ECHO Project

PAMA Array

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Preamble:

This accompanying document gives an overview of the basis and rationale behind the PAMA array, the building of templates and routing, and a description of the Array-Only and Presentation mix workflow. This includes text values or screen grabs of many of the effects including the additional reverbs, levels, use of spots, some of my thinking behind the mix approach, and my initial reflections on the array, process, and some things I'd do differently next time round.

Rationale

Stemming from orchestral film and game music, PAMA (*Prototype Atmos Microphone Array*) is an in-progress design that aims to extend traditional recording configurations into the immersive space, while ensuring Dolby Atmos compatibility across theatrical and home entertainment platforms, and consecutive fold-downs and workflows typical of media score delivery.

Delivery to multiple end-user formats, for example from Atmos to 5.1 theatrical or streaming, stereo, and Apple binaural, is something I was particularly interested in.

The idea behind the array is to self-correct observed issues for theatrical and HE playback by a combination of polar patterns and their relative spacing. The use of bidirectional microphones help with the observed side-surround/surround array high load of information (especially in the lower mids characteristic of omnidirectional microphones) through their inherent equalisation, as well as extending the natural ambience of the recordings through their non-directionality front-to-back, and in combination with the rear super-cardioid microphones and wide channels, work well in decorrelation and provide good fold-down characteristic. The height channels assigned as overhead objects, when panned 25% in front and rear cardinal points (75% on the PT panner), suitably address theatrical arrays and HE systems in facilitating overhead L/R and F/R, further addressed by the rear Height mics being 10cm higher than the front Heights.

PAMA Configuration:

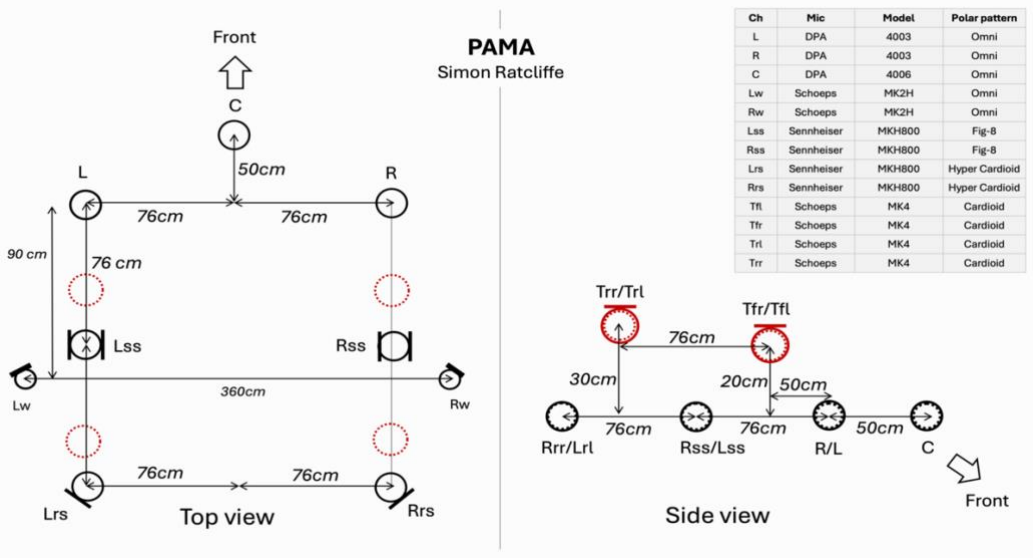
Based on a modified Decca Tree + wide pair, and extended by sides, rears and height microphones, reflecting 7-0-4/9-0-4 speaker configurations. By addressing the beds, but preserving the heights as a quad-width object, a combination of speaker arrays and front-to-back height can be addressed to extend the soundstage. It should be noted that these "speaker centric" or channel based configurations are in no way intended as the target of the scores themselves, and I am quite an advocate of using the full room space and

objects where appropriate. However, the use of speaker arrays in theatres cannot be overlooked and are desirable in disseminating ambience and reverb to a seated cinema or theatre audience, and are compatible with HE playback.

Use and Limitations

As the idea behind PAMA is largely driven behind extending the soundstage while aiming for downmix compatibility, it is specifically suitable for traditional ensemble layout or variations thereof in which the ambience behind and to the side of the ensemble is factored into the recording. This is in-part also through my observations of Atmos enabled reverbs which, while quite correctly summing out the additional channels during downmix, often lead to an impression of a dryer sound when played back in stereo.

Due to this, PAMA is tragically ill suited for circular layout recordings and while out-of-scope for this project, the circular outputs included here are purely for academic interest (and a good laugh!)



Ch	Mic	Model	Polar pattern
L	DPA	4003	Omni
R	DPA	4003	Omni
C	DPA	4006	Omni
Lw	Schoeps	MK2H	Omni
Rw	Schoeps	MK2H	Omni
Lss	Sennheiser	MKH800	Fig-8
Rss	Sennheiser	MKH800	Fig-8
Lrs	Sennheiser	MKH800	Hyper Cardioid
Rrs	Sennheiser	MKH800	Hyper Cardioid
Tfl	Schoeps	MK4	Cardioid
Tfr	Schoeps	MK4	Cardioid
Trl	Schoeps	MK4	Cardioid
Trr	Schoeps	MK4	Cardioid

PAMA Array

The Mixes

The mixes presented here are Array-Only traditional layout (with accompanying circular layout outputs for academic interest as mentioned above) and a Presentation mix of each piece. I received the audio in Pro Tools, mixed in Nuendo using the native Atmos renderer, QC'd in Dolby DAR and assembled and checked the desired volume target of -23LUFS in the Dolby Album Assembler. I monitored on ATC SCM50ASL's and IK MTM iLouds, Sennheiser HD560s and APL Virtuoso, and since I was traveling during the project, Neumann KH 420 + surrounds for the last few hours.

Array-Only - Traditional Layout

All the Array-Only mixes are all set as follows:

L 0dB
C -1.5dB
R 0dB
Left Wide 0dB, panned F/R (towards side surround) 70 (30% in from front)
Right Wide, panned F/R (towards side surround) 70 (30% in from front)
Lss -0dB
Rss -0dB
Lrs +9dB
Rrs +9dB
Tfl +5dB
Tfr +5dB
Trl +6dB
Trr +6dB

It was agreed that Pass D (the re-amp) would be set -3.6dB when compared with Pass A.

All Atmos binaural metadata was set to NEAR and folddown DEFAULT (given that the ADMs are meant to be evaluated binaurally with the supplied Virtuoso exports.)

No LFE was utilised.

A small amount of corrective/non-Presentation EQ was utilised as follows, with the aim of using as little as possible.

L/C/R and Wides -1.2dB at 103Hz Q: 1.3.
Wides: -2dB at 5.93KHz Q:2.1 and -1.6 at 9.71KHz Q:1.5. Hi pass at 50Hz
Lss/Rss/Ls/Rs: -1dB at 394Hz Q:1.0
Tops: 80Hz High pass, -1.6dB at 409.7Hz Q2.1, -3dB at 161Hz Q: 2.4, -2.2dB at 267Hz Q4.5
The 7.1.2 Bed had a linear EQ -0.3dB cut at 212Hz Q2.9 and -1.9dB cut at 10KHz Q3.1 and a 25Hz hi pass.

Array-Only - Circular (FOR REFERENCE ONLY)

While out of the scope of this array as mentioned, the Circular Array-Only mixes are suppled as above and with the passes relative volume set as such against Pass A.

Pass B: -1.6dB
Pass C: -1.8dB
Pass D: -3.6dB

THE PRESENTATION MIXES

While the session build of the Schreker piece and the Train Journey pieces was the same in terms of routing and so forth, one of the things I really enjoyed about these Echo Presentation mixes was the different approach in the mixing I felt was necessary between the two, which I will comment on later. For now, suffice it to say that I opted to mix the Train Journeys more like how I'd approach a film score, which is more interventionist than when compared with the Schreker and it definitely led to some insight regarding the array for use in the two different applications, media vs classical.

The Atmos Metadata was set LCR Off, Sides Mid, Rear Far, Tops Far with Object OH for Train Journey 1 Mid and Fr for Train Journey 2 Far

The Session Build

Setting up a mix template and the Presentation mixes were accomplished as follows:

1) Pull in the data, routing and level correction.
2) Setting up groups, subgroups, FX (mainly reverbs) and a VCA for overall volume rides
3) Getting a sound up for the tree and ambient mics
4) Routing the spots to their appropriate subgroups and groups, and working on a 2nd reverb setup (see below)
5) Isolating where spots were required, and muting out or using volume automation for areas where not needed (ie, off for the most part by default, but bringing in channels for focus as needed). These were typically eq'd and processed in such a way that they just added focus, so were quite filtered at times.
6) Automation passes on spots against tree, and then overall using the VCA.

The arrays as described above in the Array-Only mixes are routed as such to a 7.1.2 Bed being L/C/R/Lss/Rss/Ls/Rs and LFE. I opted for 7.1.2 and not 7.1 mainly because I like having the standard bed width, but I knew I would want the option of .2 overhead low level reverb glue not only from the main array, but from the spot mics which would utilise an additional reverb.

The LCR Mics were dropped by -1dB for the Schreker piece compared to the Array-Only levels above, and were set back to the Array-Only levels for the Train Journey pieces.

The Top Channel mics were assigned to overhead objects 11-14.

The routing was as such-
Cardinal mic placements as described to the bed via a 7.1.2 with group (aux) named PAMA A in preparation for the Train Journey tracks that had a "D" pass, with the Wides panned in by 30% towards the Lss/Rss position and assigned to a stereo group (aux).
These in turn went to a Bed Master which was allocated to the renderer as a bed track (1-10.)

The four top mics were assigned to a PAMA A Quad group, which in turn was assigned to a QUAD width Object master.

The LFE mic (1) was sent to the PAMA A tree group LFE, with an 80Hz low cut and -2.2dB bell at 58Hz Q1 at -11dB, and was delayed by 14ms to line up with the tree. The Bottom mics were panned front and back and added to the PAMA A tree at -9dB, EQ and processing details to follow. I had not used bottom mics in this manner before but enjoyed what they brought to the overall sound when blended in.

The spot mics were clustered into Sub groups (Strings, Winds, Perc) and sent to a Spot A master group, which in turn fed the Bed master. Each of these was panned sympathetically to their layout position in relation to the tree, with the exception being the piano (panned towards the front) and the woodwind pair which I additionally also fed slightly into the OH Quad Objects Front as I like the additional sense of height with the woods elevated. (This is not how I normally do it, but this fits the Echo bed and object layout scheme.)

Eg: Strings solo 1 -> Strings subgroup -> Spots A group -> Bed Master

The Bed, OH and for Train Journey 1 and 2 Re-amp Group (PAMA D) and supplied Production stems group channels were assigned to a VCA for overall volume automation.

The Array channels were equalised as described above.

The SCHREKER main Tree channel was equalised as such using a combination of linear and dynamic EQ:

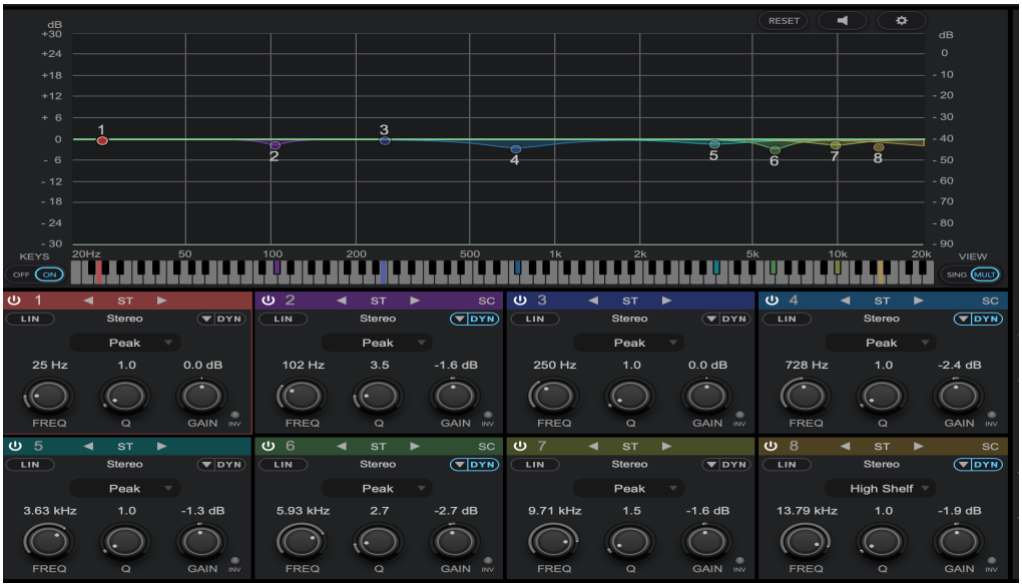
What I did find quite interesting with the piece compared to the Train Journeys was that I needed to add in the EQ band # 8 towards a sound that I considered more appropriate to the piece, which I'll comment on in "On Reflection" at the end of this document.

The TRAIN JOURNEY tracks had the following array processing:

UAD Massive Passive across all channels in 7.1.2 (incl LFE although but with no processing) and just the dynamic eq elements of above.

Copies of Massive Passive applied to Bed channels

For the SCHREKER Wide mics, the following EQ was used, as well as a small amount of width being applied with Waves S1 (1.25), and low threshold amount of Oeksound Soothe 2 set with a focus at 5.6KHz.



Strings Wide EQ-Schreker

For the TRAIN JOURNEY Wide mics, a small amount of multiband tape saturation was applied in 3 bands from 150Hz and up which employed a width control, which I felt created more warm articulation in those channels. The S1 was dropped.

REVERBS (All pieces)

The main reverb for the project was the Seventh Heaven M7, as well as a secondary reverb from Cinematic Rooms for the spot mics where it was possible to shape the proximity and edit the properties of each area (front, surround, rear, top) in order to create dimension around the spot mics before feeding it variously into the master reverb.

The main reverb by default was set variously from -16 to -18.5 across the Presentation mixes relative to the main array, and all the reverbs erred on low Crossfeed amounts as I wanted to feature the sonic characterists of the various mics that made up the array in a more discrete fashion without too much cross-triggering of the reverbs.

There was a curtailed version of the main reverb as a stand-alone (tighter and shorter) in a QUAD configuration for the object based OH/Top mics and channels.

Main Reverb

Example of Spot reverb for dimension (slight changes between tracks)

OH Reverb

The Bed Master had no processing on the SCHREKER, but I did opt to use a UAD Manley Vari Mu on each output for the TRAIN JOURNEY's, engaged but with no compression taking place. I went this route because this processor has a very natural inherent audio sculpting in that it gives a lift on top and subtle thickness while also creating some subtle room in the midrange, which is something I would typically look to create in film mixing, which I'll discuss in ON REFLECTION.

SPOT MICS

With the main array in place, I evaluated the spots to see where they could feature when necessary. Examples of this are the high solo violin part in the Schreker from approx 42s-50s, and the middle section of Train Journey 1 from 1m - 1m40s.

Strings:

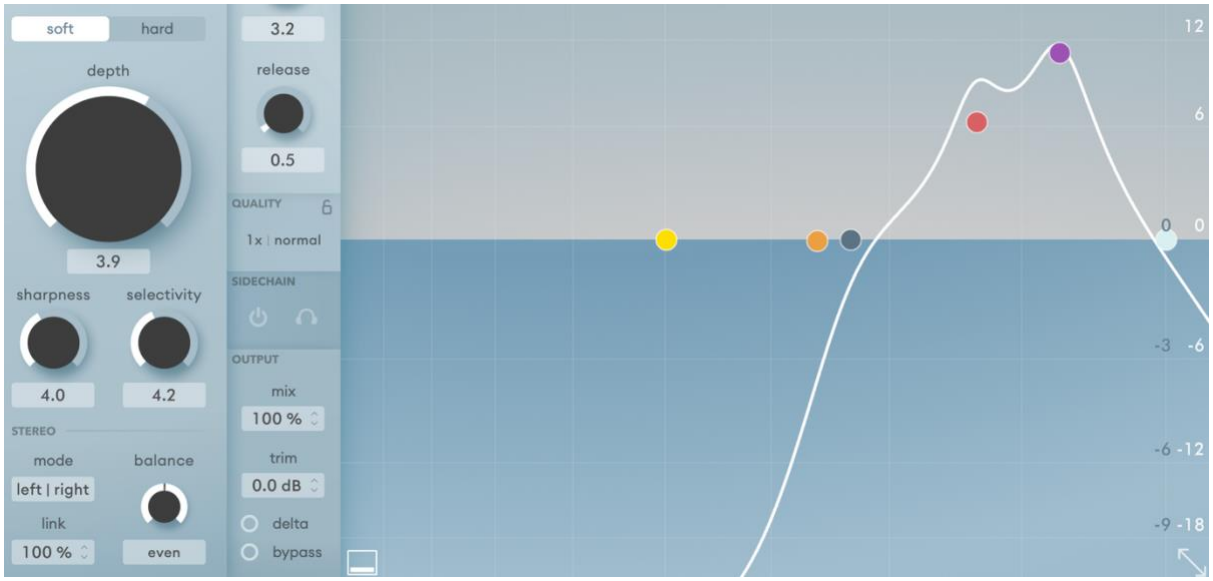
You'll note that the solo mics are employed in favour of the section mics which I haven't really used, with the exception of the CB (bass) mic. The CB mic also has an LFE effect feed (see below) and a tape saturator for a touch of additional grit on the upper end (hence the 15 ips setting, since the low end was less of what I was after.)

The strings mute, automated and EQ'd as such (Schreker as example):

Mute and automation example of strings (Schreker)

String EQ (Schreker as example)

The high solo strings had an Oeksound Soothe 2 with settings based on this:



High strings, set to very mild threshold and triggering

Winds:

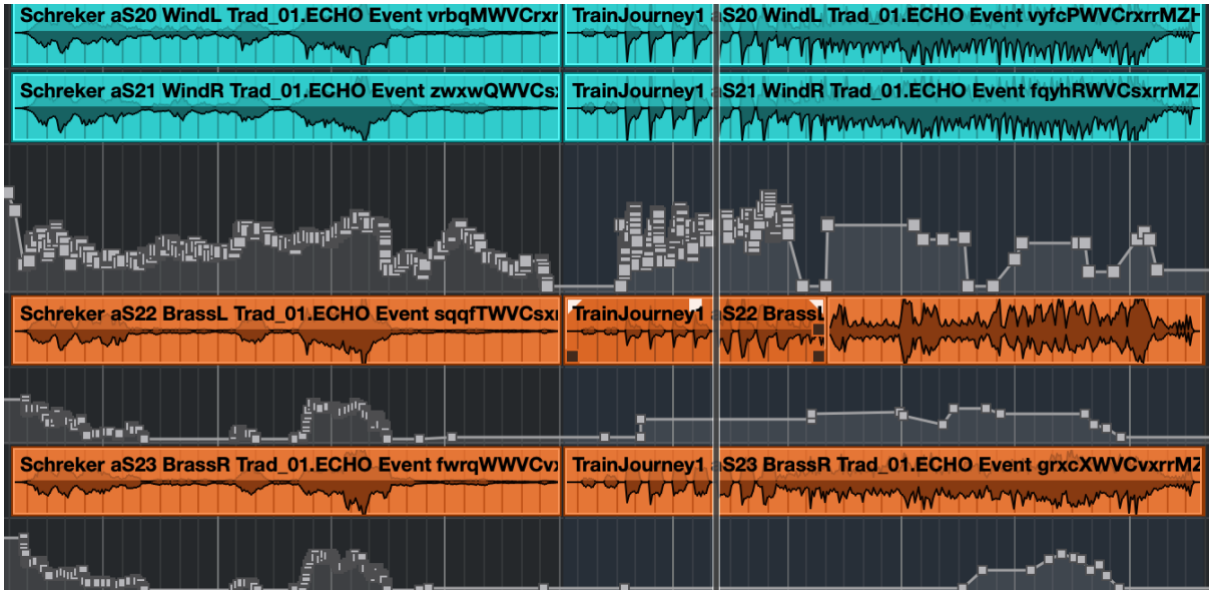
The Winds were hi passed at 104Hz, low passed at 11Khz, and typically had -4.5dB at 243Hz Q1.0 and a +1.6dB shelf at 3.9KHz. They were sent to the front tops at -12dB.

They were quite heavily volume automated. These are relatively low when compared to the Tree level (as are all the spots) but I did like how they focused on the articulate parts of phrases.

Brass:

Similar to above, with hi pass at 54Hz and low pass at 11.4KHz
Dynamic EQ on the horns up to -4.2 dB at 394 Hz Q1.1 and linear EQ -3dB at 580Hz Q2
The trumpets also have -2.1dB at 1.07KHz Q 1.2. The dynamic eq here was also something that got somewhat factored in to TRAIN JOURNEY 3 due to the horns being very present in the room.

The horns additionally have a slight filtered slapback delay applied in the rear channels, -11dB at 89ms, for the Train Journey pieces.



Example of Wind automation (blue) and Brass automation (orange) Schreker on left and Train Journey 01 on right.

Piano:

I placed the piano spot in front and 36% left of centre, even though it was behind the array. The track has been edited so that only the active parts are present, and was the instrument that I primarily used to shape and edit the secondary spot mic reverb initially. It has a low cut at 148Hz at 12dB per oct, -5.9dB at 653Hz Q1.3, -6.1dB at 270Hz Q1, and +2.8dB shelf at 5.3KHz. I also have an Oxford Transmod transient designer at +18%.

Percussion:

The Percussion is only used sparingly in the Schreker track, and as a spot giving weight and attack to the array, which already sounds present and beefy thanks to the lovely Air room (the intro to Train Journey 2 is a great example of how it breathes in the hall).

I have done a fair amount of processing here, with the key elements being an EQ1P passive EQ (not something I would normally do but I wanted to access those sympathetic bands), an Oxford Inflator at 25% (29% curve), an Oxford Transmod at +17%, and a Waves Rbass at -5, at 42Hz, and very tight and substantial cut at 69Hz to pull out a resonance, and -1.8dB at 103.7Hz Q3.0

EQP1 passive eq on percussion subgroup

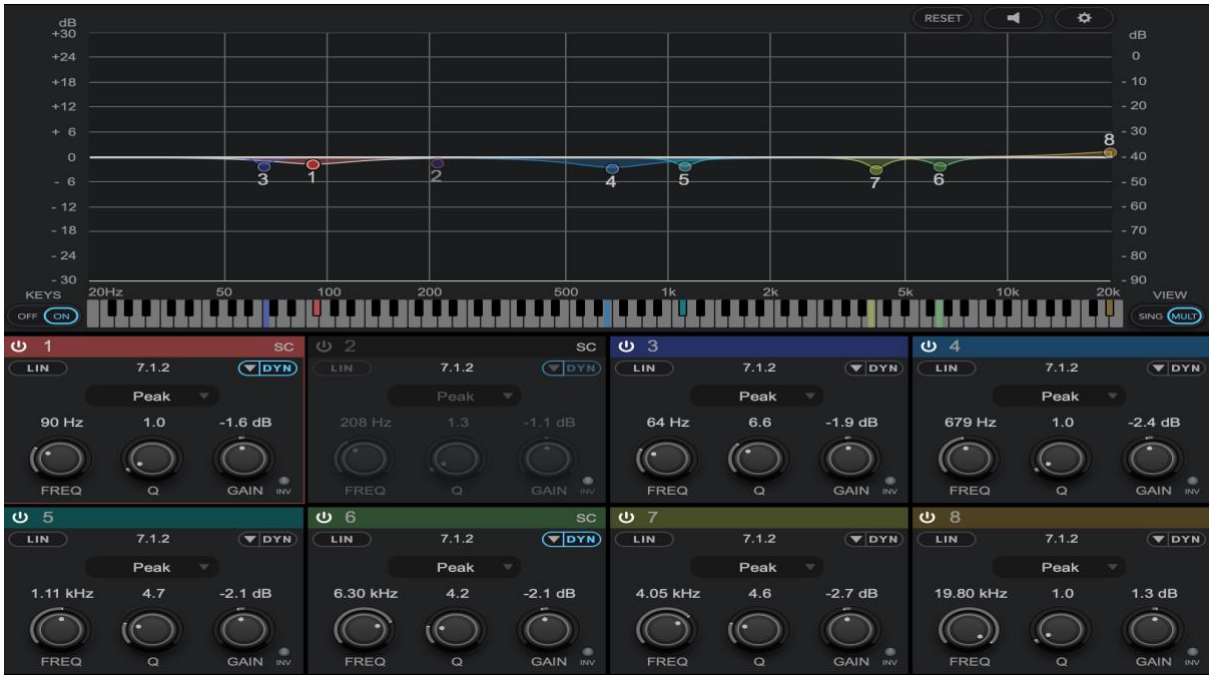
REAMPS AND PLAYBACK TRACKS-Train Journey 1 and 2

I opted not to use any of the spot mics for the reamp and relied purely on the tree for this pass. Additionally, the nature of the Echo project was to focus on the efficacy of the arrays so it made sense to focus on that element. That sentiment lead through to my approach with regards to the stems supplied by the composer, in that I used for the most part a 50/50 blend between the direct stems in the session and the re-amp recordings of those stems from the array.

While I did add several effects that I felt enhanced the "story" of the train rides, I didn't rely on any artificial reverb with the space and dimension coming purely from the array.

The array was set at a baseline of -6.5dB against the orchestral stripe for Train Journey 1, and -10.2dB for Train Journey 2.

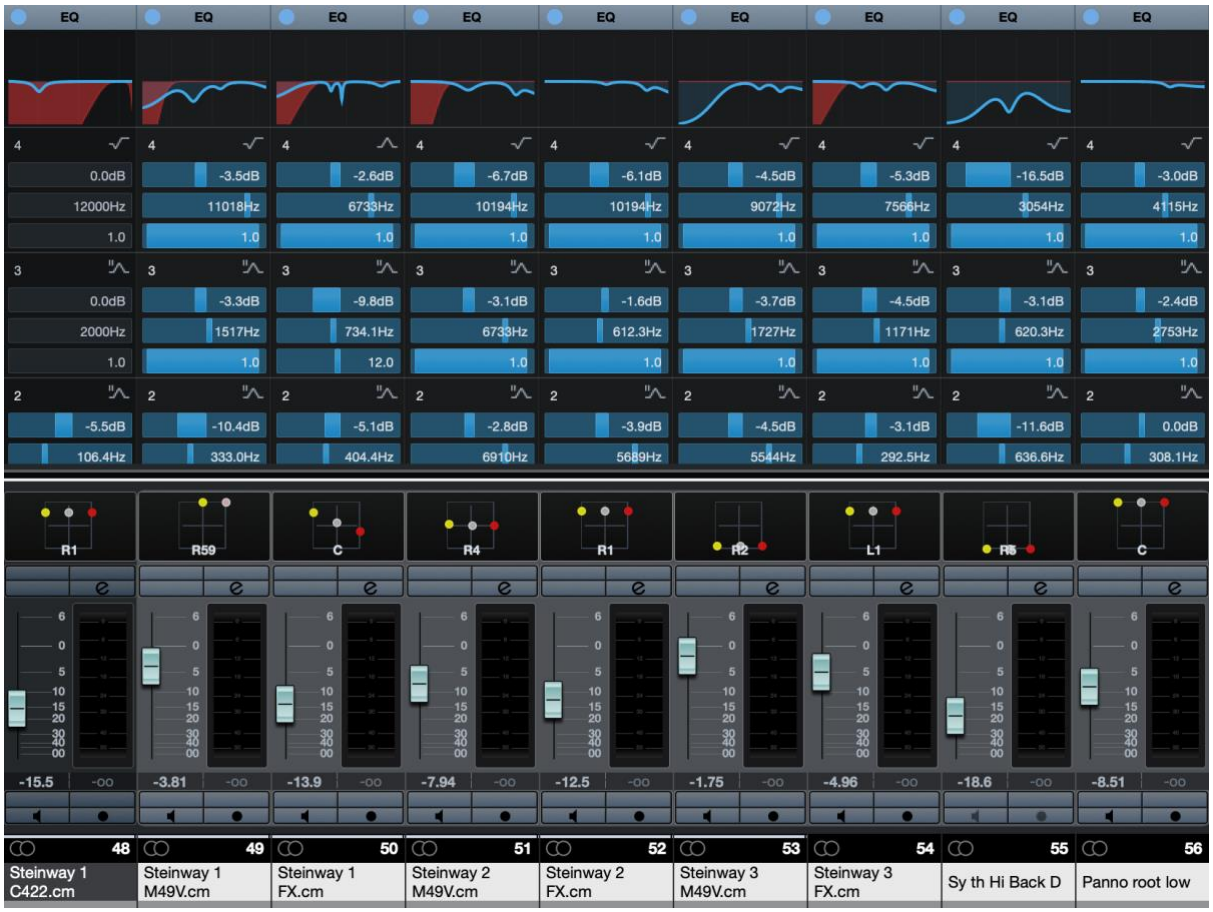
The panning and internal balancing was maintained exactly as described in the ARRAY-ONLY mix, and the Pass D array had the following master EQ:



Re-amp Array EQ + hi pass at 25Hz, 48dB per Octave

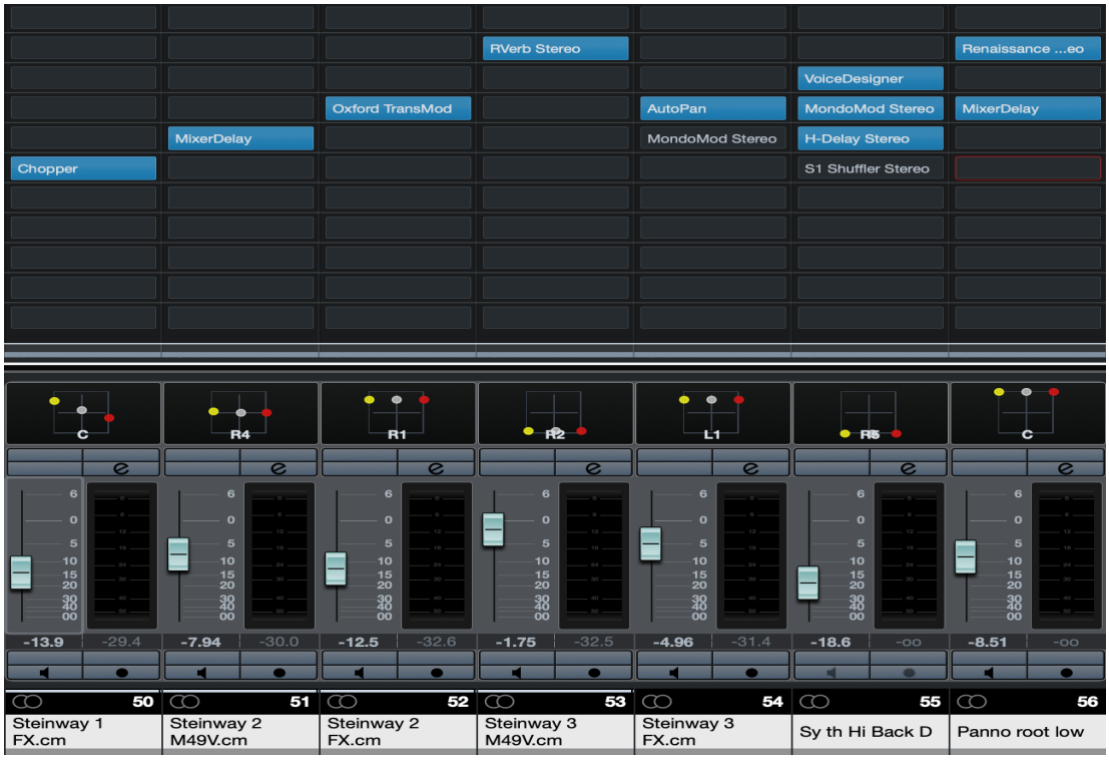
I used mostly the M49 mics, although I did also use the 422 for Steinway 1 of Train Journey 2 hi-hat element (the left most track below, which is heavily EQ'd) and cut the piano elements of that track onto a separate channel. I also used the Royer 121 for a tonal shift occasionally on Steinway 2 of Train Journey 2.

Here are the EQ, volume and pan positioning data:



Just an important note that I am always sensitive to “exit sign” mixing where a sound in the rears grabs your attention from the “action” in front. While these are music only tracks, and not music-to-picture, I did carry that thinking through to these tracks as an emulation of the media mixing process. With that in mind, stems 2 and 3 in Train Journey 1 and Train Journey 2 were flipped round back to front positioning wise from one to the other, as I felt that the positioning established in the first piece when applied to the 2nd piece was grabbing too much focus due to its attack and upper midrange content.

The following inserts were applied:



From L to R:
-The Chopper was used as an autopanner set with a slow sync that ran every 2 bars. It was also panned in such a way as to move from front left to side right, which I liked the sound of on speakers for the subtle movement and spatialisation (considering how quiet it is) but more importantly, was done to access the metadata settings for binaural playback.
-The MixerDelay was set to 25ms separation from L to R.
-The Transmod was set to -11% attack
-The Rverb was set to a small amount of early reflection on track 2 so that it could gel slightly more. The same was for the last track ROOT LOW which was only for Train Journey 2.
-Autopan set to 71% width at 0.15Hz movement
-The Synth HI Back D is a duplicate of the Steinway FX track and is used throughout Train Journey 1 and the second half of Train Journey 2. This is panned rear and up, has a formance shift to change the tone and also add something flattering and not phasy in fold down, a slow 180% chorus at 0.20 Hz and a delay at 401ms frequency limited to 138Hz-3.8Khz. The idea here is to mix in a little bit of subtle movement that creates a halo without detracting from the source.

These tracks were also sent to an Dry FX (stems) group that were attached to the master VCA for small volume automation rides at the end of the mix.

ADDITIONAL PROCESSING

In addition to all of the above, a handful of processors were used as a send.

I used a Lo Air subharmonic processor to send directly to the LFE track, with content typically filtered at low pass 80Hz.

“Storytelling” FX

When reading Volker Bertlemann (Haushka’s) statement and listening through the pieces, I was naturally keen to tease out elements from the story he’s telling. Here’s a couple of effects I used for that purpose.

-For Steinway 2 in Train Journey 1, and Steinway 3 in Train Journey 2, I matrixed a number of effects together that each had a character delay that sat in the front (Crystalizer) rear and top (supermassive) and side (tremolator) with each effect triggering the next through an FX send. Ie, Crystalizer aux send to Supermassive, aux send to Tremolator.
I wanted the rhythmic elements in this particular send to create a shimmering in the full soundfield, which importantly has a sense of motion cascading front to back, or motion for your journey!

Granular echo and movement FX matrix (Steinberg tracks 2 and 3)

-For Train Journey 2, I applied another reverb to the percussion track (a Cinematic Rooms atmos chamber, 1.96s) to help with the wonderful resonance and scrapes in the last 3rd of the track. For the long wind exhales (steam) for Train Journey 3, I used the Cinematic Rooms Amethyst Hall at 3.93s with a high pass at 300Hz to open up just on those very specific elements, especially at the very end.

-I also used a sync stuttery delay at quite low level with manually automated panning on Steinberg 3 on Train Journey 1, and Steinberg 2 on Train Journey 2, and shaped the panning window so that the panning when toggled L and R on the Z axis creates a front bottom to rear top effect. Typically this is something I would do as an object so that it can make use of the Top Front and Back independently, however that was out of scope for this project.

I used this to once again help with a subtle sense of motion as the nature of this particular delay is that it increases volume a little towards the end of the low amount of feedback, once again echoing the Train Journey and the world passed outside. This is mainly used in Train Journey 1. The effect was filtered to respond from 650Hz-7KHz and had a low amount of Soundtoys Little Plate before the signal reached it.

Manual pan automation stutter delay

-In support of this and in building on the idea of the journey and the sense of motion and environment, I had a bit of fun imaging the sound of stone on steel, or the metal sound of the tracks. This was from thinking of the train sounds within the music, and how a little effect could support that. I made a quad impulse of the attack of stones clacking on a non resonant metal, time corrected it to be in time with the BPM of the track, and used the Steinberg REVerence purely as a reverb impulse trigger. This was triggered by Steinway FX 1 and routed to the QUAD Overhead output, my thinking being that I wanted it to be just a feeling rather than something overt, but still give the sensation of it even when downmixed without getting in the way. Send was at -10dB for Train Journey 1 and -20dB for Train Journey 2.

I cannot stress enough that the above effects are just there to help push the "story" along, and are not meant to in themselves be a feature.

ON REFLECTION

Besides feeling overwhelmingly blessed at being part of the Echo Project with such amazing colleagues, mixing the pieces and writing this up has given some interesting insights.

Firstly, I actually circled back to the Schreker after building the initial mix template and proceeding to the Train Journey mixes. While my choice for the DPA 4006 is a) based on selecting a set of LCR mics that are widely available in most studios for tree applications and b) their relative neutrality, most notably in terms of preferring to keep the PAMA design manufacturer agnostic and not tied to a specific brand or model, I would likely have dropped the 40mm APE's for the classical piece. Or at the very least previewed them without the APE's, or tried the 30mm.
I have always been happy with 40mm (in favour of 50mm) but that's in the context of score to picture. I found for the Schreker that I needed to dial back on the brightness (the EQ band # 8 I mentioned earlier.)

It's a very worth while lesson I really enjoyed: My workflows are generally for media music, where the score is required to work with and hold space for dialogue, to pop through sound effects, and be effective through X curves such as those inherent in theatrical playback (by virtue of perf-screens and horn systems) or ISO or Atmos calibration curves. While additional articulating or attack, brightness and shaping the midrange such as the subtle curves that were applied by the Manley Massive Passive and Vari Mu is desirable for film mixing, as well as the added brightness and focus of the APE's, I am glad that I went back to the Schreker to treat it differently. It sounds obvious in retrospect, of course!

Secondly, I had never considered bottom mics before, but this is something I will be adding to my workflow going forward. As was mentioned in Prof Hyunkook Lee and Andrew Scheps interview, the addition of these mics in that position does give a sense of

being lower in relation to the variously higher mics in spatial playback incl binaural, and are naturally equalised by their location to add extra beef.

Thirdly, as much as I love immersive audio and how it can translate to audiences in ways that were previously not possible, I had to remind myself in amongst all the wonderful ideas and many options in the Presentation mixes that I do actually have a process. Even though things change from one project and environment to another, the one rule that I refocused on was to go back, check out Volker's statement, and listen to his own temp mix. Teasing out lines here and there using the spot mics to support the array was one element, and adding in the supplied stems and applying the "story" effects to them to try and add a little bit of interpretive spice based on Volker's storytelling was another. While these are not meant to be overt, I do hope that the small details help with the journey.