

altiverb



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Making Impulse Responses from real acoustic environments for music production

This documentation :

Making IR's for music.pdf

This manual describes how to make Impulse Responses in acoustic spaces such as concert halls, studios, and churches in order to use the resulting files to process music using the Altiverb. We assume that you want to create the highest possible quality impulse responses.

Related documentation :

Making post production IR's.pdf

This manual describes how to make Impulse Responses in locations such as film sets, bathrooms and outdoor spaces in order to use them for post production purposes (i.e. for ADR and Foley). It focuses on quick and practical ways to use portable equipment to obtain impulse responses.

Making IR's from gear.pdf

This manual describes how to create impulse responses from hardware effects processors such as reverb and EQ units.

Making starter Pistol IR's.pdf

This manual describes how to make impulse responses by making recordings of starter pistol shots. While this is the quickest way to obtain impulse responses, it gives lesser quality than the sine wave sweep method, described in *Making post production IR's.pdf* and *Making IR's for music.pdf*

This manual describes how to make impulse responses in acoustic spaces such as concert halls, studios, and churches in order to use the resulting files to process music using the Altiverb. We assume that you want to create the highest possible quality Impulse Responses.

The process involves playing back sine sweep tones using a speaker, and to record the results using a number of microphones that correspond to the number of reverb output channels required (stereo, quad etc.). The resulting recordings are processed using the Altiverb Impulse Response Preprocessor, to create Impulse Response files used by Altiverb.

Outline:

1. Determining what to record
2. Selecting gear
3. Setup
4. Creating the Sweep Tone
5. Level Adjustments
6. Recording and File Naming
7. Recording Another Configuration
8. Assembling the takes in folders
9. The Altiverb™ IR Preprocessor
10. About editing the takes

1. Determining what to record

We want to get possibly two samples with quadraphonic output. This will also result in four stereo samples. We need the two quadraphonic samples with both mono and stereo input. The recordings are made at a 48 kHz because we want to use the Impulse Response files mainly in 48 KHz projects; the time required for preset switching will be less when the IR sample rate matches the projects sample rate. Using 24-bit recordings provides sufficient definition in the end of the reverb tail for use with high-quality audio files.

2. Selecting gear

The following recommendations are included merely as a guideline; there are many alternatives which will provide equal quality.

Microphones and Pre-amps

We prefer to use omnidirectional microphones. We have had good results with Bruel & Kjaer 4006 and 4003's (Bruel & Kjaer are now doing business under the name DPA). We use four microphones—they should preferably be matched to each other, but two matched sets will also work.

Using a microphone pre-amp will allow you to set identical levels on all 4 inputs without having to calibrate by watching meters. We use a Metric Halo Mobile I/O for our pre-amp, since it has the 24-bit AD converters we require. Since the built-in microphone inputs on some other audio interfaces are often not very sensitive, you may need another separate microphone pre amplifier to get a sufficient input level so that the audio interface can make use of the 24 bits of AD resolution.

Speaker

We use one or two self-powered studio monitors for playing back the sine sweep tones we use when making recordings. We have used a Genelec S30 when creating most of our own Impulse Responses—we find that the Genelecs add only a small amount of coloring to the direct sound, which means that the resulting direct sound in the IR will sound very much like the bypassed signal when using the Altiverb.

Recorder:

Although any recorder that can record 4 channels of 24-bit audio can be used, it is convenient if you can use the same recorder to play back the sine wave sweep tone. In the following example, we will be recording directly into a Macintosh.

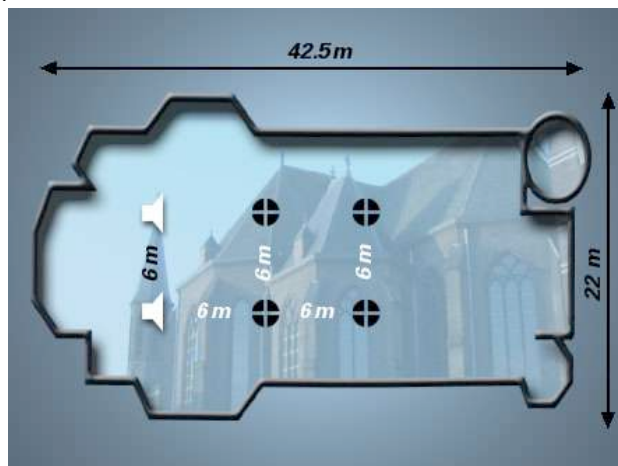
You'll also need a measuring tape, masking tape for marking microphone locations, and something to make notes on.

3 Setup

You should find an isolated listening environment to use as a “control room” when making recordings. You can use closed headphones for monitoring if an isolated listening environment isn't feasible.

The studio monitor should be set up first, and placed at center stage. After we set up the monitor speaker, we play back a loop composed of some dry sounds (we use a sequence trumpet, drums, and vocal material) and we will walk down the center of the space to find distances from the monitor speaker that sound nice.

If we are working with two monitor speakers, we generally space the left and right stage speakers the same distance as from the speakers to the front most set of microphones—about 7 meters (21 ft.). The rest of the microphone spacing follow from this initial distance. We have used the following configuration several times with good results:



All distances are set to 6 meters (20 ft). This setup will produce a decent difference between the front and the rear microphones. If the distance between left and right microphones is too small, there will be small differences between the left and right output channels of the reverb and the resulting Impulse Responses will have too much bottom end. A left-right microphone spacing of between 2 and 6 meters (6-36 feet) gives a nice deep stereo image.

No pillars should interrupt the line of sight between each speaker and microphone position. In addition, speakers and microphones should not be too close to the ground, walls, or pillars. We normally mount the studio

monitors on a 1.5 meter (4.5 foot) stand facing the room. Microphones are normally mounted at or just above the level of the speaker's tweeter. If the microphone is mounted too high, you'll lose high frequency response in the direct sound, because you are moving out of the tweeters "sweet spot"—as a rule, the height of the tweeter is understood to be the height of the speaker.

You should make good notes on speaker and monitor placements during the recording session. It will help you when you create graphic overviews of them as later reference.

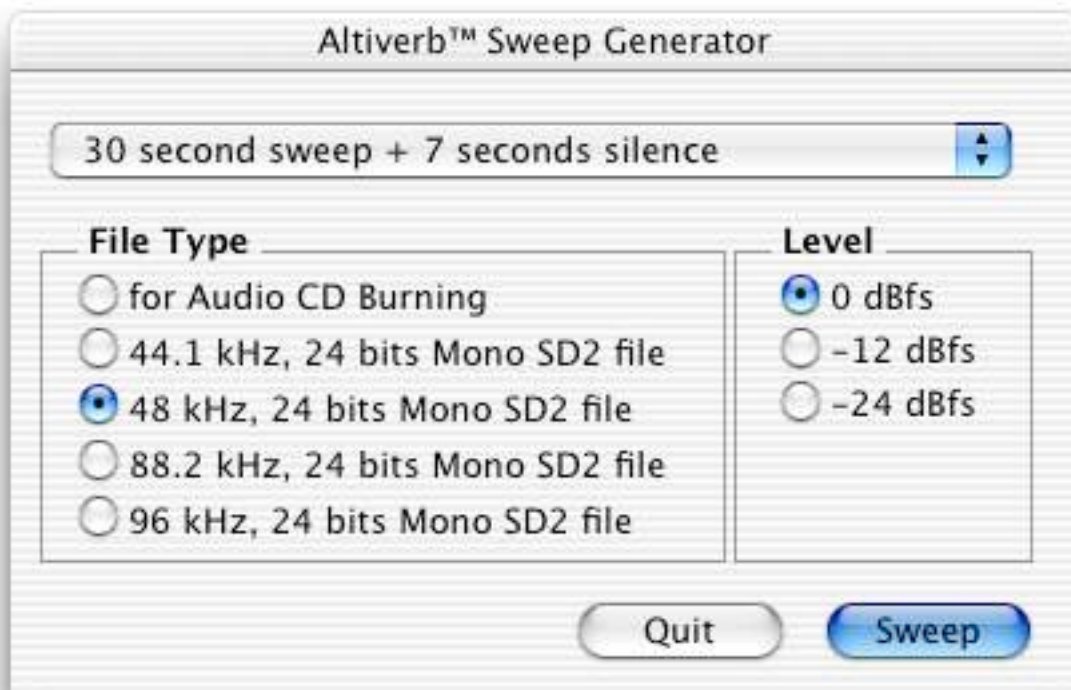
Good microphone and speaker placement is very important. If the center of the sound stage doesn't reach the front microphones at the same time, you'll get an off-center stereo image, or the recordings you produce with the resulting Impulse Response may not be usable for mono output. For more information on measuring the 90 degree angles that you'll need to be properly aligned, see Appendix A.

The microphone connection to audio tracks should follow this scheme:

mic nr	position
1	front left
2	front right
3	rear left
4	rear right

4. Creating the sweep Tone

To create the sine wave sweep tone, launch the Altiverb™ Sweep Generator, and set it up as follows:



Sweep Length

When choosing the length of time used for a sine wave sweep, you should consider the following:

Using a longer sweep tone will provide a better signal-to-noise ration in the final IR, but you'll need to spend more time at the recording venue and the longer time required for a recording will mean there's less chance of a take free of incidental noise. In practice, you may need to record a couple of longer sweep tones and pick the one with the least incidental noises. In addition, the resulting recordings will require more system memory for processing and consume more processing time when using the Altiverb IR Preprocessor.

If you're sampling in a reasonably silent recording studio, 10 or 30 seconds will produce good quality Impulse Responses. For a space like a cathedral in a city center, you may need 300 second sweeps.

Silence length

As rule of thumb you should choose the silence length twice as long as the reverb time of the venue. 3 seconds should only be used in small, dry rooms. 7 or 10 is ok for larger rooms and (small) concert halls. Cathedrals will need 16 seconds or even more, and piano's (without dampers), silo's, canyons etc. might need 45 seconds of silence.

File Type

If you want to play back the sweep tone from a CD connected to your monitor, you'll need to create a CD using a program such as Apple's iTunes or Roxio Toast. You'll find a 44.1 kHz 16-bit interleaved stereo AIFF file called 'for Audio CD Burning' with audio in the left channel and silence in the right channel that you can use. You should burn this file to an audio CD.

If you'd like to learn more about the limited advantages of higher samples rates in IR recording, read the section "*Altiverb and Sample Rates of 88.2 kHz and Higher*" on page 25 of the Altiverb manual..

Level

If you're going to play the sweep tone back from a CD player you've connected directly to an active studio monitor speaker, the input level may be too hot for the studio monitor to handle without distorting. While it be best to put an attenuating fader between the player and the monitor, this may not be practical in the field. In a situation like this, you may want to create a sweep tone at a lower amplitude level.

Now drag the sweep file onto a playback track. You'll notice that the file does not have a flat envelope—the envelope you see is provided to better fit the distortion limits of most speakers.

5. Level adjustments

Setting Sweep Playback Levels

You can save time setting playback levels by setting them in your studio before you leave, and making a note of the levels you use. You can then use them when you're making field recordings. Start by playing the sine tone back at a low volume level and listen to the clean signal. You should then turn up the output levels until the sound of the sweep tone begins to change (3rd harmonic distortion will make it sound a bit like a square wave — it isn't very difficult to hear distortion in a sine tone), and then back off the volume 3 dB and verify that the sine sweep is smooth again. You can then use these settings when you do field recordings.

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If you have not set your playback levels in advance, you should begin by setting the playback level for the sweep tone at about -40 dB to avoid overloading and damaging your speaker and then gradually increase the playback level. The goal is to play back the sweep tone on the speakers as loudly as possible without speaker distortion, since a louder, distortion-free sweep tone will give you a better signal-to-noise ratio.

When you first connect the playback channel directly to an active monitor, it will almost certainly be too loud. You can protect your monitor by setting its output at a low level along with the sweep tone's output fader. If you maintain a constant playback volume by turning down the monitor speaker's volume while you increase the volume of the sweep tone's playback fader, you will be increasing the resolution of the output signal.

Noise, Hum, and Other Environmental Concerns

In order to determine whether there is any noise or a hum that needs fixing, you should ask everyone else to be silent (if you're not alone) and turn the volume on your headphones way up, and listen.

If you find a hum in the recording system, make sure you separate any amplifiers and computers from mic lines. If you can, you should set your preamp for mic levels so that your audio travels at line levels for the most part. If you've got a ground loop, you'll need to lift the earth connection from one or more of the power cords you use.

The lighting in a space is a potential source of hum—especially lighting systems that use dimmers. Sources of hum include the actual lights themselves, and also hum propagated through your own system's wiring. If possible, we suggest that you sample in darkness to avoid these problems, and to use flashlights when you move about a room while the recordings are taking place. You should also keep in mind that the light fixtures themselves may continue to produce noise as they cool after they're turned off, maybe even for as long as 15 minutes.

If possible, shut down the air-conditioning in the hall. While the sound artifacts produced by air-conditioning in a large hall are normally too low in frequency to be audible, they will show up clearly in your level meters and may distort your recordings. Heating is also potential source of problems—it makes air move, and also makes buildings expand and contract, resulting in various kinds of unwanted noise.

While lower ambient noise levels are always better, you don't need a completely silent room—we've made some very good Impulse Response recordings even with clearly audible traffic noise.

Setting the microphone levels

The speaker should still be located at its center stage position. Now play back the sweep in a loop in order to determine the levels on your mic pre amps. It is very difficult to make any corrections at a later stage, so it is important that the left-right balance is perfect. Some preamps are not matched carefully or do not have very precise gain controls. Since it's quite possible that the space you're in isn't symmetrical with respect to left and right sides, unequal levels will cause peaks and troughs along the sweep at different positions in different channels. This will make adjusting levels very difficult, either by using your ear or by watching the level meters. If you really need to do leveling by ear and eye, you should play back either white noise or music rather than the sweep tone. However, it's best if you can simply and reliably copy the setting of one channel to the other.

Move the speaker to its stage left position. The left channel microphones should now get a louder signal, so you should confirm that you still have enough headroom for the recording. If you need to decrease the gain of the left mic a bit, you should also decrease gain of the right mic by the same

amount. When you've completed this step, you'll have a single setting that will work when recording from all three stage positions.

You should write down all the gain values for your future reference.

At this point, we normally also make a reference recording—we play back the same dry mono audio file we used when listening to the space and finding mike positions earlier, and record the results using the four microphones. We find it valuable to be able to compare the resulting recording to the same dry audio file being played back through Altiverb later on.

6. Recording and naming files.

At this point, your speaker should still be set up at stage left. Wait until the room is silent and begin recording. You will hear a short beep after the silence following the sweep tone, which indicates you can stop recording. If you stop recording before you hear the beep, the take will be unusable.

Make sure your four audio files are properly named and saved. You should rename the recordings immediately after they are made to avoid mistakes later on.

The four audio files resulting from playing back the sweep tone and recording it from stage left should be named using the naming convention:

Venue - configuration.speaker position.microphone number

<i>mic nr</i>	<i>position</i>	<i>sound file name</i>
1	front left	Main Hall config one.L.1
2	front right	Main Hall config one.L.2
3	rear left	Main Hall config one.L.3
4	rear right	Main Hall config one.L.4

You should now move the speaker to the center position you have measured and marked with tape earlier. Repeat the recording process above, keeping notes. Use the following naming convention for these files (C stands for Center):

:

<i>mic nr</i>	<i>position</i>	<i>sound file name</i>
1	front left	Main Hall config one.C.1
2	front right	Main Hall config one.C.2
3	rear left	Main Hall config one.C.3
4	rear right	Main Hall config one.C.4

C stands for Center.

Move your speaker to the marked stage right position and repeat the recording sequence, naming the resulting audio files as follows:

<i>mic nr</i>	<i>position</i>	<i>sound file name</i>
1	front left	Main Hall config one.R.1
2	front right	Main Hall config one.R.2
3	rear left	Main Hall config one.R.3
4	rear right	Main Hall config one.R.4

When you've completed this step, you already have the data to create a few good IR's.

7. Recording using a second microphone configuration

If you've still got some time, perhaps you can record another configuration. If you have time, you may want to process the recording files you've made on-site to create a 'preview IR.' That way, you can try out your new IR in Altiverb and decide what you'd like to do next based on your recordings—if you've used the file naming we've described above, you can do this pretty quickly. The procedure for doing this is described in sections 8 and 9. If your time is short, you may just want to record another configuration while you have your gear set up.

We normally choose different mic positions rather than different stage positions when recording for a second configuration, since it's handy to use the same speaker positions you've already measured and marked.

Suppose the configuration in picture one is your first recording situation. You can now record the same microphone "square" with the front mics at 9 meters or 27 feet (right between the previous front and rear mics). You will then have microphone distance recordings for positions at 6, 9, 12, and 15 meters.

For a really 'wet' sound, you can move the front pair of mics all the way to 18 meters. You will then have microphone distance recordings at 6, 12, 18, and 24 meters.

Using precisely the same stage portions for the speaker for the second set of recordings will allow you to create 6 different 4-channel combinations from these four distance recordings.

Regardless of where you place your microphones, it saves time to start recording with the sweep tone being played back from their current location (which should be stage right, after you've completed your first set of recordings). This would also be a good time to make another reference recording.

It's also probable that the gains for your microphones will need to be adjusted a bit. Make sure you adjust them symmetrically, if you adjust them at all.

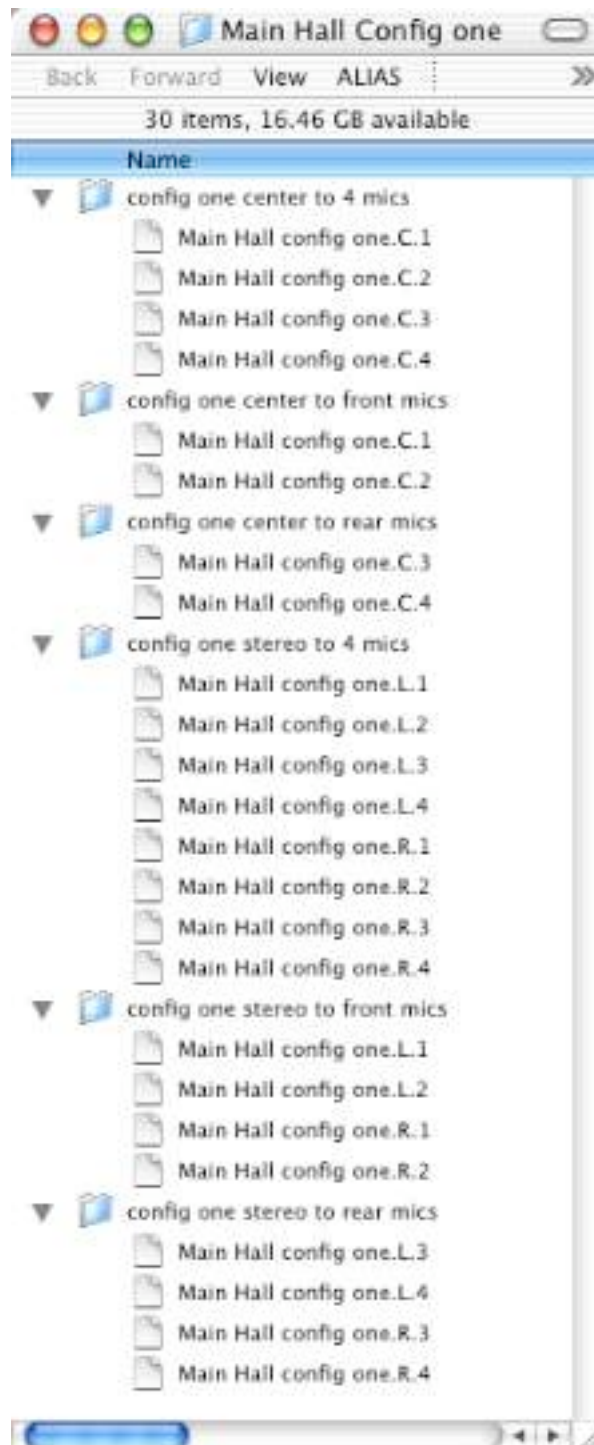
You should name your take files using the following convention:

<i>mic nr</i>	<i>position</i>	<i>sound file name</i>
1	front left	Main Hall config two.R.1
2	front right	Main Hall config two.R.2
3	rear left	Main Hall config two.R.3
4	rear right	Main Hall config two.R.4

Repeat this naming procedure for the center and stage left audio files.

8. Assembling the takes in folders.

You should now assemble the take files you've created in the properly named folders. These folder names will appear as the preset names in the Altiverb IR selection pop-up menu you see when you use the Altiverb. Using the file take names described in section 6, we can construct the mono input IR's and stereo input IR's:



9. The Altiverb™ IR Preprocessor

- Create a new empty folder in your *Impulse responses* folder (located in the *Applications/AudioEase/Altiverb* folder and call it for instance “*Main Hall*” This phrase will show up as the gray category item in the Impulse responses Pop up in Altiverb.
- Drag all the folders you have just created onto the Altiverb™ IR Preprocessor application.

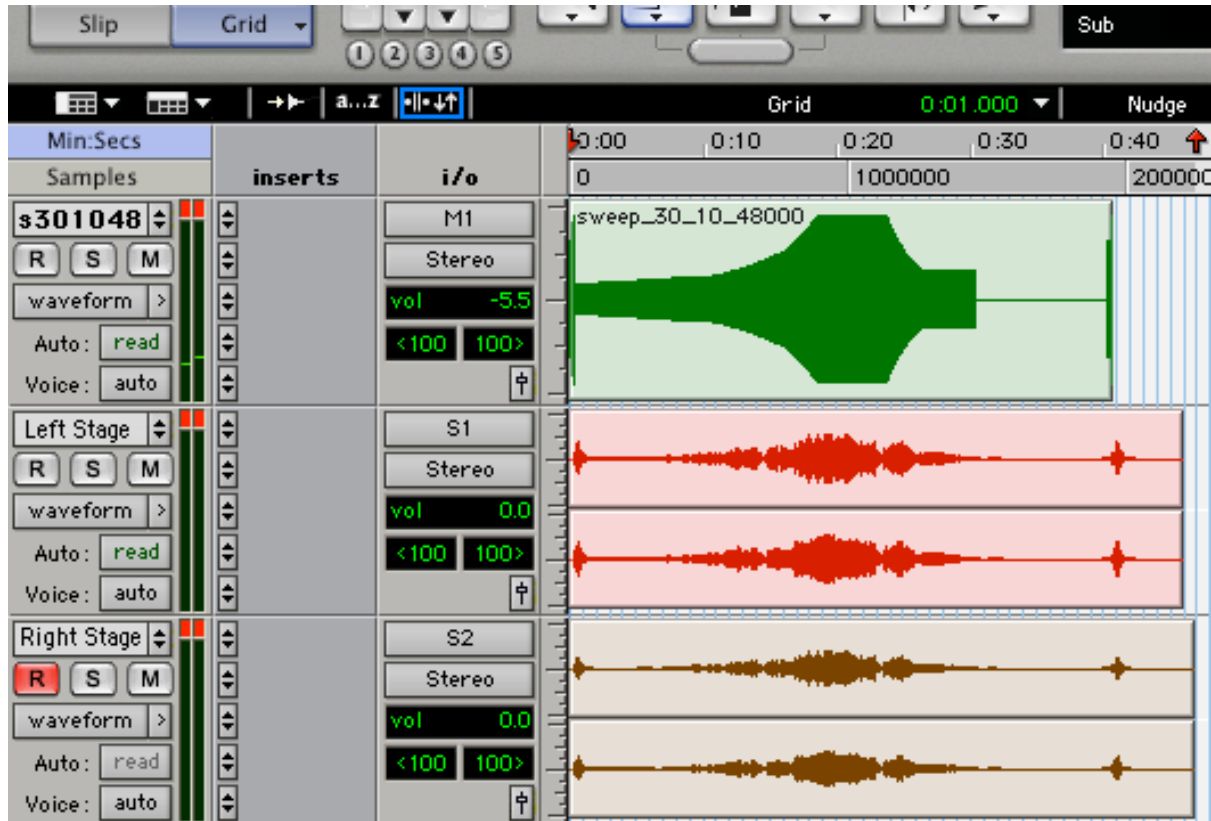




- Click on the upper Select button and choose the file “*Sweeps - not to be equalized*” located in the *Altiverb IR Preprocessor/Pre-processor Correction Files* folder.
- Click on the output folder Select button and select the empty “*Main Hall*” folder that you have just created inside the *Altiverb/Impulse Responses* folder.
- Optionally you can manually select the sweep you used while recording. This speeds up the sweep determination process. In case you get a sweep determination error this will help processing your files too. Do this by selecting *Settings* from the *edit* menu and choosing the sweep you used during recording.
- Click on the Process button.
The Altiverb™ IR Pre-Processor will automatically correct playback and recording clock deviations, edit beginnings and endings, fade tails into the noise floor and correct for the characteristics of specific Boomboxes. It will equalize levels to make the Impulse response fit in with other impulse responses, and place the results in your *Altiverb/Impulse Responses/Main Hall* folder.

You are now ready to launch your sequencer or audio editor to listen to your new IR's in Altiverb.

10. About editing the takes



1. The picture above shows a stereo-to-stereo Impulse Response recording session. Since the left stage and right stage recordings from the session shown here are already in perfect sync with one another, the files from this session can be used without editing.
2. If you have created your Impulse Response recording by playing a CD and recording the results to a DAT machine, you will need to use an audio editor to extract the recorded takes from your DAT recording. In this case, you should treat the left stage and right stage recordings as mono to stereo Impulse Responses—once they have passed through the preprocessor, you can put them in a single folder to create a stereo-to-stereo Impulse Response (but not before preprocessing).
3. There is a third possibility: you can record on a multitrack tape machine and use it much like the computer recording example above (1.). Play back from track 1 and record, in multiple runs, on the tracks below that. Transfer all tracks in sync to your audio workstation including the original. When you edit the recordings you can use the original as a guide. This will enable you to assemble a stereo to stereo IR before you drop it on the IR-Pre-Processor, and thus preserve inter channel time delays better.