ECHO Project 2L-PRISM Array

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2L

Our aim in the ECHO-project is to examine and compare how different microphone arrays captures a musical performance at the same position in a room simultaneously. Given the complexity of the mechanics of 108 microphones in the same space, the placement was a best guesstimate based on our common experience. It was not possible to move the microphones once the session was started. There was also limitations in how to monitor and enable critical listening to multiple arrays at the same time. The sounding result only constitute one part of what is the process of recording music. Normally we would listen and adjust placement of the microphones, then engage with the musicians in their sound making.

A secondary perspective of this experiment is to examine how the placement of the musicians in the room affects our sonic and musical perception. The same music was recorded with the orchestra in a circular layout around the listener and in a more traditional stage layout. The microphone arrays were stationary and representing the listener.

The 2L-cube is really a direct consequence of the speaker configuration in the immersive playback systems. Time of arrival, SPL and on-axis HF texture is directly preserved in this 7.1.4 microphone configuration. Proportions are cubical and the dimensions could vary from 150 cm for a large orchestral array down to 40 cm in an intimate chamber musical context. I always use true omnidirectional microphones in the main array. Depending on the room, the music and the instruments, I alternate between the DPA 4003 and the 4041, the latter with the larger membrane providing a more focused on-axis texture. Refining the microphone array is a constant evolution. We started with a 2L-cube for 5.1.4 then expanded it with side-fills within the cube for 7.1.4. Lately, we tend to stretch the cube into a 2L-prism where the sides are now the surrounds, and the surrounds slide further back to become rears. The typical dimensions are one meter wide, two meters deep and one meter high. Our philosophy is simple; one microphone straight to one speaker. The important aspect is to configure the array so time of arrival is captured and released in natural order.

Array-Only (puristic microphone capture)

The seven 4041-S in the bed layer is a matched set from DPA and serves as a reference in the array in terms of both sensitivity and spectral qualities. These are at equal gain thru all stages and is our reference level in gain structure.

The four DPA 4006 used as height microphones in this experiment is not a matched set. Unfortunately, the reference is somewhat compromised as front and rear are different yearmodels. Sensitivity differs by 13 dB between the four, not limited to pairs. The left rear height also feature an elevated THD (distortion) especially noticeable on the sound of the violins.

To balance the heights with the bed reference, the following gain compensation has been applied:

Left front height: +11 dB Right front height: +13 dB Left rear height: +2 dB Right rear height: 0 dB

Orchestra Front IR M S	TrainJourney1 a201 ML_L Circ_01 (1) - Peak -9.7dB2.7dB
No Input P Fx V E A	
Orchestra No Automation +	TrainJourney1 a202 ML_R Circ_01 (1) - Peak -10.5dB2.7dB
R Front IR M S	
Orchestra No Automation	
2 Center IR M S	TrainJourney1 a203 ML_C Circ_01 (1) - Peak -10.0dB2.7dB
Orchestra Gain Bus 1 Gain 🕂	
3 LFE1 IR M S No Input P Fx V E A	TrainJourney1 a212 ML_LFE1 Circ_01 (1) - Peak -32.9dB15.7dB
Orchestra Gain Bus 1 Gain 📑	
4 E LFE2 IR M S No Input P Fx V E A	TrainJourney1 a213 ML_LFE2 Circ_01 (1) - Peak -6.9dB13.7dB
Orchestra Gain Bus 1 Gain 🖶	····
5 Surround IR M S	TrainJourney1 a204 ML_Lss Circ_01 (1) - Peak -9.9dB2.7dB
Orchestra Gain Bus 1 Gain +	
SS Surround IR M S No Input P Fx V E A	TrainJourney1 a205 ML_Rss Circ_01 (1) - Peak -11.6dB2.7dB
No Input P PX V C A Orchestra No Automation +	
6 Rear IR M S	TrainJourney1 a206 ML_Lrs Circ_01 (1) - Peak -10.1dB2.7dB
No Input P Fx V E A Orchestra Gein Bus 1 Gein +	
	TrainJourney1 a207 ML_Rrs Circ_01 (1) - Peak -9.4dB2.7dB
No Input P Fx V E A Orchestra No Automation +	
7 Hight Front	TrainJourney1 a208 ML_Tfl Circ_01 (1) - Peak -22.3dB - 8.3dB
No Input P Fx V E A Orchestra Gain Bus 1 Gain +	
E Thight front	TrainJourney1 a209 ML_Tfr Circ_01 (1) - Peak -23.4dB - 10.3dB
No Input P Fx V E A Orchestra No Automation	
8 Height roor IR M S	TrainJourney1 a210 ML_Trl Circ_01 (1) - Peak -14.1dB0.7dB
No Input P Fx V E A Orchestra No Automation	
ET Height rear	TrainJourney1 a211 ML_Trr Circ_01 (1) - Peak -10.6dB2.7dB
No Input P Fx V E A Orchestra No Automation	
Perc 1 I Front IR M S	TrainJourney1 b201 ML_L Circ_01 (1) - Peak -3.2dB4.3dB
No Input P Fx V E A	
Perc 1 No Automation	
Perc 2 Pront IR M S No Input P Fx V E A	TrainJourney1 c201 ML_L Circ_01 (1) - Peak -13.0dB4.5dB
Perc 2 No Automation	
Reamp Front IR M S	TrainJourney1 d201 ML_L Circ_01 (1) - Peak -15.6dB6.3dB



Lfe1 (Perc) and Lfe2 (Double Bass) low-pass filtered at standard 120Hz 24dB/octave.

The layer for the traditional orchestral setup has been gained 1dB more to compensate for the fact that a larger number of musicians are seated further away from the microphones compared to the circular layout.

These are the resulting ADM files labeled «raw»:

Trim And Downmix Controls		Immersive Master Pro		
Trim and Downmix	← Add Input Files	Immersive 🔅 Master I	Pro	
5.1 and 5.1.x. LoRo – default 🗸	ECHO-project 01 Train Journey 1 - circular - 2L - RAW.wav		Immersive Master Pro 1.1.0	Type: ADM
5.1 to 2.0: LoRo - default 🗸				Channels: 12 Objects: 4 Beds: 1
2.0 Direct 5.1 & 2.0 5.1.2 5.1.4 7.1	Track Name	TD RSC Start Time E	ind Time Duration Integrated	dbTP Gain
	 ECHO-project 01 Train Journey 1 - circular - 2L - RAW ECHO-project 02 Train Journey 2 - circular - 2L - RAW)3:02:50:15 00:02:50:15 -19.40 LKFS)3:06:16:20 00:03:21:20 -25.36 LKFS	
Surround -3 dB	 ECHO-project 03 Train Journey 3 - circular - 2L - RAW ECHO-project 04 Schreker - circular - 2L - RAW 	03:08:39:00 0	03:08:34:23 00:02:14:23 -22.03 LKFS 03:10:53:03 00:02:14:03 -22.25 LKFS	5 –6.85 dBTP 0.00 (
Height -3 dB	 ECHO-project 05 Train Journey 1 - traditional - 2L - RAW ECHO-project 06 Train Journey 2 - traditional - 2L - RAW ECHO-project 07 Train Journey 3 - traditional - 2L - RAW 	03:14:04:00 0)3:14:00:23 00:02:50:15 –21.08 LKFS)3:17:26:20 00:03:22:20 –25.07 LKFS)3:19:45:08 00:02:15:08 –20.67 LKFS	5 –8.83 dBTP 0.00 d
FRONT/BACK BALANCE	 ECHO-project 07 train journey 3 - traditional - 2L - RAW ECHO-project 08 Schreker - traditional - 2L - RAW)3:22:14:10 00:02:24:10 -22.47 LKFS	
Overhead 0 %				
Listener Plane O % B F				
Auto trim settings		■● Dolby Atmos		Process

Presentation Mix

Source levels for all microphones in the array is the same as for the RAW.

Level modification from raw to mix: Bed: +1dB Heights: -1dB This is to give a slight priority to direct instrumental texture over diffuse room.



DSP, Rear microphones in bed: The rear pair 4041-S is pointing directly to the string instruments for maximum on-axis response. In a regular recording session I would have shifted the angle upwards to smoothen the texture. To simulate a slight off-axis response of the 4041-S an EQ 6.17kHz 2Q -1.6dB has been applied.



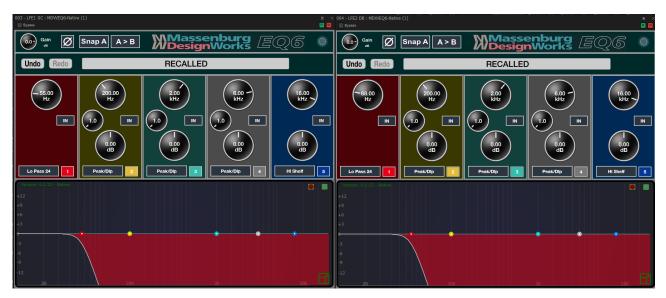
DSP, height front microphones: These microphones had both the black diffuse field grid and the APE50 that made for a somewhat brittle spectral character. This EQ emulates «undo» and seek to reset to what a DPA 4006 with regular grid and without the APE could have sounded like. EQ 9kHz 1.4Q -5dB



DSP, height rear microphones: These microphones had the APE50 that made for a somewhat brittle spectral character. This EQ emulates «undo» and seek to reset to what a DPA 4006 without the APE could have sounded like. EQ 4.74kHz 3.6Q -3.69dB. This EQ also limits the impact of the elevated THD of the faulty left rear height microphone.



DSP, Lfe1 (Perc) has been low-pass filtered at 55 Hz 24dB/octave. Lfe2 (Double Bass) has been low-pass filtered at 65 Hz 24dB/octave.



DSP, Lfe1 and Lfe2: 14ms delay to align with Center channel in bed



A Stratus-3D reverb is fed equally from all source layers and comes back into the mix attenuated by 18dB. Early reflections are reduced in the reverb algorithm as what I seek is a tail while preserving clarity.



On the Master Bus there is MQA deblur and Noise Shaped Dither to 20-bit.



For the RAW all metadata is set to Default Dolby trim values and Near BIN. For the MIX the trim is set to manual and instruct a 9dB attenuation of the heights when folding down from immersive to surround and to stereo. Heights are set to Mid BIN.

us Channels	Assignment	Description	Group	Binaural Render Mode
tmos	Bed + Top/Wide Channels	as Objects		
tmos - L	001 - Main Bed - L	Atmos	7.1.4	Near
tmos - R	002 - Main Bed - R	Atmos	7.1.4	Near
tmos - C	003 - Main Bed - C	Atmos	7.1.4	Near
tmos - LFE	004 - Main Bed - LFE	Atmos	7.1.4	Off
tmos - Lss	005 - Main Bed - Lss	Atmos	7.1.4	Near
tmos - Rss	006 - Main Bed - Rss	Atmos	7.1.4	Near
tmos - Lrs	007 - Main Bed - Lrs	Atmos	7.1.4	Near
tmos - Rrs	008 - Main Bed - Rrs	Atmos	7.1.4	Near
tmos - Ltf	011 - Object 1	Atmos - Ltf	7.1.4	Mid
tmos - Rtf	012 - Object 2	Atmos - Rtf	7.1.4	Mid
tmos - Ltr	013 - Object 3	Atmos - Ltr	7.1.4	Mid
tmos - Rtr	014 - Object 4	Atmos - Rtr	7.1.4	Mid
vnmix Controls 5.1 downmix n Controls	Direct Render	~	5.1 to 2.0 downmix Lo/R	to ~
5.1 and 2.0	✓ Set Default	Trim :	Surround Height	-3.00 d
Automatic		Front/back balance :	Overhead B	F 0%
Manual		Frontyback balance :	Listener plane B	F 0%

These are the resulting ADM files labeled «mix»:

Trim And Downmix Controls		Immersive Master Pro	
Trim and Downmix	← Add Input Files	Immersive 🔅 Master Pro	
5.1 and 5.1.x Direct render V	ECHO-project 01 Train Journey 1 - circular - 2L - MIX.wav	Created with: Pyramix Virtual Studio 14.0.0 Bit Depth: 24 bit Duration: 00:02:50:15	Type: ADM Channels: 12
5.1 to 2.0: LoRo - default ✓ 2.0 Direct 5.1 & 2.0 5.1.2 5.1.4 7.1		Frame Rate: 24 Stort Time: 03:00:00.00 Somple Rote: 48KHz FFOA: ::	
	Track Name	TD RSC Start Time End Time Duration Integrated d	IbTP Gain
	 ECHO-project 01 Train Journey 1 - circular - 2L - MIX ECHO-project 02 Train Journey 2 - circular - 2L - MIX 		-1.73 dBTP 0.00 c
Surround -3 dB	 ECHO-project 03 Train Journey 3 - circular - 2L - MIX ECHO-project 04 Schreker - circular - 2L - MIX 	O 03:08:39:00 03:10:53:03 00:02:14:03 -22.36 LKFS -	-7.74 dBTP 0.00 d -6.95 dBTP 0.00 d
Height -9 dB	 ECHO-project 05 Train Journey 1 - traditional - 2L - MIX ECHO-project 06 Train Journey 2 - traditional - 2L - MIX 	● 03:14:04:00 03:17:26:20 00:03:22:20 -25.13 LKFS -	-6.61 dBTP 0.00 d -10.19 dBTP 0.00 d
FRONT/BACK BALANCE	 ECHO-project 07 Train Journey 3 - traditional - 2L - MIX ECHO-project 08 Schreker - traditional - 2L - MIX 		-5.88 dBTP 0.00 d -6.65 dBTP 0.00 d
Overhead O %			
Listener Plane O %			
		Delby Atmos Proc	cess