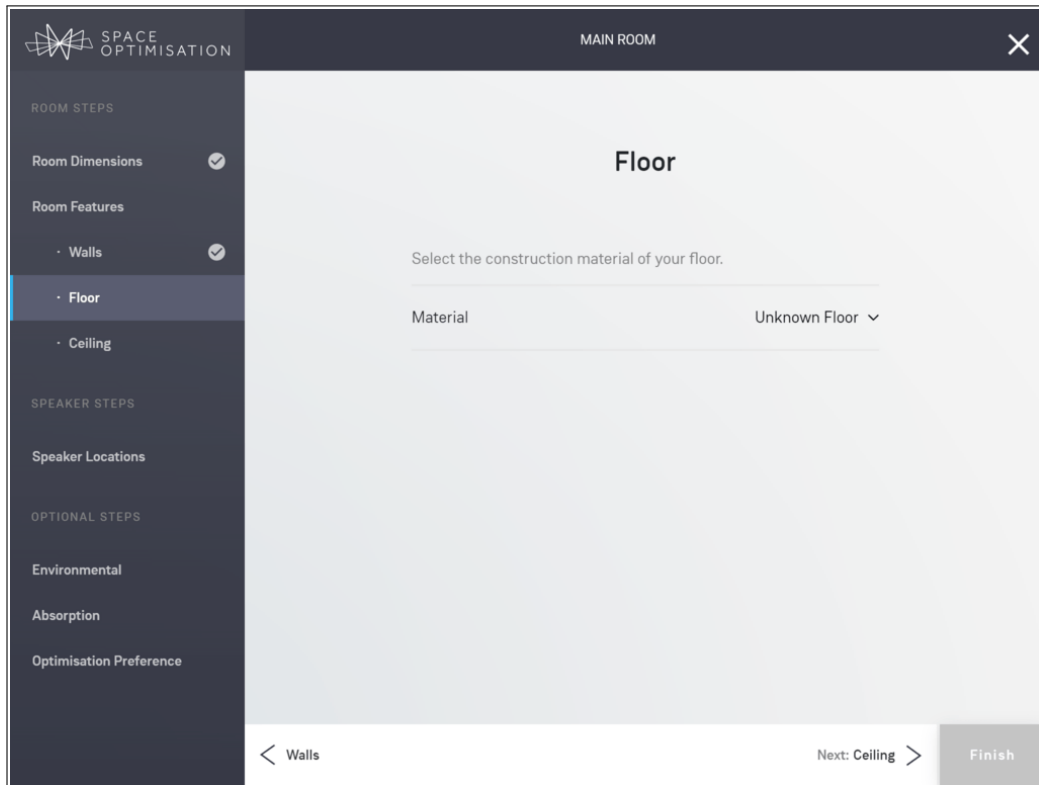
You can add features to the selected wall by clicking on the **Add Feature** button in the contextual control bar at the top; a dialog prompting you to provide the feature type, material and dimensions will appear, as shown below. Select the feature type and material from the drop-down menus, enter the feature dimensions, and click on the **Add** button.



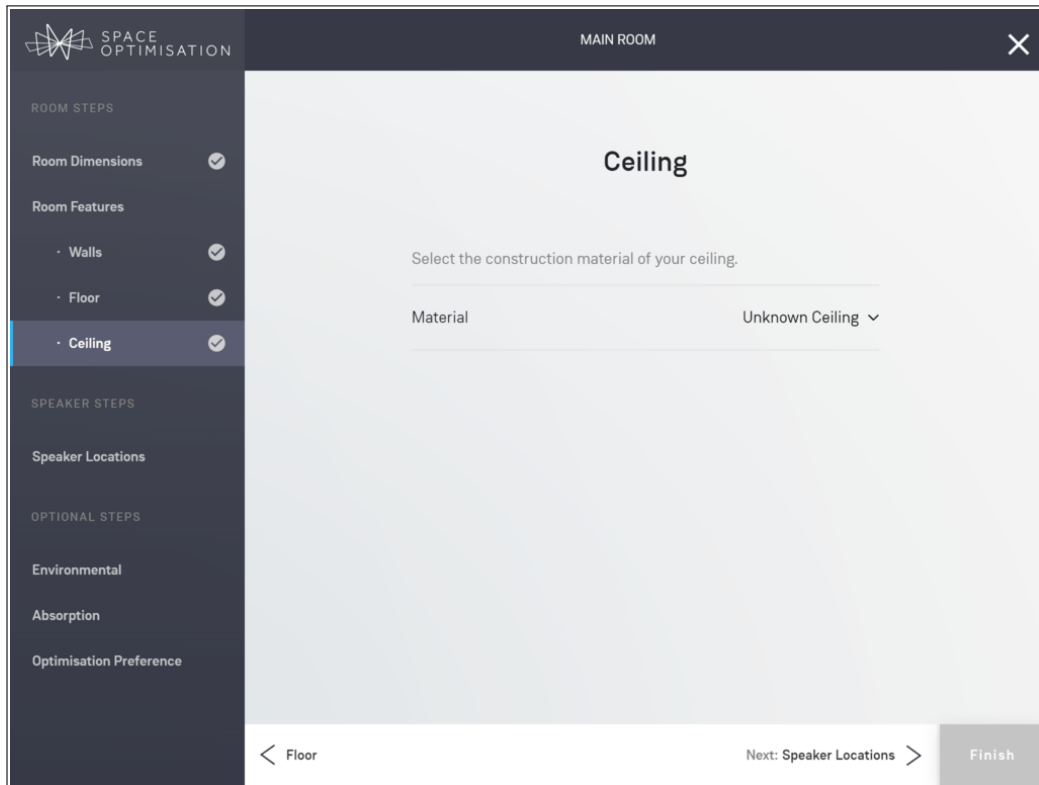
Once a feature has been added to the wall, as shown below, you can select it with a click and drag it to any desired location, or enter the measurements in the contextual control bar at the top, switching between the **Left (m)** and **Right (m)** measurements, and similarly between the **Top (m)** and **Bottom (m)** measurements, by clicking on the  $\nabla$  button below the appropriate measurement. Deselecting the feature by clicking anywhere on the wall, you can add multiple features, and even layer features on top of one another, allowing you to add complex features such as doors with inset windows. Note that you can delete a feature at any time by selecting it with a click and clicking on the **Delete** button in the contextual control bar at the top.



Once the construction material and features have been defined for all of your walls click on the **Next: Floor**  $>$  link in the bottom navigation pane to enter the **Floor** stage, as shown below. Select the construction material using the **Material** drop-down menu: **Concrete** describes any solid or heavy construction, including concrete or stone; **Suspended Floor** describes any suspended construction, including suspended floorboards; **Unknown Floor** provides an averaged absorption coefficient which should be used when the construction material is unknown. Note that floor features are currently unsupported, and so an approximation procedure must be adopted, as outlined in §3.2.1.



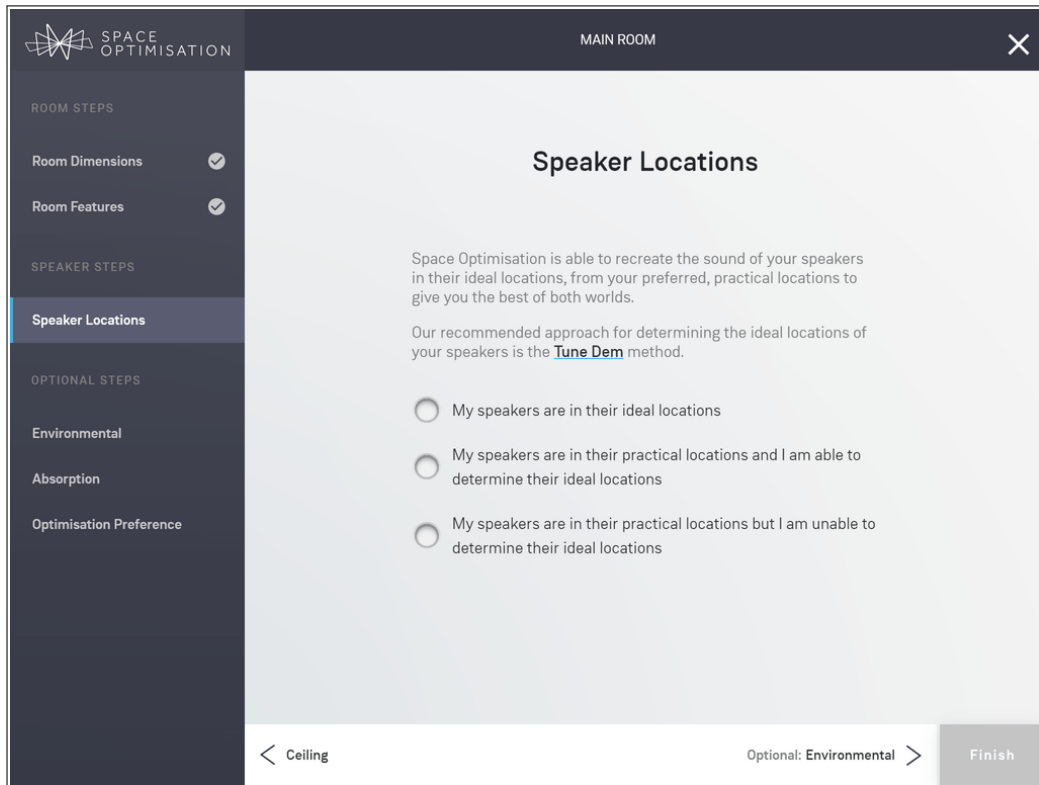
Once the construction material has been defined for your floor click on the **Next: Ceiling >** link in the bottom navigation pane to enter the **Ceiling** stage, as shown below. Select the construction material using the **Material** drop-down menu: **Concrete** describes any solid or heavy construction, including concrete or stone; **Suspended Ceiling** describes any suspended construction, including suspended plasterboard or ceiling panels; **Unknown Floor** provides an averaged absorption coefficient which should be used when the construction material is unknown. Note that ceiling features are currently unsupported, and so an approximation procedure must be adopted, as outlined in §3.2.1.



### 2.3.2 Entering your speaker and listening locations

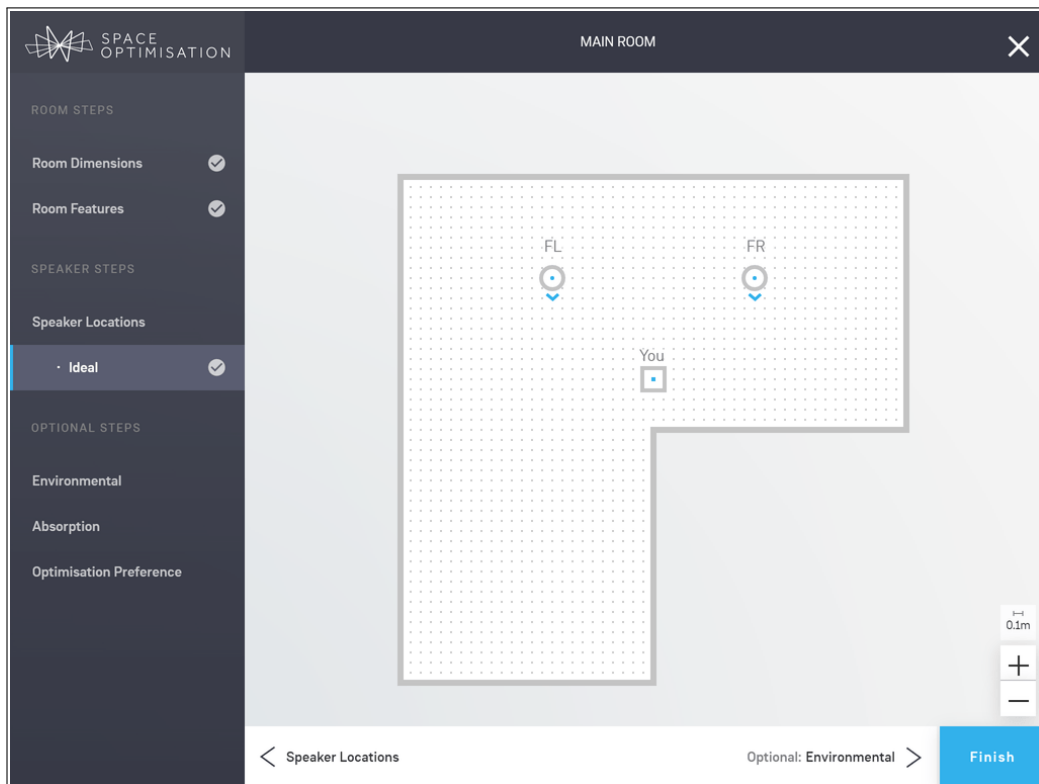
Space Optimisation takes account of the characteristics of your speakers, such as the position of each drive unit and the response of bass reflex ports. You must therefore inform your Linn account of your speakers' locations, as well as your listening location.

Click on the **Next: Speaker Locations** > link in the bottom navigation pane to enter the **Speaker Locations** stage; you will be prompted to select the speaker location scenario that best matches your situation, as shown below. The **Speaker Locations** stage is then split into one or two stages, **Practical** and/or **Ideal**, depending on your speaker location scenario. It is recommended that you determine the ideal locations for your speakers using the [Tune Dem](#) method to achieve the full potential of both your music system and Space Optimisation; however, sometimes you may need to make a compromise and move your speakers to more practical locations, or you may not have the ability to determine the ideal locations.

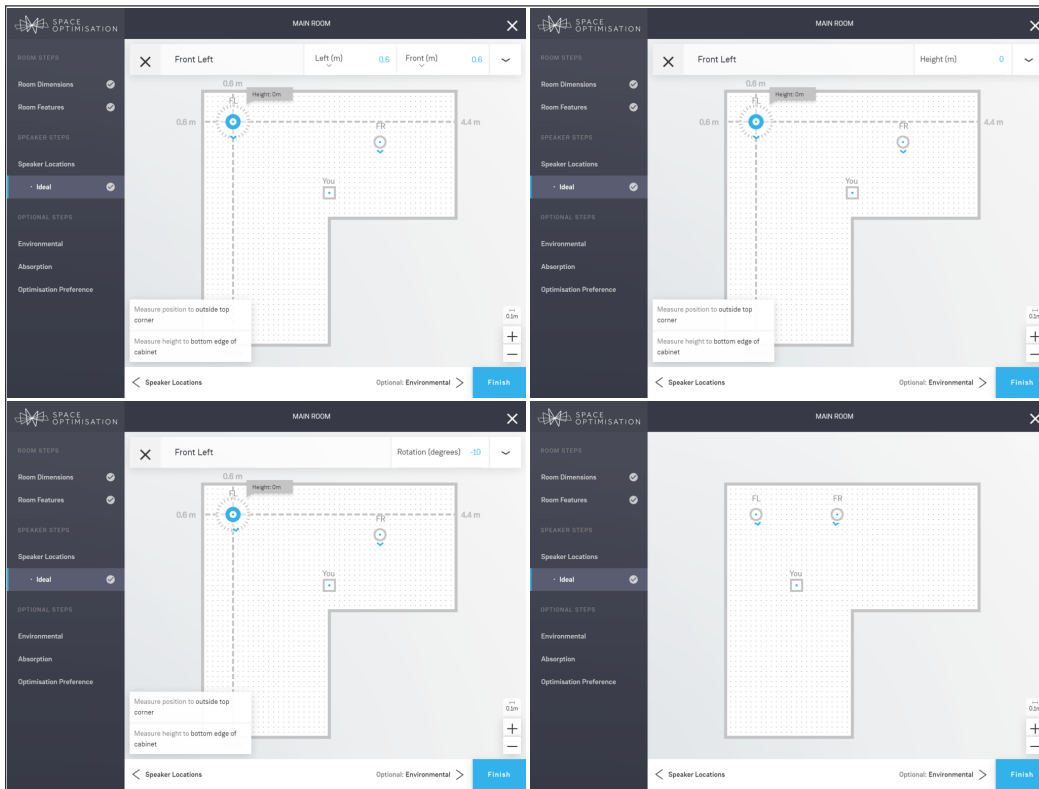


### Ideal locations only

If you have determined the ideal locations for your speakers, and they can remain in these ideal locations, select the **My speakers are in their ideal locations** radio button and click on the **Next: Ideal >** link in the bottom navigation pane to enter the **Ideal** stage. Your speakers will automatically appear, labelled according to their assigned channel, alongside your listening location, labelled as **You**, as shown below.



You can select any speaker with a click; when a speaker is selected, helpful hints will appear in the bottom left-hand corner with guidance on where measurements should be made to on the speaker. Once a speaker has been selected you can define its location and orientation using three simple mechanisms, as shown below: you may drag the speaker to any desired location, or enter the measurements in the contextual control bar at the top, switching between the **Left (m)** and **Right (m)** measurements, and similarly between the **Front (m)** and **Back (m)** measurements, by clicking on the  $\nabla$  button below the appropriate measurement; you may enter the speaker's **Height (m)** measurement by clicking on the far-right  $\nabla$  drop-down menu in the contextual control bar at the top, selecting **Height**, and entering the measurement; and finally, you may enter the speaker's **Rotation (degrees)** measurement by clicking on the far-right  $\nabla$  drop-down menu in the contextual control bar at the top, selecting **Rotation**, and entering the measurement. These mechanisms give you complete control over the speaker's location and orientation. Similarly, you can select the listening location with a click, and define its location with the same mechanisms as those for the speaker locations; this listening location should be measured to the average location of the centre of your head during normal listening.



## Practical and ideal locations

If you have determined the ideal locations for your speakers, but have been forced to move them to more practical locations, select the **My speakers are in their practical locations and I am able to determine their ideal locations** radio button and click on the **Next: Practical** > link in the bottom navigation pane to enter the **Practical** stage. Define your speakers' practical locations as outlined above.

Once your speakers' practical locations have been defined, click on the **Next: Ideal** > link in the bottom navigation pane to enter the **Ideal** stage. Define your speakers' ideal locations as outlined above.

## Practical locations only

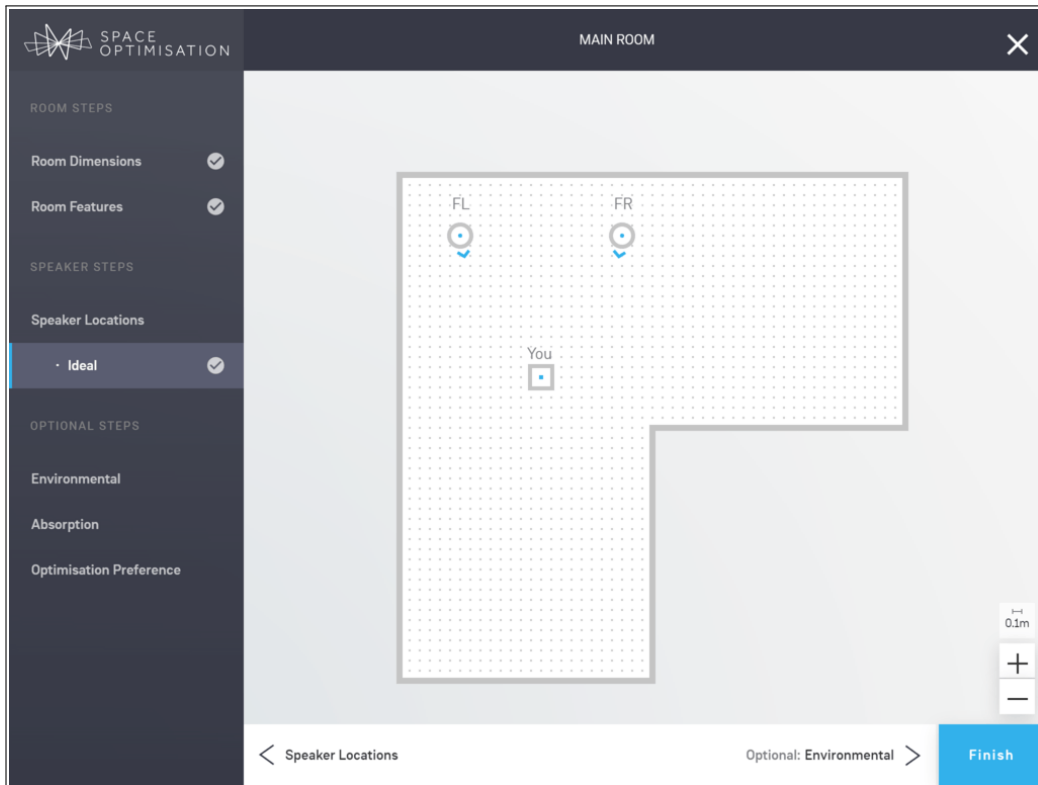
If you are unable to determine the ideal locations for your speakers select the **My speakers are in their practical locations and I am unable to determine their ideal locations** radio button and click on the **Next: Practical** > link in the bottom navigation pane to enter the **Practical** stage. Define your speakers' practical locations as outlined above.

If you are unable to determine the ideal locations for your speakers, you may be able to achieve the full potential of both your music system and Space Optimisation by using the Virtual Tune Dem method outlined in §3.5.

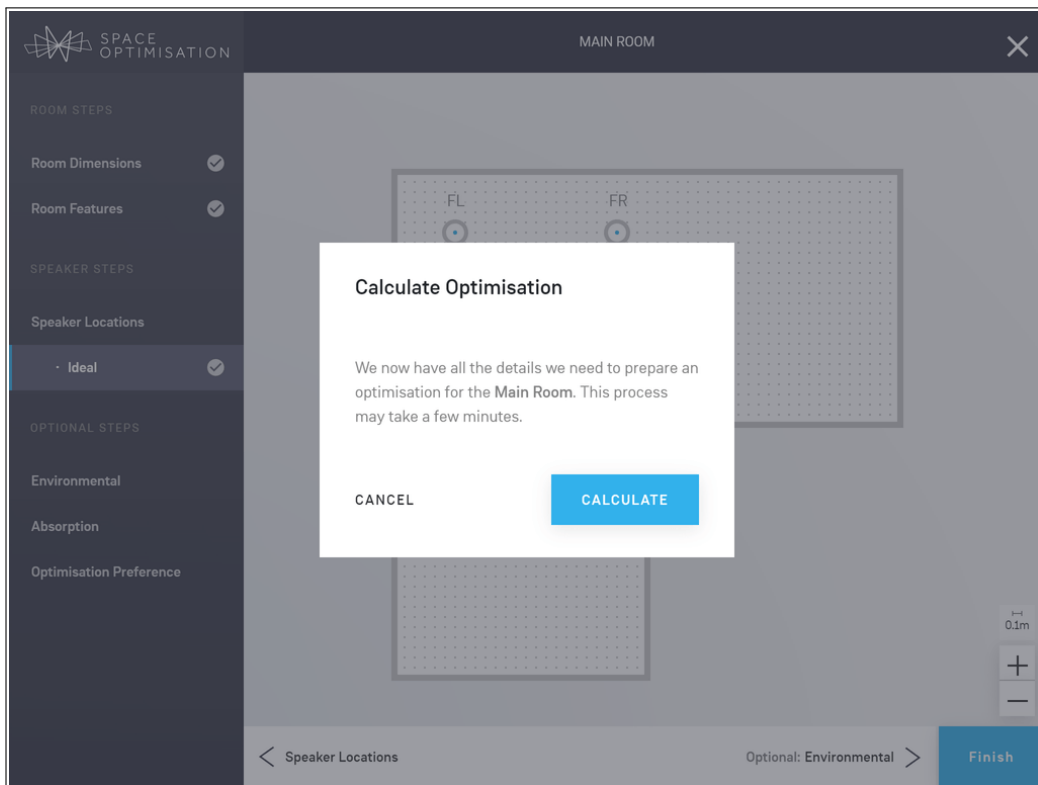
### 2.3.3 Calculating the optimisation

Once your room dimensions, room features, and speaker locations have been defined, the **Finish** button in the bottom navigation pane will turn blue, as shown below.

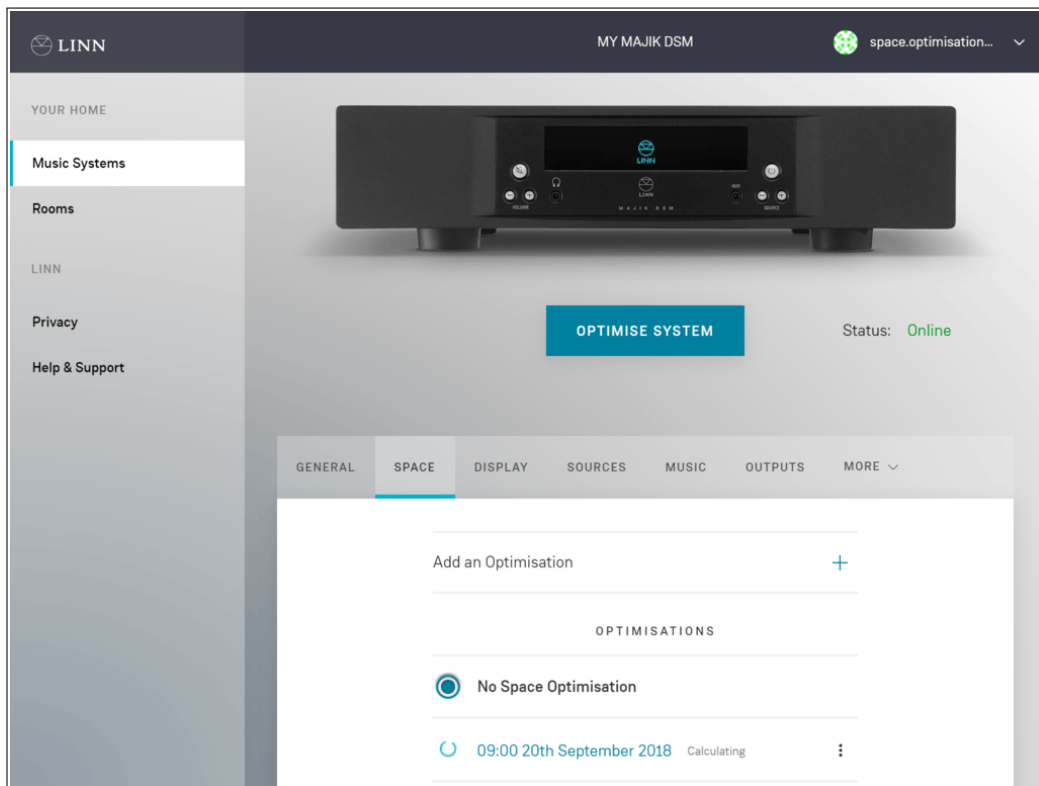




Click on the **Finish** button; a confirmation dialog will appear, as shown below. Click on the **Calculate** button to calculate your optimisation; this may take a few minutes.

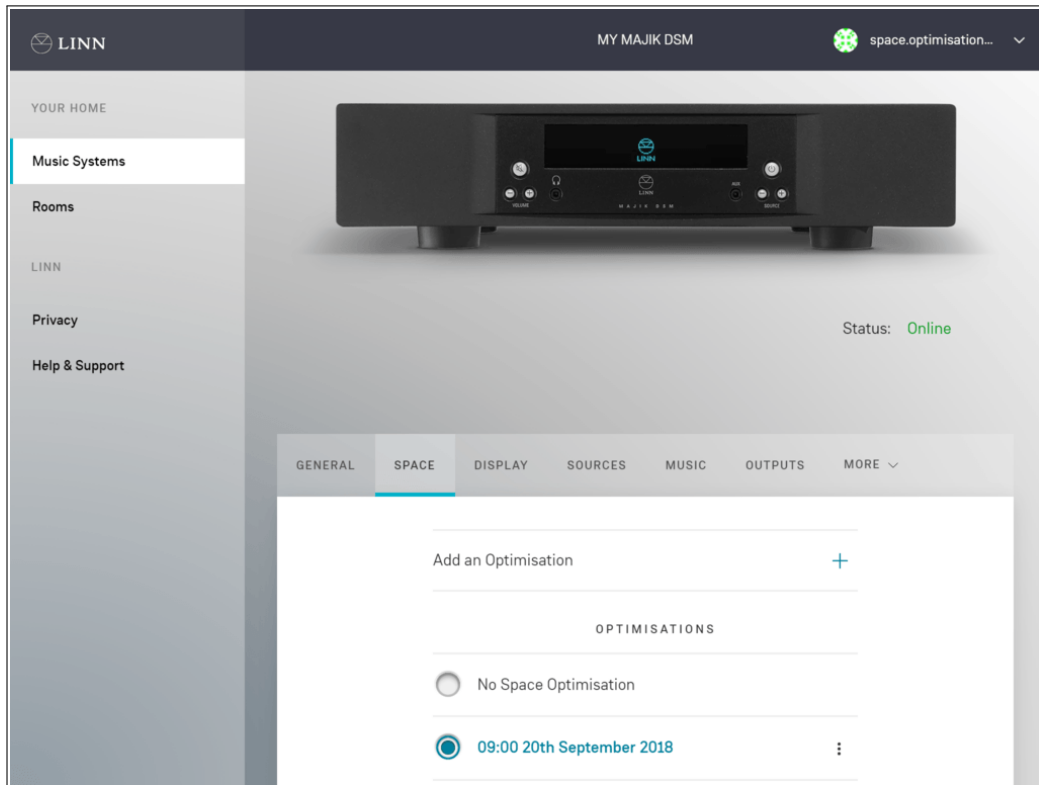


Whilst your optimisation is calculating you will be taken to the **Space** tab on the **Music Systems** page for your system, where your optimisation will be added to a list of optimisations below the **Optimisations** heading; it will be named with a time stamp, and flagged as **Calculating**, as shown below, until the calculation is complete.



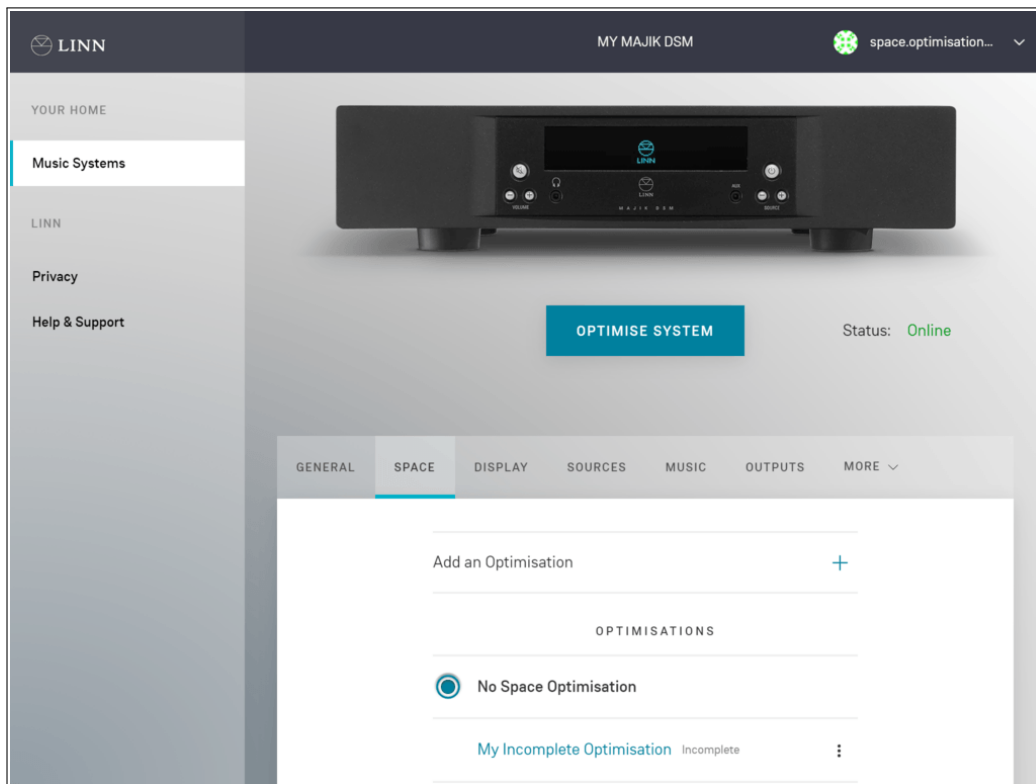
### 2.3.4 Applying the optimisation

Once calculated, the optimisation may be applied to your music system by clicking on the radio button next to its name, as shown below.



### 2.3.5 Resuming an incomplete optimisation

Note that you can exit the optimisation procedure at any time by clicking on the  $\times$  button in the top right-hand corner of the Space Optimisation user interface. The optimisation will be added to a list of optimisations below the **Optimisations** heading under the **Space** tab on the **Music Systems** page for your system; this optimisation will be flagged as being incomplete, as shown below. You may resume an incomplete optimisation at any time by clicking on the  $\vdots$  drop-down menu to the right of its name and clicking on **Resume**; the process of defining the optimisation now proceeds as outlined above.

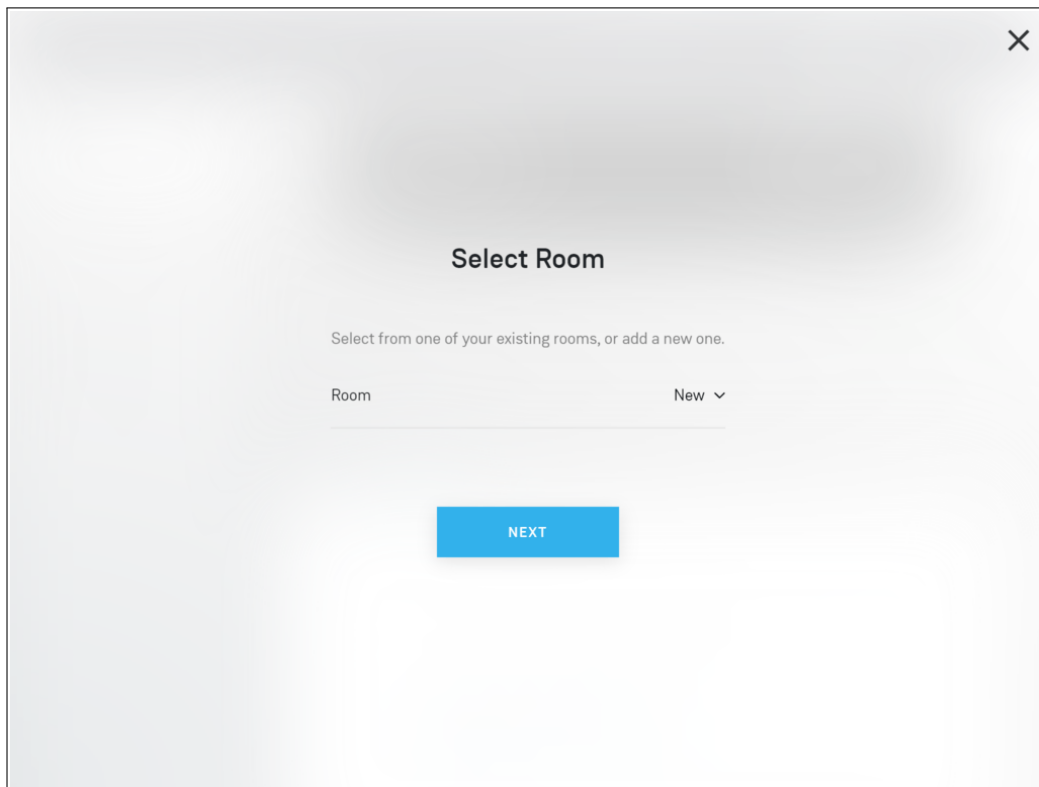


## 2.4 Re-optimising your music system


### 2.4.1 Adding an optimisation

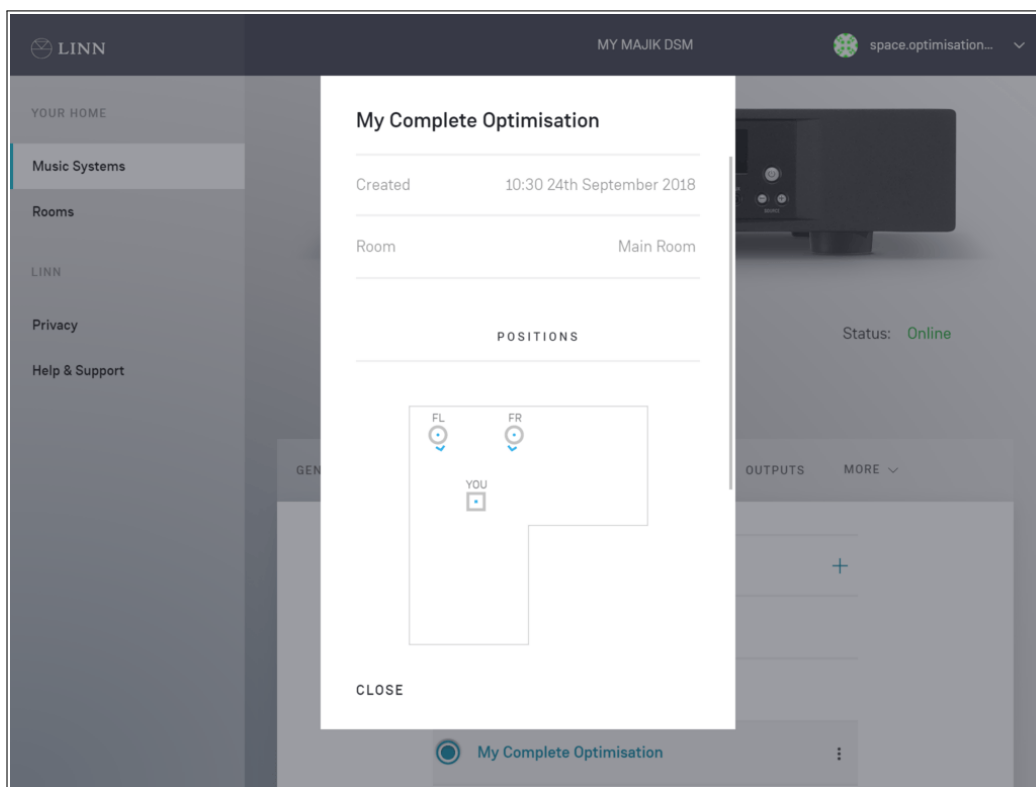
Once you have optimised your music system through your Linn account the **Optimise System** button below the graphic of your music system will disappear; you can now add further optimisations by clicking on the **Add an Optimisation** link under the **Space** tab on the **Music Systems** page for that system.

Click on the **Add an Optimisation** link; the dialog with a brief explanation of Space Optimisation will appear. Click on the **Begin** button; a dialog prompting you to choose the room you wish to create an optimisation for, or whether you wish to define a new room, will appear, as shown below. Choose a room to optimise for, or select **New** and enter an appropriate name for your room, and click on the **Next** button; the process of defining the optimisation now proceeds as outlined in §2.3.



#### 2.4.2 Adjusting an optimisation

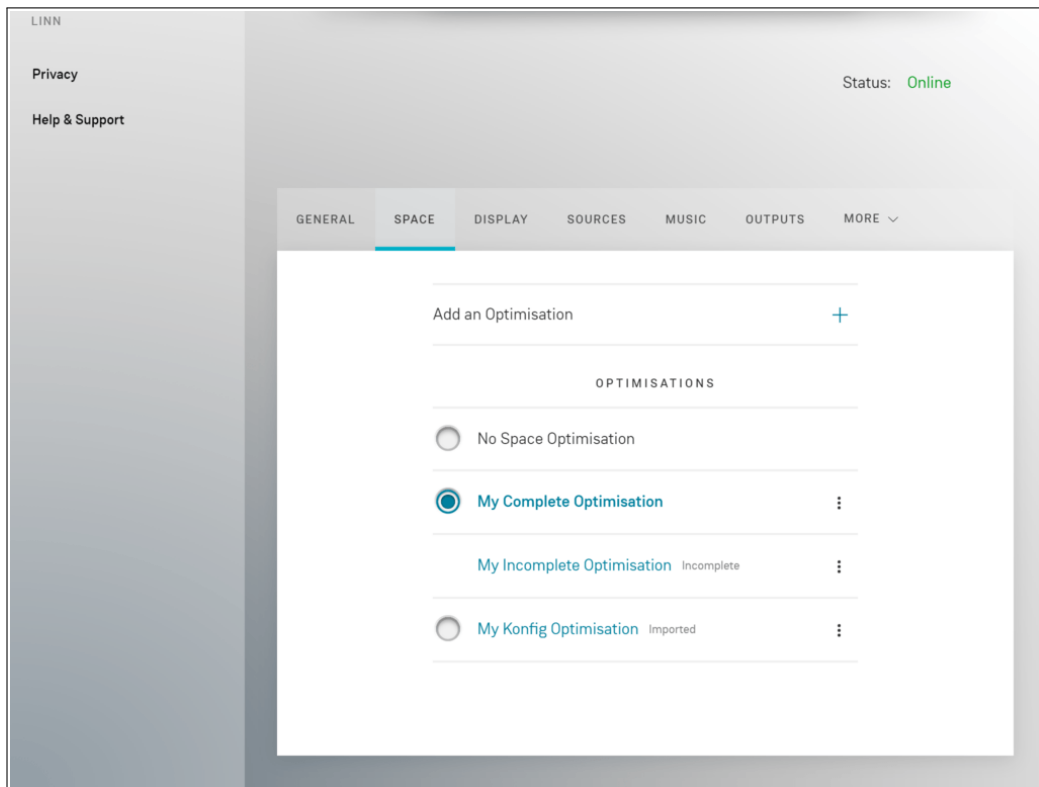
You may view the details of any complete optimisation created through your Linn account by clicking on the  drop-down menu to the right of its name and clicking on **Details**. A dialog with the details of the optimisation will appear, as shown below; within this dialog will be a graphic of your room and speaker setup, with further links to more detailed information on speaker and listening locations.



Should the details of an optimisation not match what you desire, the optimisation may be adjusted by clicking on the  $\text{⋮}$  drop-down menu to the right of its name and clicking on **Adjust**. The process of defining the optimisation now proceeds as outlined in §2.3; however, note that all information will already be defined as per the original optimisation, allowing you to make only the necessary adjustments.

## 2.5 Optimisation history

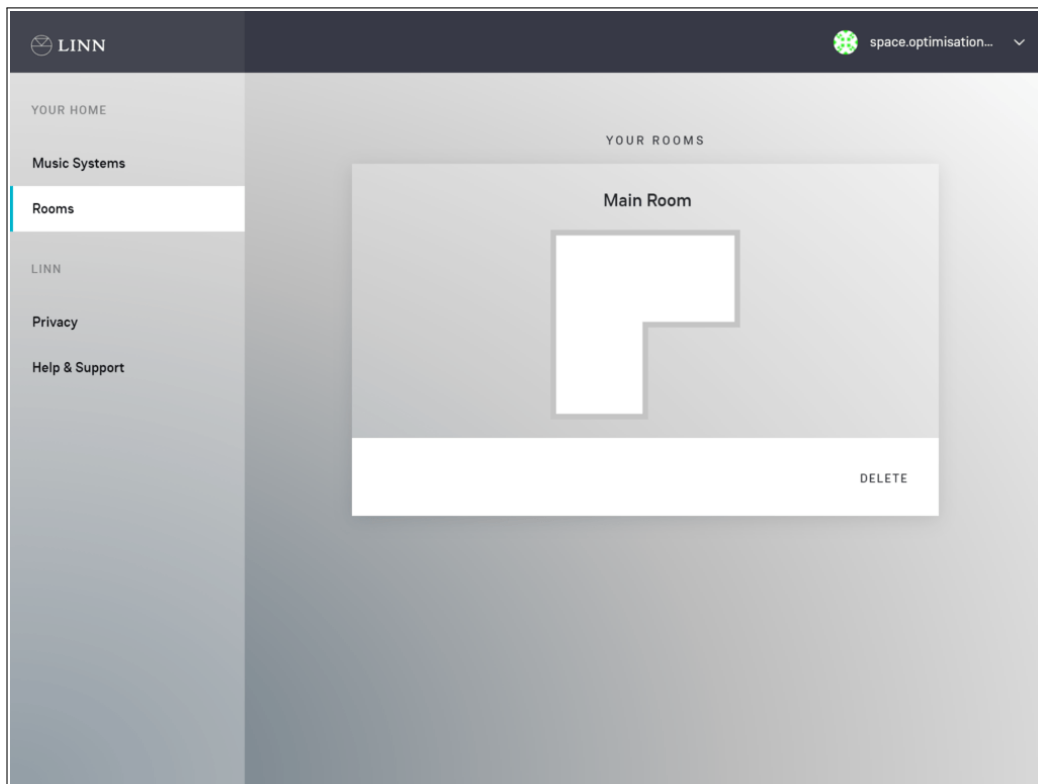
All optimisations created through your Linn account, both complete and incomplete, which are compatible with your music system and speakers, as well as any optimisations created through Linn Konfig which have been imported to your Linn account as outlined in §1.3, will appear below the **Optimisations** heading under the **Space** tab on the **Music Systems** page for that system, as shown below. Any complete optimisation, or **No Space Optimisation**, may be applied to your music system by clicking on the radio button next to its name.



You can rename any optimisation by clicking on its name, resume any incomplete optimisation as outlined in §2.3.5, adjust any complete optimisation created through your Linn account as outlined in §2.4.2, or delete any optimisation by clicking on the  $\vdots$  drop-down menu to the right of its name and clicking on **Delete**.

## 2.6 Rooms

Your Linn account stores your room information separately from your music system; this makes it quick and easy to upgrade your music system, or move your music system to a new room, as outlined in §2.4.1. You can view all of your rooms on the **Rooms** page, as shown below.



Note that a room may be deleted at any time by clicking on the **Delete** button below its graphic; deleting a room will not affect any completed optimisations, but you will no longer be able to adjust any optimisations made using that room. It is therefore advised that rooms be deleted only when you no longer have access to that room, for example if you move house.



## 3 Advanced setup

Space Optimisation produces a very accurate model of the interaction between your room and speakers through the use of highly sophisticated acoustic modelling; however, there exist cases where some adjustment of the optimisation inputs is required.

If the environmental conditions of your room are different to the standard environmental conditions the optimisation may incorrectly predict the frequencies that are artificially distorted; the methodology for entering your room's environmental conditions is outlined in §3.1.

If the construction materials of your room do not closely match the options provided the optimisation may incorrectly predict the amount of correction required at the artificially distorted frequencies; the methodology for adjusting the absorption of your room's construction materials is outlined in §3.2.

The optimisation has been designed to give a good balance of low- and mid-frequency energy. However, your personal preference may differ to the default balance; the methodology for adjusting the low- and mid-frequency energy balance is outlined in §3.3.

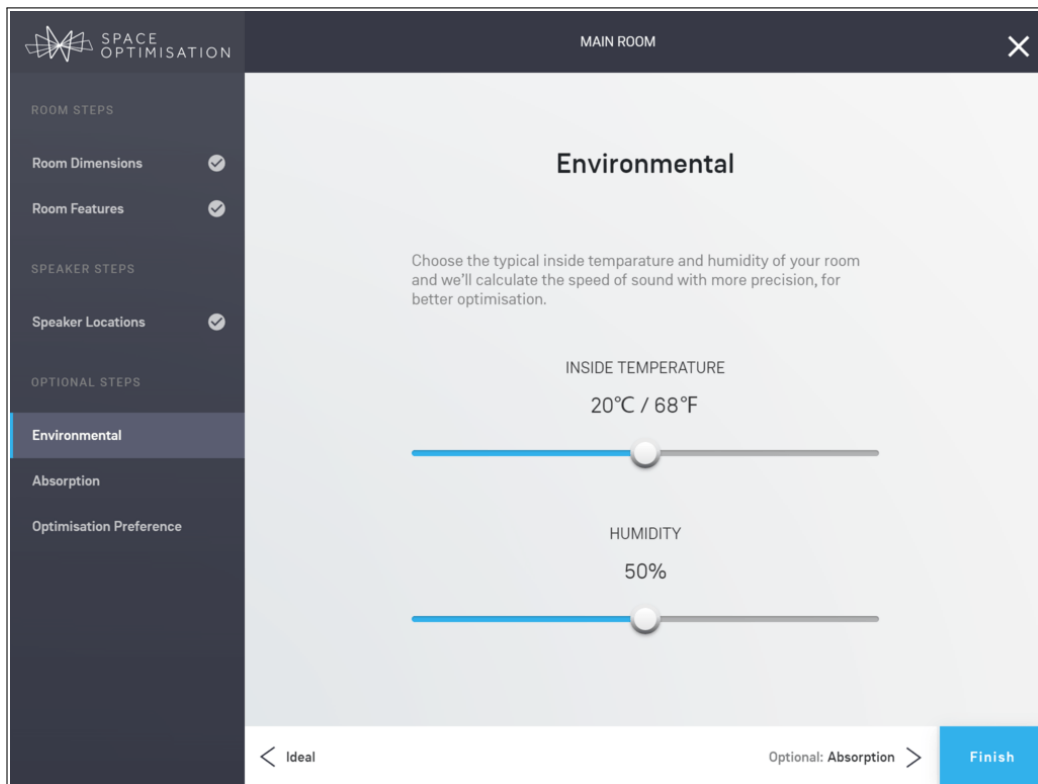
If your room does not have a flat floor or ceiling the optimisation may incorrectly predict the frequencies that are artificially distorted; the methodology for simplifying your room's dimensions to better fit the flat floor and ceiling model is outlined in §3.4.

Finally, if you are unable to determine the ideal locations for your speakers, you may be able to achieve the full potential of both your music system and Space Optimisation by using the Virtual Tune Dem method; this method is outlined in §3.5.

### 3.1 Environmental

If the environmental conditions of your room are different to the standard environmental conditions the speed of sound used in the optimisation will be incorrect, and so the frequencies that are artificially distorted may be incorrectly predicted; the environmental conditions must therefore be entered to give the correct speed of sound.

Whilst creating an optimisation, click on the **Environmental** link in the left-hand navigation pane to enter the **Environmental** stage, as shown below.

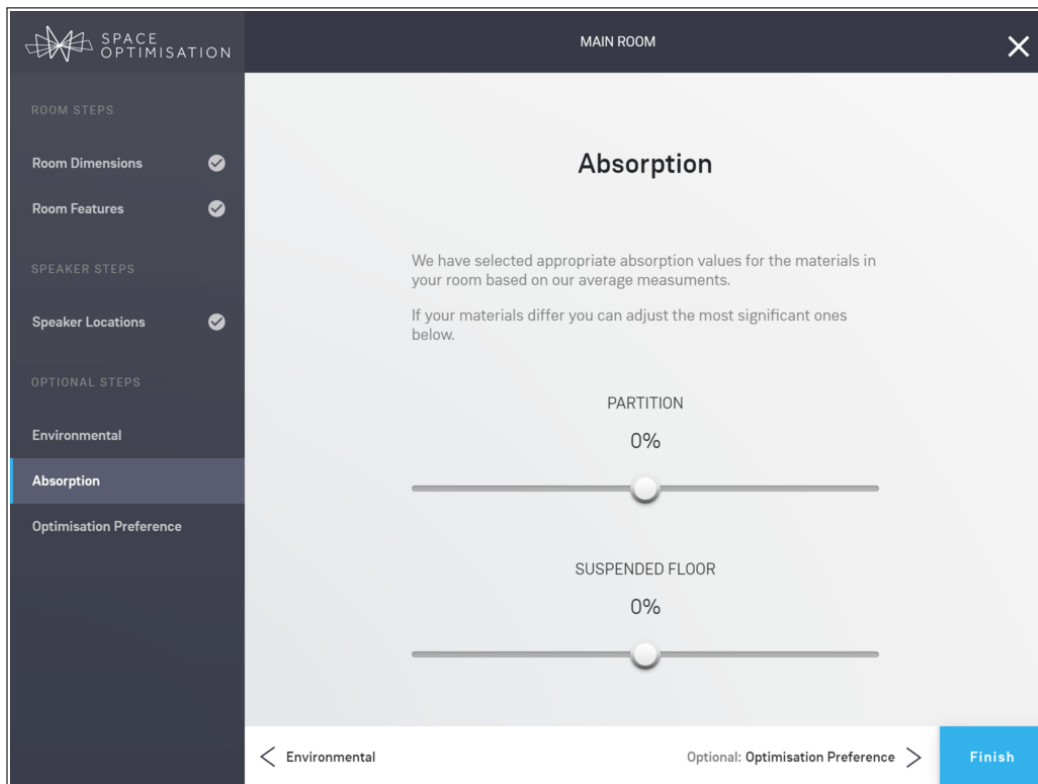


Using a thermometer and hygrometer measure the temperature and humidity in your room, and enter the values using the **Inside Temperature** and **Humidity** sliders: increasing the temperature or humidity will increase the speed of sound, therefore increasing the frequencies that are artificially distorted; decreasing the temperature or humidity will decrease the speed of sound, therefore decreasing the frequencies that are artificially distorted. Once the temperature and humidity values have been set, click on the blue **Finish** button in the bottom navigation pane to recalculate the optimisation.

### 3.2 Absorption

If the construction materials of your room do not closely match the options provided their absorption characteristics will be incorrect, and so the optimisation may incorrectly predict the amount of correction required at the artificially distorted frequencies; the absorption characteristics of the construction materials must therefore be adjusted to give the correct behaviour.

Whilst creating an optimisation, click on the **Absorption** link in the left-hand navigation pane to enter the **Absorption** stage, as shown below. The construction materials of your room will be listed, in order of decreasing absorption area.



If a particular construction material does not closely match the options provided its absorption characteristics can be adjusted here: decreasing the absorption will result in an optimisation that takes deeper, sharper cuts at the artificially distorted frequencies; increasing the absorption will result in an optimisation that takes shallower, broader cuts at the artificially distorted frequencies. Note that adjusting the absorption of construction materials at the top of the list will have more effect than those at the bottom of the list. Once the absorption characteristics of any offending construction materials values have been adjusted, click on the blue **Finish** button in the bottom navigation pane to recalculate the optimisation.

You should adopt a Tune Dem method for varying the absorption characteristics: increase the absorption of the first offending construction material in the list by a large amount and recalculate the optimisation; then decrease the absorption of the first offending construction material in the list by a large amount and recalculate the optimisation. Then perform an AB demonstration to compare the two adjusted optimisations and note down any characteristics that you like from each adjusted optimisation. You should then adjust the absorption of the first offending construction material to an appropriate average value depending on your preference from the two previous adjusted optimisations and recalculate the optimisation; this process should be repeated iteratively until the absorption characteristics of the first offending construction material closely match those of your room surfaces. You should then apply this process for each offending construction material.

### 3.2.1 Approximating Floor and Ceiling Features

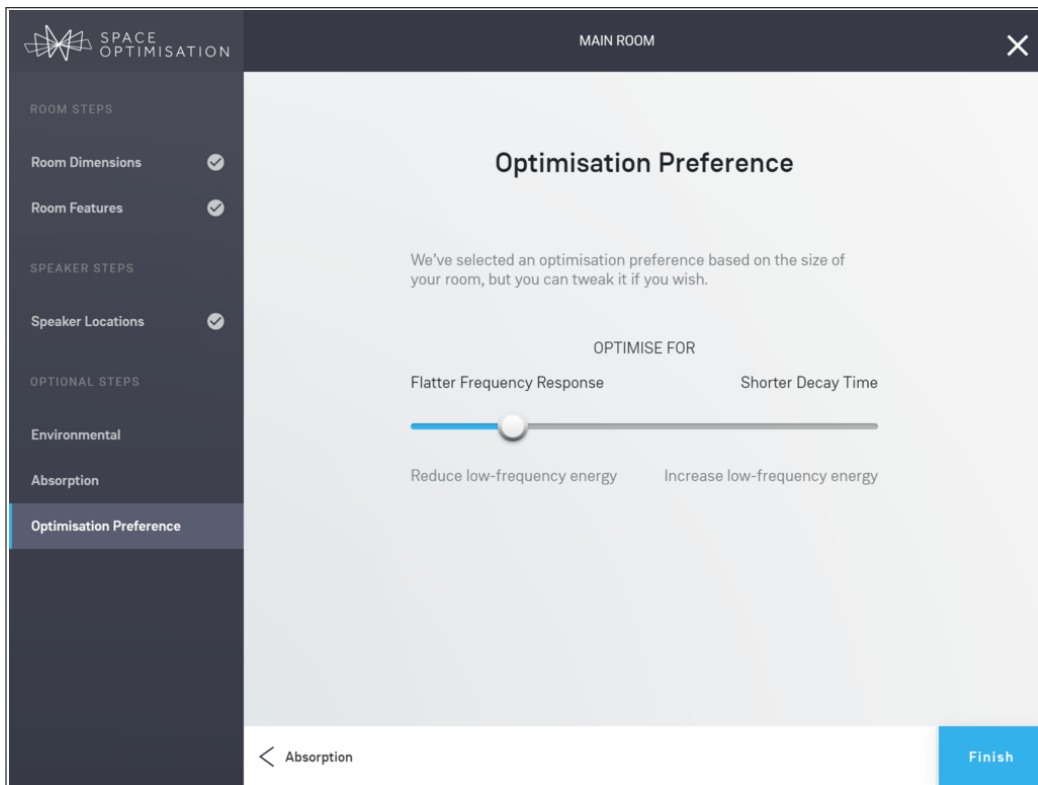
Note that floor and ceiling features are currently unsupported, and so an approximation procedure must be adopted; note that this approximation procedure takes a similar approach to that which was implicitly made in previous versions of Space Optimisation, available through Linn Konfig, where the effects of features were averaged across a surface.

The presence of floor or ceiling features, such as trapdoors or skylights, will tend to increase the average absorption of the floor or ceiling; therefore the floor or ceiling absorption should be increased in the **Absorption** stage. Note that the amount of increase required will depend on the fraction of total area taken up by such features, with large features having more effect than small features.

### 3.3 Optimisation preference

The optimisation has been designed to give a good balance of low- and mid-frequency energy. However, your personal preference may differ to the default balance; the optimisation can therefore be adjusted to match your preference.

Whilst creating an optimisation, click on the **Optimisation Preference** link in the left-hand navigation pane to enter the **Optimisation Preference** stage, as shown below.



If the optimisation does not suit your preference, the optimisation preference can be adjusted here: moving the slider toward **Flatter Frequency Response** will result in an optimisation that takes deeper cuts and applies less decay control at the artificially distorted frequencies; moving the slider toward **Shorter Decay Time** will result in an optimisation that takes shallower cuts and applies more decay control at the artificially distorted frequencies. Once the optimisation preference has been adjusted, click on the blue **Finish** button in the bottom navigation pane to recalculate the optimisation.

You should adopt a Tune Dem method for varying the optimisation preference, similar to that outlined at the end of §3.2.

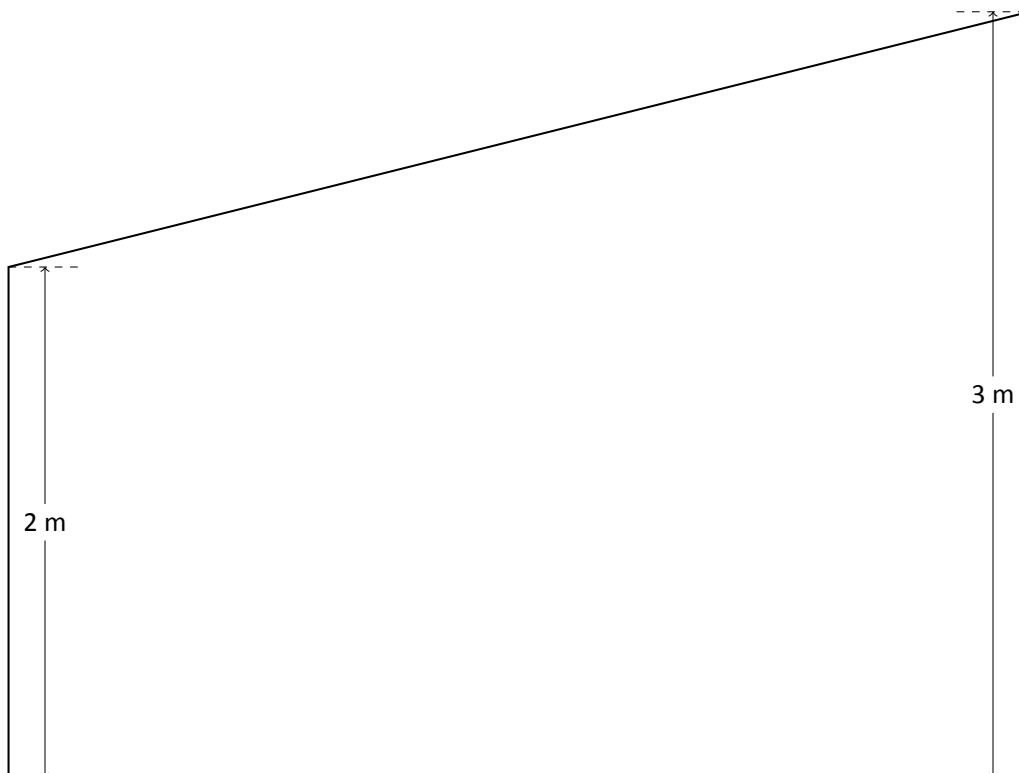
### 3.4 Simplifying room dimensions

The optimisation algorithm in Space Optimisation is based on the assumption of a flat floor and ceiling; if your room does not have a flat floor or ceiling you must decide on an optimal averaged height dimension.

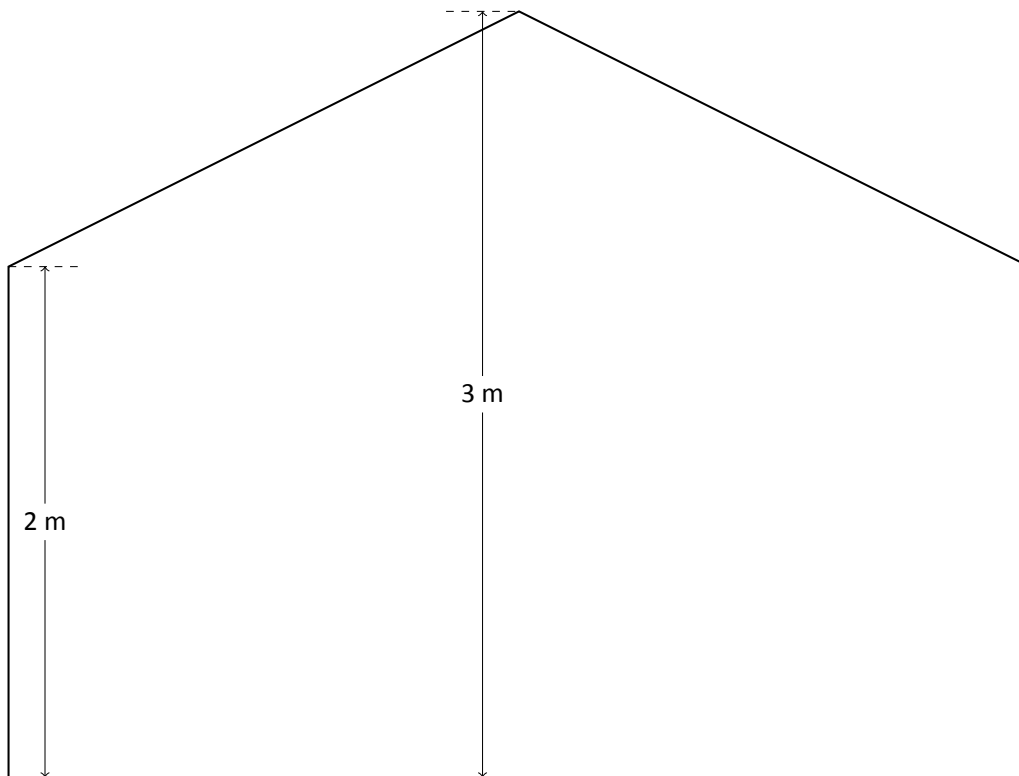
#### 3.4.1 Rooms with a sloped or pitched ceiling

Where ceilings are sloped or pitched it is recommended to take an average height measurement: for a sloped ceiling this average height measurement will be halfway between the minimum and maximum height of the ceiling; for a pitched ceiling this average height measurement will be the minimum height plus a third of the difference between the minimum and maximum height of the ceiling.

Consider a sloped ceiling, as shown below; the average height measurement here would be 2.5 m.



Consider a pitched ceiling, as shown below; the average height measurement here would be 2.33 m.

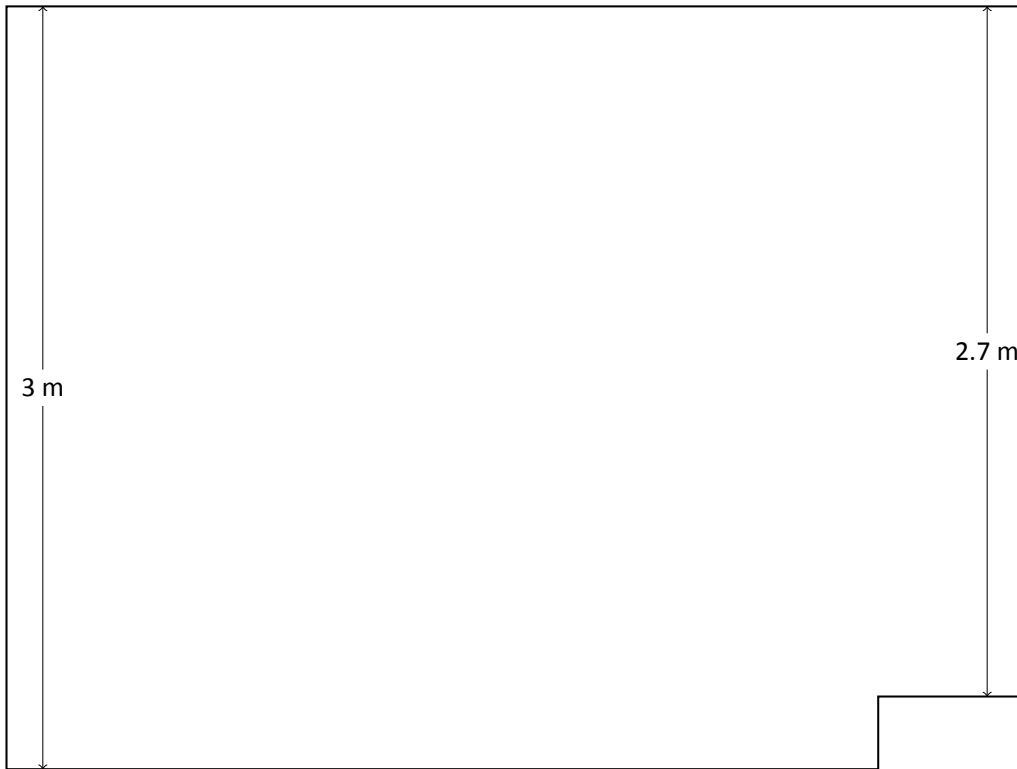


The effect of such non-flat ceilings is to reduce the strength of any modal behaviour between the floor and ceiling, and to cause a smearing of any associated artificially distorted frequencies; due to its flat ceiling assumption the optimisation may incorrectly predict the amount of correction required at these artificially distorted frequencies. This issue can be remedied by increasing the absorption of the ceiling construction material, as outlined in §3.2, resulting in shallower, broader cuts at the associated artificially distorted frequencies.

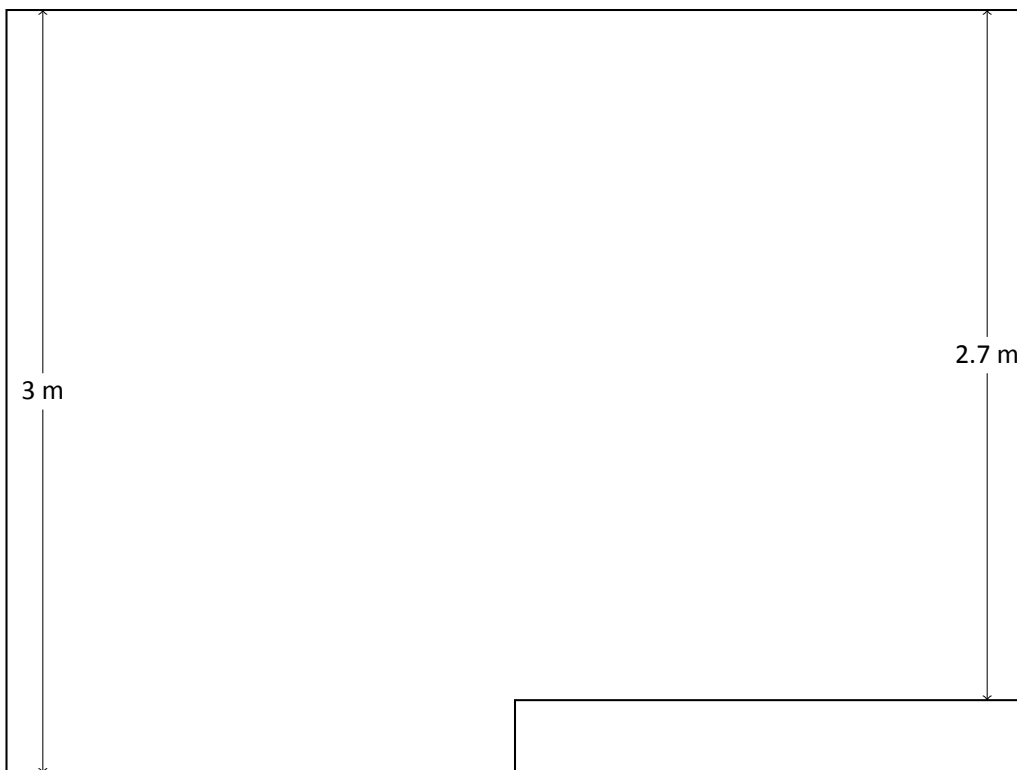
### 3.4.2 Rooms with a stepped floor

Where floors are stepped it is recommended to take an average height measurement: depending on the surface area of each floor section this average height measurement will lie somewhere between the minimum and maximum height.

Consider a stepped floor with a small raised section which covers less than 50% of the surface area, as shown below; the raised section can be ignored here, so that the average height measurement would be 3 m.



Consider a stepped floor with two equal-area sections, as shown below; the average height measurement here would be the standard average height, 2.85 m.



The effect of such non-flat floors is to reduce the strength of any modal behaviour between the floor and ceiling, and to cause a smearing of any associated artificially distorted frequencies; due to its flat floor assumption the optimisation may incorrectly predict the amount of correction required at these artificially distorted frequencies. This issue can be remedied by increasing the absorption of the floor construction material, as outlined in §3.2, resulting in shallower, broader cuts at the associated artificially distorted frequencies.

### 3.5 Virtual Tune Dem

If you are unable to determine the ideal locations for your speakers for physical reasons you may be able to achieve the full potential of both your music system and Space Optimisation by using the Virtual Tune Dem method.

To perform a Virtual Tune Dem, whilst creating an optimisation click on the **Speaker Locations** link in the left-hand navigation pane to enter the **Speaker Locations** stage.

Now, instead of selecting the **My speakers are in their practical locations and I am unable to determine their ideal locations** radio button, select the **My speakers are in their practical locations and I am able to determine their ideal locations** radio button, and click on the **Next: Practical >** link in the bottom navigation pane to enter the **Practical** stage.

Define your speakers' practical locations as outlined in §2.3.2, then click on the **Next: Ideal >** link in the bottom navigation pane to enter the **Ideal** stage. You can now adjust the ideal speaker locations to reflect any changes you would make if you were physically moving your speakers; once you have chosen an ideal location, click on the blue **Finish** button in the bottom navigation pane to calculate the optimisation. You should repeat this process using a Tune Dem method to establish the virtual ideal speaker locations.