METU SPARG Eigenmike em32 Acoustic Impulse Response Dataset v0.1.0

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1 Measurements

This document accompanies METU SPARG Eigenmike em32 Acoustic Impulse Response Dataset (v0.1) which includes acoustic impulse response (AIR) measurements made using an Eigenmike em32 and the room impulse response measurements carried out at the same position using an Alctron M6 measurement microphone. The measurements were made in the classroom S-05 at the METU Graduate School of Informatics on 23 January 2018.

The classroom in which the measurements were made has a high reverberation time (T60 $\approx$ 1.12 s) when empty. The room is approximately rectangular and has the dimensions $6.5 \times 8.3 \times 2.9$ m. AIR measurements were made at 240 points on a rectilinear grid of 0.5 m horizontal and 0.3 m vertical resolution surrounding the array. The array was positioned at a height of 1.5 m. The measurement planes were positioned at the heights of 0.9, 1.2, 1.5, 1.8 and 2.1 m from the floor level. These positions cover the whole azimuth range and an elevation range of approximately $\pm 50^\circ$ above and below the horizontal plane. Fig. 2 shows the measurement positions on the top view of the room.

The sound source was a Genelec 6010A two-way loudspeaker whose acoustic axis pointed at the vertical axis of the array. Logarithmic sine sweep method was used for the AIR measurements with a 5 s long sweep. Measured impulse responses were then truncated to 2 s. Fig. 2 shows a photo from the measurement.

The microphone array used in the measurements was an Eigenmike em32 (`http://www.mhacustics.com`) rigid spherical microphone array (see Fig. 3). The azimuth, ϕ, and inclination angles, θ, of each of the microphones on the Eigenmike em32 array are given (in degrees) in Table 1.

Note that the azimuth angle, $0 \leq \phi < 2\pi$ is defined as the angle from the $+x$ direction, and the inclination angle $0 \leq \theta \leq \pi$ is the angle from the $+z$ direction. For the latter, $\theta = 0$ and $\theta = \pi$ correspond to $+z$ and $-z$ directions, respectively.

The omnidirectional microphone used in the RIR measurements was Alctron M6 (`http://www.alctron-audio.com/English/contents/100/464.html`).

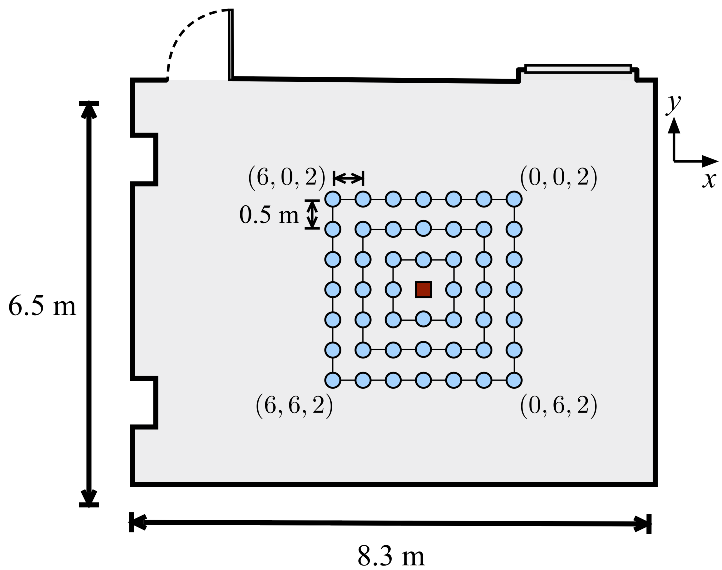

Figure 1: Measurement positions and the indexing convention used in this dataset

Figure 2: AIR measurement using an Eigenmike em32. The yellow marks on the carpet indicate the measurement positions.

Channel Index	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Inclination, θ (°)	69	90	111	90	32	55	90	125	148	125	90	55	21	58	121	159
Azimuth, ϕ (°)	0	32	0	328	0	45	69	45	0	315	291	315	91	90	90	89
Channel Index	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Inclination, θ (°)	69	90	111	90	32	55	90	125	148	125	90	55	21	58	122	159
Azimuth, ϕ (°)	180	212	180	148	280	225	249	225	180	135	111	135	269	270	270	271

Table 1: Positions of microphones on the Eigenmike em32 microphone array.

Figure 3: Eigenmike em32 (Serial no. 59) at the measurement venue.

2 File format

The AIRs and RIRs are provided as 16-bit signed integer `WAVE` files. The sampling rate is 48 kHz.

3 Naming Convention

There are two folders: `em32` and `alctron`. The former includes AIR measurements, and the latter includes the RIR measurements.

`em32` folder includes 244 subfolders where each subfolder is named as `XYZ` where each letter is a positive integer, from `000` through to `666` (i.e. all points on the grid except the microphone array position at `332`). Note that the measurements right above and right below the array (i.e. `330`, `331`, `333`, and `334`) are not ideal since the acoustic axis of the loudspeaker did not face the array for these positions meaning direct path was recorded to be much less than it should have been for an omnidirectional source due to the directional response of the employed loudspeakers. Therefore, these particular were not used in the publications given below, an are also not recommended for research. The position with respect to the array position taken as origin can be calculated simply as:

$$x = (3 - X) \times 0.5 \quad \text{(m)}$$
$$y = (3 - Y) \times 0.5 \quad \text{(m)}$$
$$z = (2 - Z) \times 0.3 \quad \text{(m)}$$

Each subfolder under the folder `em32` includes 32 AIR measurements in `WAVE` format named `IR00001.wav` to `IR00032.wav` corresponding to the 32 channels of the Eigenmike em32 microphone array. Emulating an em32 recording is possible by convonving these AIRs with dry/anechoic sound signals.

`alctron` folder includes 243 room impulse responses (RIRs) measured at the same positions, but with a calibrated omnidirectional microphone. These can be used, for example, to calculate the true direct-to-reverberant energy ratio (D/R ratio) for the given source/microphone position configurations. The files are named similarly (i.e. `112.wav` corresponds to the RIR due to a source in the horizontal plane at an azimuth angle of $\pi/4$).

4 License

5 How to cite

The dataset has the DOI number 10.5281/zenodo.2635758 and can be cited as:

Olgun, O. and Hacihabiboglu, H., METU SPARG Eigenmike em32 Acoustic Impulse Response Dataset v0.1, Dataset on Zenodo, doi: 10.5281/zenodo.1153887

The data presented here was used in one journal article and two conference papers as of the time of writing this documentation. Please also consider citing these papers if you find this dataset to be useful in your research:

Çöteli, M. B., Olgun, O., and Hacıhabiboğlu, H. (2018). Multiple Sound Source Localization With Steered Response Power Density and Hierarchical Grid Refinement. IEEE/ACM Trans. Audio, Speech and Language Process., 26(11), 2215-2229.

Olgun, O. and Hacıhabiboğlu, H., (2018) "Localization of Multiple Sources in the Spherical Harmonic Domain with Hierarchical Grid Refinement and EB-MUSIC". In Proc. 2018 16th Int. Workshop on Acoust. Signal Enhancement (IWAENC-18) (pp. 101-105), Tokyo, Japan.

Çöteli, M. B., and Hacıhabiboğlu, H., (2019), "Multiple Sound Source Localization with Rigid Spherical Microphone Arrays via Residual Energy Test", Proc. 2019 IEEE Int. Conf. on Acoust., Speech and Signal Process., (ICASSP-19), Brighton, UK.