

## Maida Vale MV4 VR Capture

**York Team:** Acoustics: Gavin Kearney, Ben Lee, Jacob Cooper. Patrick Cairns, Anthony Hunt, Francesca Theresa Lorico.

Visualisation: Danielle Hall, Demi Thorsteinsson, Ioanna Efstathoulidou, Valeria Carrillo Garza.

**BBC Team:** Emma Young, Chris Pike, Jack Reynolds, Florian Schweiger, Andy Rogers.

### Measurement Summary

#### MV4 Live Room:

- Acoustic Setup 1 - 3DOF Measurements
  - Measurements from 4 performer positions using Eigenmike to facilitate 3DOF VR rendering.
- Acoustic Setup 2 - 6DOF Measurements
  - Measurements from 4 performer positions to a grid of receiver positions using Eigenmike to facilitate 6DOF rendering.
- Acoustic Setup 3 - Performer KEMAR Reference Measurements
  - Measurements from 4 performer positions using KEMAR binaural head with voice box and 6 Genelecs as sources and KEMAR also as receiver. KEMAR position alternates between performer positions.
- Acoustic Setup 4 - ISO 3382 Measurements
  - Standardised measurements to capture the acoustical characteristics of the space for more broad reference.

#### Sweep Details:

- Genelec:
  - 20Hz to 20kHz, 48kHz, 24 bit
  - [3 second current measurement voice ident; Metadata burst; 2 second silence; 32 second overlap sweeps; 3 sec silence; 3 second next measurement voice ident; 17 seconds silence] = 60 seconds
- Dodecahedron:
  - 20Hz to 20kHz, 48kHz, 24 bit
  - [3 second current measurement voice ident; Metadata burst; 2 second silence; 20 second sweeps; 3 sec silence; 32 seconds silence ] = 60 seconds
- KEMAR Voice Box:
  - Integrated with overlapping sweeps for Acoustic Setup 3. Sweep pre-equalised for voicebox.

**Setup and calibration:**

All sources calibrated to 85dBc SPL (slow integration) at 1m with -20dBFS rms pink noise.

Preamp calibration set to -18dBFS for loudest source/receiver combination.

KEMAR Calibrated with 8030A at 1m.

Eigenmike Calibrated above 8030A.

Lav reference microphone calibrated above 8030A (mounted to Eigenmike).

## Measurement Grids:

### Studio MV4

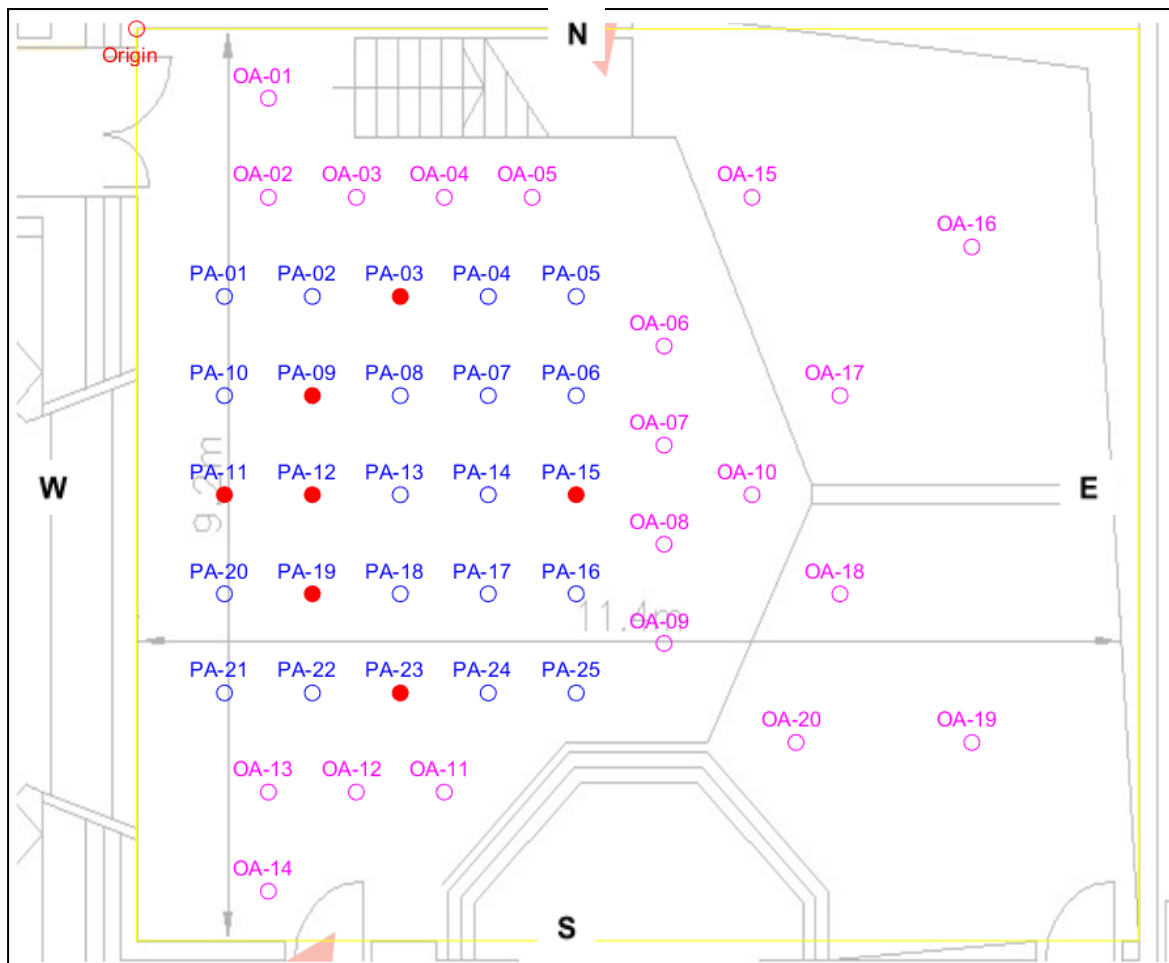


Figure 1. Measurement points in MV4 live room (blue is 'Performance Area', Pink is 'Outside performance Area').

Measurement points:

Origin = 0 0

Origin 2 = 6.1350 2.8200

Performance Area (Blue) =

|        |        |         |
|--------|--------|---------|
| PA-01: | 1.0000 | -2.7000 |
| PA-02: | 2.0000 | -2.7000 |
| PA-03: | 3.0000 | -2.7000 |
| PA-04: | 4.0000 | -2.7000 |
| PA-05: | 5.0000 | -2.7000 |
| PA-10: | 1.0000 | -3.7000 |
| PA-09: | 2.0000 | -3.7000 |
| PA-08: | 3.0000 | -3.7000 |
| PA-07: | 4.0000 | -3.7000 |
| PA-06: | 5.0000 | -3.7000 |
| PA-11: | 1.0000 | -4.7000 |
| PA-12: | 2.0000 | -4.7000 |

|        |        |         |
|--------|--------|---------|
| PA-13: | 3.0000 | -4.7000 |
| PA-14: | 4.0000 | -4.7000 |
| PA-15: | 5.0000 | -4.7000 |
| PA-20: | 1.0000 | -5.7000 |
| PA-19: | 2.0000 | -5.7000 |
| PA-18: | 3.0000 | -5.7000 |
| PA-17: | 4.0000 | -5.7000 |
| PA-16: | 5.0000 | -5.7000 |
| PA-21: | 1.0000 | -6.7000 |
| PA-22: | 2.0000 | -6.7000 |
| PA-23: | 3.0000 | -6.7000 |
| PA-24: | 4.0000 | -6.7000 |
| PA-25: | 5.0000 | -6.7000 |

Outside Performance Area (Pink) =

|        |        |         |
|--------|--------|---------|
| OA-01: | 1.5000 | -0.7000 |
| OA-02: | 1.5000 | -1.7000 |
| OA-03: | 2.5000 | -1.7000 |
| OA-04: | 3.5000 | -1.7000 |
| OA-05: | 4.5000 | -1.7000 |
| OA-06: | 6.0000 | -3.2000 |
| OA-07: | 6.0000 | -4.2000 |
| OA-08: | 6.0000 | -5.2000 |
| OA-09: | 6.0000 | -6.2000 |
| OA-10: | 7.0000 | -4.7000 |
| OA-11: | 3.5000 | -7.7000 |
| OA-12: | 2.5000 | -7.7000 |
| OA-13: | 1.5000 | -7.7000 |
| OA-14: | 2.0000 | -8.2000 |
| OA-15: | 7.0000 | -1.7000 |
| OA-16: | 9.5000 | -2.2000 |
| OA-17: | 8.0000 | -3.7000 |
| OA-18: | 8.0000 | -5.7000 |
| OA-19: | 9.5000 | -7.2000 |
| OA-20: | 7.5000 | -7.2000 |

**Note Performer perspectives are from PA-11, PA-3, PA-15 and PA-23.**

## FULL ACOUSTIC MEASUREMENT PROGRAMME

### MV4 Live Room Measurements

#### Acoustic Setup 1 - 3DOF Measurements

Aim - To get 4th-order Ambisonic Source-Receiver Measurements for each of the VR performers for 3DoF rendering.

Method: 7 Genelec loudspeakers were set up and an Eigenmike captured acoustic measurements above each loudspeaker in different configurations. Within each configuration the Genelecs were rotated to 4 orientations (North/South/West/East) to facilitate 1st order source directivity post-processing. Source excitation signals were 20 second exponential sine sweeps. Each sweep played out from each loudspeaker 2 seconds apart, in an overlap method. The 2 second gap allowed IRs to be deconvolved out separately.

Source: Genelec 8030

Receiver: Eigenmike

Source Positions and heights (measured to tweeter):

- PA-03: 1.5m
- PA-09: 1.2m
- PA-11: 1.2m
- PA-12: On floor
- PA-15: 1.5m
- PA-19: 1.2m
- PA-23: 1.5m

PA-09, PA-11, PA-12 and PA-19 were configured to represent a source with extent such as a drum kit.

Receiver Positions - All receiver positions at 1.6m

7 Source positions x 4 source orientations x 4 Receiver Positions = 112 measurements

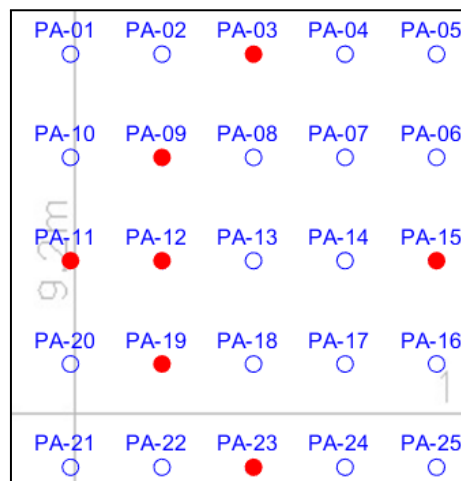


Figure 2: Acoustic Setup 1 source positions. Note: 7 Genelec 8030 loudspeakers were in place throughout this phase, with their orientation changed in each measurement set.

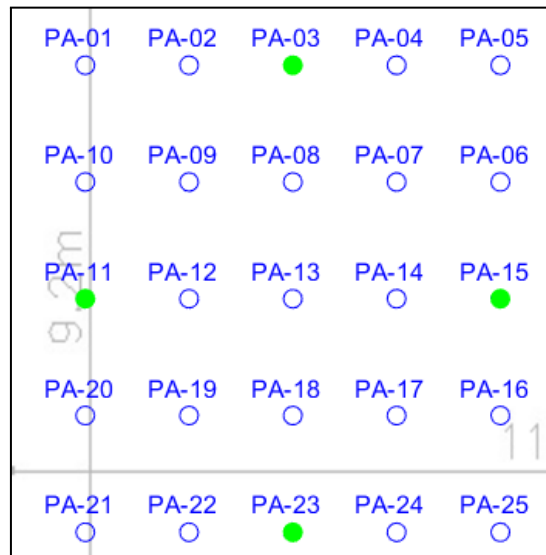


Figure 3: Acoustic Setup 1 receiver positions. Note the Eigenmike was moved to these positions for each measurement set.

## Acoustic Setup 2 - 6DOF Measurements

Aim - To get 4th-order Ambisonic Source-Receiver Measurements for each of the performer positions for 6DoF rendering.

Method: 7 Genelec loudspeakers were set up and the Eigenmike captured acoustic measurements along a grid of receiver points. At each measurement point, the Genelecs were rotated to 4 orientations (North/South/West/East) to facilitate 1st order source directivity post-processing. Source excitation signals were 20 second exponential sine sweeps. Each sweep played out from each loudspeaker 2 seconds apart, in an overlap method. The 2 second gap allowed IRs to be deconvolved out separately.

Source: Genelec 8030

Receiver: Eigenmike

Positions and heights of sources were the same as in Acoustic Setup 1.

Height of the receiver were the same as in Acoustic Setup 1.

7 Source positions x 4 source orientations x 45 receiver positions = 1,260 measurements

Protocol: Same as Acoustic Setup 1.

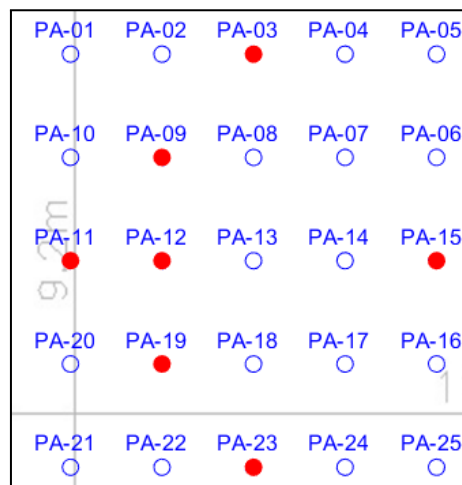


Figure 4: Source positions for Acoustic Setup 2. Sources were seven Genelec 8030A loudspeakers.

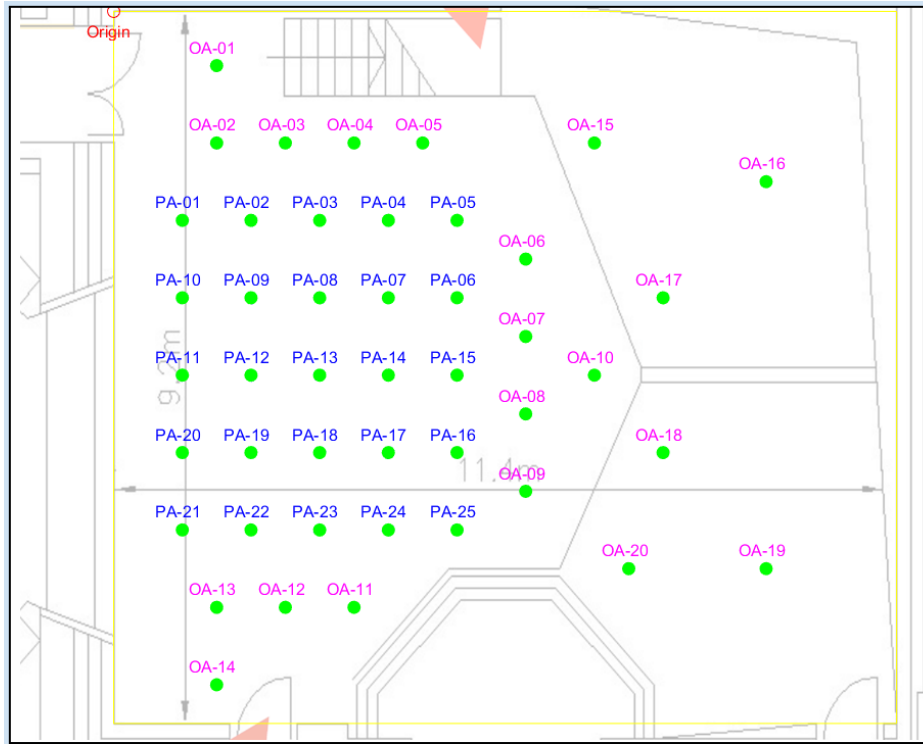


Figure 5: Receiver positions for Acoustic Setup 2. Receiver is the Eigenmike..



### Acoustic Setup 3 - Performer KEMAR Reference Measurements

Aim - To get KEMAR reference measurements for each of the performer positions

Method: 6 Genelec loudspeakers and 1 KEMAR binaural head with voicebox were set up as sources. The in-ear microphones of the KEMAR were used as receivers. Within each configuration the Genelecs were rotated to 4 orientations (North/South/West/East) to facilitate 1st order source directivity post-processing.

KEMAR remained static in each configuration and faced mid-point PA13. Four different configurations from the main performer positions were considered, with KEMAR moving to each main performance point.

Source excitation signals were 20 second exponential sine sweeps. Each sweep played out from each loudspeaker and KEMAR 2 seconds apart, in an overlap method. The 2 second gap allows IRs to be deconvolved out separately. The KEMAR sweep was pre-equalised for flat output from the voicebox.

Sources: Genelec 8030 and KEMAR (Voice box)

Receiver: KEMAR.

KEMAR ear height set to 1.6m.

7 Source positions x 4 rotations x 4 rotated receiver configurations = 112 measurements.

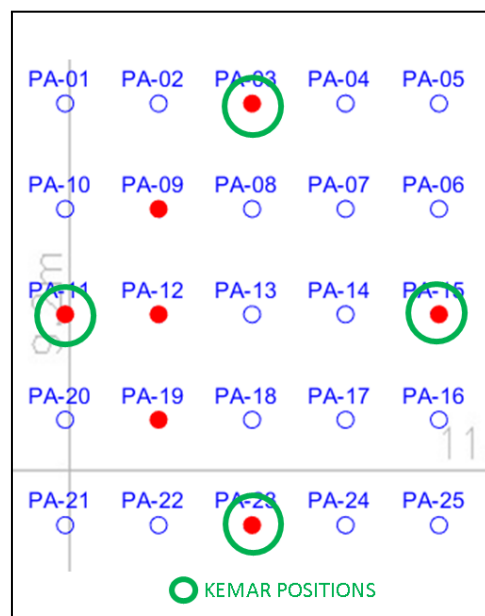


Figure 6: Source positions for Acoustic Setup 3. Sources are 6 Genelec 8030A loudspeakers and KEMAR voice box. KEMAR alternates into each performer position.

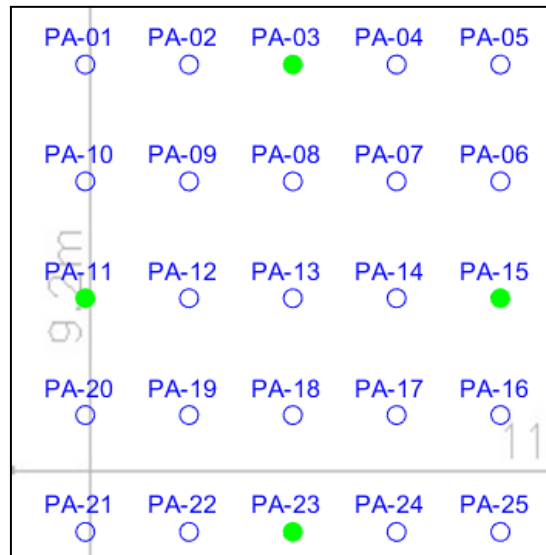


Figure 7: Receiver positions for Acoustic Setup 3. KEMAR alternates into each receiver position.

## Acoustic Setup 4 - ISO 3382 Measurements

Aim - To get standardised measurements of the full space in accordance with ISO-3382.

Method: Omnidirectional source (dodecahedron) measured in 3 different positions across 6 receiver positions spanning the full acoustic space. Temperature and Humidity will also be measured.

Source: Dodecahedron

Dodecahedron height: 1.5m

Receivers: Eigenmike and KEMAR

Eigenmike set to 1.6m

3 Source positions x 6 receiver positions

Protocol: The naming convention of the measurements will follow the Eigenmike position.

Measurements will be taken as follows

OA-02-1: KEMAR/Eigenmike at OA-02, Source at PA-05

OA-02-2: KEMAR/Eigenmike at OA-02, Source at PA-13

OA-02-3: KEMAR/Eigenmike at OA-02, Source at PA-23

OA-07-1: KEMAR/Eigenmike at OA-07, Source at PA-05

OA-07-2: KEMAR/Eigenmike at OA-07, Source at PA-13

OA-07-3: KEMAR/Eigenmike at OA-07, Source at PA-23

OA-13-1: KEMAR/Eigenmike at OA-13, Source at PA-05

OA-13-2: KEMAR/Eigenmike at OA-13, Source at PA-13

OA-13-3: KEMAR/Eigenmike at OA-13, Source at PA-23

OA-15-1: KEMAR/Eigenmike at OA-15, Source at PA-05

OA-15-2: KEMAR/Eigenmike at OA-15, Source at PA-13

OA-15-3: KEMAR/Eigenmike at OA-15, Source at PA-23

OA-16-1: KEMAR/Eigenmike at OA-16, Source at PA-05

OA-16-2: KEMAR/Eigenmike at OA-16, Source at PA-13

OA-16-3: KEMAR/Eigenmike at OA-16, Source at PA-23

OA-20-1: KEMAR/Eigenmike at OA-20, Source at PA-05

OA-20-2: KEMAR/Eigenmike at OA-20, Source at PA-13

OA-20-3: KEMAR/Eigenmike at OA-20, Source at PA-23

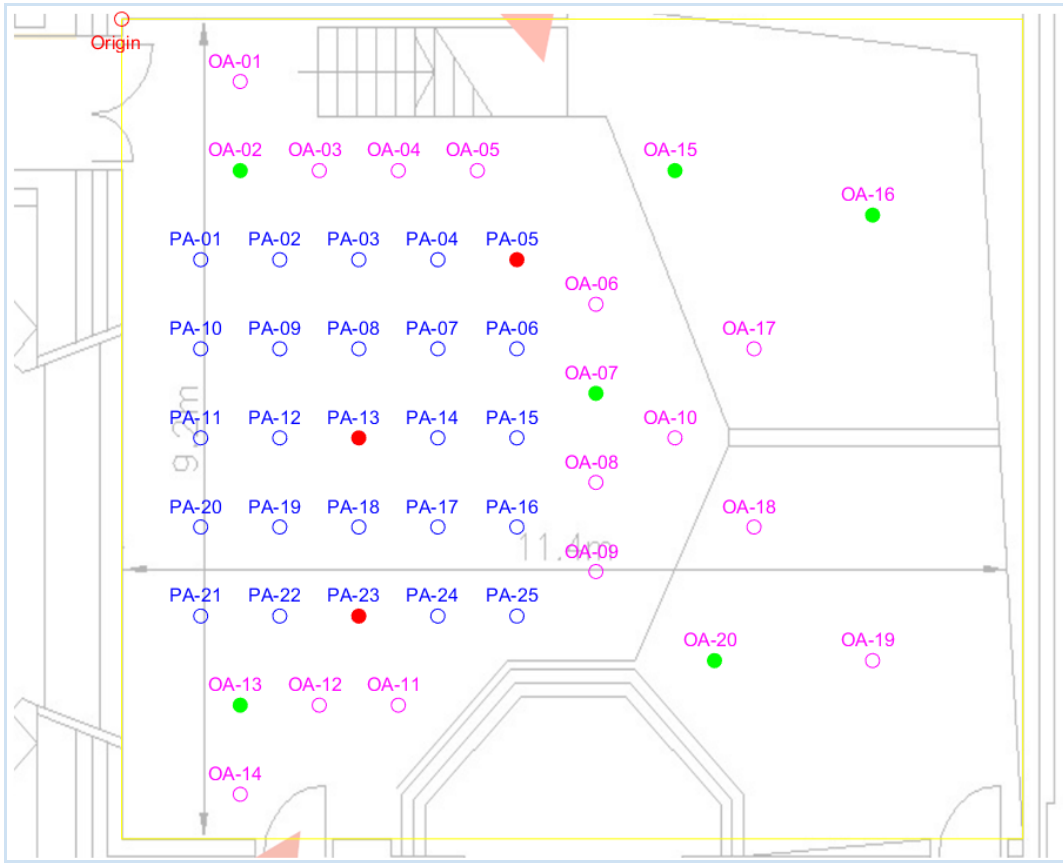


Figure 8: Source and receiver positions for ISO 3382 Measurements