IoSR listening room multichannel BRIR dataset

Jon Francombe

Institute of Sound Recording, University of Surrey, Guildford, UK.

j.francombe@surrey.ac.uk

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Abstract

This documentation describes the IoSR Listening Room Multichannel BRIR dataset, which is available to download from:
`https://github.com/IoSR-Surrey/IoSR_ListeningRoom_BRIRs`.

The dataset contains binaural room impulse responses measured at head angles of 0–360 degrees in 2.5 degree steps, for 24 loudspeakers in the standard positions for 22.2 reproduction. The BRIRs are available in SOFA and MATLAB formats.

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1 Introduction

This documentation describes the Institute of Sound Recording (IoSR) Listening Room Multichannel Binaural Room Impulse Response (BRIR) dataset. The dataset contains BRIRs measured at head angles of 0–360 degrees in 2.5 degree steps (i.e. 144 head orientations), for 24 loudspeakers at the standard positions for 22.2 reproduction (as described in Table 3 of ITU-R rec. BS.2051-0 [2014] and reproduced here in Table 2).

The data can be accessed from:

- `https://github.com/IoSR-Surrey/IoSR_ListeningRoom_BRIRs`
- `https://doi.org/10.15126/surreydata.00813511`

1.1 Licence

If you use the data, please reference the dataset as follows:

Francombe, Jon, 2017: 'IoSR Listening Room Multichannel BRIR dataset', Institute of Sound Recording, University of Surrey, UK. DOI: `https://doi.org/10.15126/surreydata.00813511`.

2 Recording details

2.1 Room

The measurements were made in the IoSR Listening Room (see Figure 1). This room conforms to the requirements outlined in ITU-R rec. BS.1116-3 [2015], and has dimensions 7.35 m $\times$ 5.70 m $\times$ 2.50 m. The reverberation time in octave bands between 63 Hz and 8000 Hz is given in Table 1.

Table 1: IoSR listening room reverberation time

Centre frequency (Hz)	**RT_{60} (s)**
63	0.461
125	0.373
250	0.236
500	0.231
1000	0.219
2000	0.207
4000	0.196
8000	0.180

Further details are available at `http://iosr.surrey.ac.uk/facilities/listeningroom.php`.

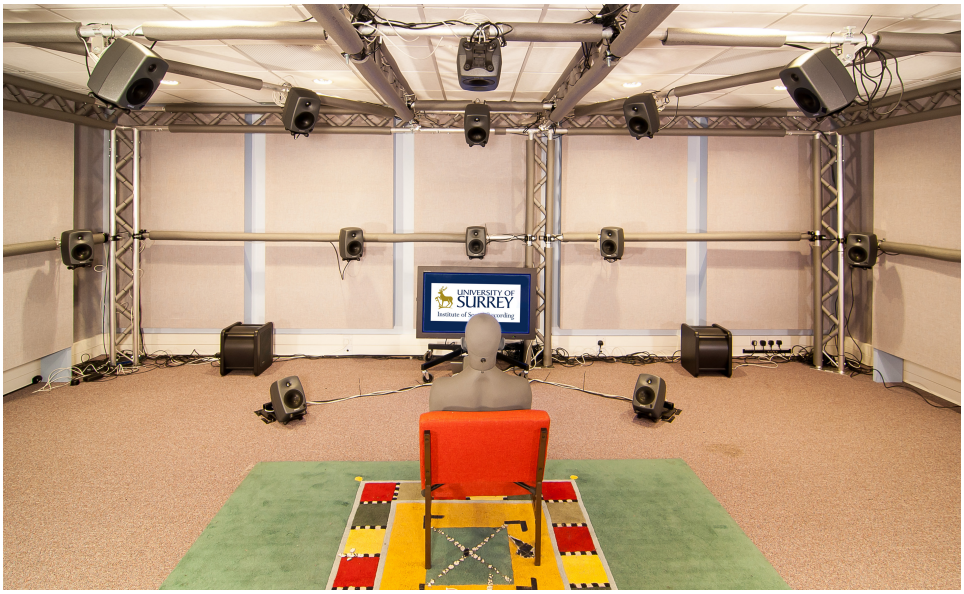

Figure 1: The IoSR listening room

2.2 Microphones

The measurements were made with a Cortex MKII head and torso simulator (HATS). The HATS utilised diffuse field equalisation, performed in the digital domain with analogue-to-digital and digital-to-analogue conversion perfumed at 48 kHz in the HATS controller. To capture the analogue signal output from the HATS, analogue-to-digital conversion (48 kHz, 24 bit) was performed using an RME Fireface 800.

An Outline ET2 turntable was used to rotate the HATS from 0–360 degrees in steps of 2.5 degrees (a total of 144 angles).

2.3 Loudspeakers

The loudspeakers used were as follows.

- 22 × Genelec 8330A
- 2 × Genelec 7350A subwoofers

Digital-to-analogue conversion was performed by a MOTU 24Ao audio interface. The loudspeaker system includes bass-management, time alignment, and equalisation of level and frequency response [Mason 2016].

The loudspeakers were positioned according to the 22.2 standard [ITU-R rec. BS.2051-0 2014, Table 3]; these positions are detailed in Table 2.

2.4 Impulse response capture

The sine sweep method was used to capture impulse responses, using a sweep from 20–24000 Hz at 0.2 s/octave.

Table 2: Loudspeaker positions. As specified in ITU-R rec. BS.2051-0 [2014], angles are given in degrees anticlockwise from the positive x axis, where: the x axis points to the front; the y axis points to the left; and the z axis points upwards.

Channel	**Label**	**Azimuth (deg.)**	**Elevation (deg.)**
1	FL	60	0
2	FR	−60	0
3	FC	0	0
4	LFE1	39	−18
5	BL	135	0
6	BR	−135	0
7	FLc	30	0
8	FRc	−30	0
9	BC	180	0
10	LFE2	−39	−18
11	SiL	90	0
12	SiR	−90	0
13	TpFL	45	30
14	TpFR	−45	30
15	TpFC	0	30
16	TpC	-	90
17	TpBL	135	30
18	TpBR	−135	30
19	TpSiL	90	30
20	TpSiR	−90	30
21	TpBC	180	30
22	BtFC	0	−30
23	BtFL	45	−30
24	BtFR	−45	−30

3 Data format

The dataset is available in the spatially oriented format for acoustics (SOFA) format (see Section 3.1) and as MATLAB `.mat` files (see Section 3.2).

3.1 SOFA

The SOFA format is a standardised container for exchange of head-related transfer functions and other impulse response data [Majdak *et al.* 2013]. Data can be written or read using the tools available from `https://www.sofaconventions.org/mediawiki/index.php/Software_and_APIs`.

In the SOFA object, the impulse response data is stored as a [measurements] × [microphones] × [samples] array.

For each measurement (in this case, 24 loudspeakers × 144 head angles gives 3456 measurements), the receiver (microphone) and emitter (loudspeaker) positions are specified (as cartesian coordinates).

3.2 MATLAB

The data is also provided in `.mat` files. There is one file for each head angle with the filename `angle_[n].mat`, where `[n]` is the head angle in degrees (as specified in ITU-R rec. BS.2051-0 [2014], angles are given in degrees anticlockwise from the positive x axis, where: the x axis points to the front; and the y axis points to the left).

Each `.mat` file contains a variable `brir`, which is a [samples] × [microphones] × [loudspeakers] array.

- The microphones are the left and right ears of the dummy head (columns 1 and 2 respectively).
- The loudspeakers are in the channel order specified in ITU-R rec. BS.2051-0 [2014, Table 3] (and in Table 2 of this document).

For example, the following script could be used to load the room impulse responses for a head angle of 30 degrees and to isolate the impulse response for the front centre (FC) loudspeaker.

```
load angle_30.0.mat
IR = brir(:,:,3);
```

4 Acknowledgements

This work was supported by the EPSRC Programme Grant S3A: Future Spatial Audio for an Immersive Listener Experience at Home (EP/L000539/1) and the BBC as part of the BBC Audio Research Partnership.

The data described in this document, along with the terms for data access, are available from:

- `https://github.com/IoSR-Surrey/IoSR_ListeningRoom_BRIRs`
- `https://doi.org/10.15126/surreydata.00813511`

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