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REVERBDATA – A RIR DATABASE OF PORTUGUESE ARCHITECTONIC SPACES

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Resumo
REVERBDATA é uma base de dados com Respostas Impulsionais de Salas (RIR) de espaços portugueses significativos, considerando a sua importância acústica, arquitetónica, cultural e funcional. Gravações de respostas impulsionais multicanal são realizadas em vários pontos dentro desses espaços, processadas e adicionadas à base de dados, acessível através de uma interface para navegação e geração de reverberação artificial. Utilizando técnicas avançadas de medição e processamento, são adquiridas diversas respostas impulsionais em diferentes formatos multicanal para possibilitar uma reprodução sonora imersiva através de reverberação por convolução FFT. Embora bases de dados existentes, como Aachen Impulse Response (AIR), MOTUS, MIT IR Survey, Aalto Acoustics Laboratory e OpenAIR, ofereçam coleções extensas de respostas de salas, estas apresentam predominantemente espaços comuns com uma representação limitada de espaços significativos. O Projeto REVERBDATA desenvolve uma base de dados do património acústico português caracterizando espaços arquitetónicos significativos, servindo assim como um recurso valioso para profissionais de engenharia de som, arquitetura e design de interiores, mas também das ciências sociais. A base de dados abrange vários espaços como salas de concertos, teatros, igrejas e outros locais culturalmente significativos em todo o país fornecendo informações detalhadas sobre os mesmos, incluindo parâmetros acústicos normalizados ISO 3382-1, características arquitetónicas, dimensões, materiais e outros fatores relevantes que influenciam a acústica. Actualmente, a base de dados REVERBDATA contém aproximadamente 375 respostas impulsionais de alta resolução em formatos como AB stereo, binaural e Ambisonics de 1ª, 2ª e 3ª ordem, cobrindo mais de 140 locais em 15 espaços significativos.

Palavras-chave: património acústico português, resposta impulsional multicanal de salas, reverberação por convolução.

Abstract
REVERBDATA is a Room Impulse Response (RIR) database of significant Portuguese spaces, considering their acoustical, architectural, cultural, and functional significance. Multi-channel IR recordings are made at various points within these spaces, processed, and added to the database, accessible through a user-friendly interface for navigation and artificial reverberation generation. Utilizing advanced measurement and processing techniques, diverse impulse responses in different multi-channel formats are acquired to enable immersive sound reproduction via FFT convolution reverb. While existing RIR databases like Aachen Impulse Response (AIR), MOTUS, MIT IR Survey, Aalto Acoustics Laboratory, and OpenAIR offer extensive collections, they predominantly feature spaces that are common with limited representation of significant ones. The REVERBDATA Project develops a

Portuguese acoustical heritage database characterizing significant architectonic spaces, thus serving as a valuable resource for professionals in sound engineering, architecture, and interior design, but also in the social sciences. It encompasses various spaces such as concert halls, theatres, churches, and other culturally significant venues nationwide. Detailed information including ISO 3382-1 acoustical parameters, architectural features, dimensions, materials, and other relevant factors influencing acoustics is provided. Currently, the REVERBDATA database contains approximately 375 high-resolution impulse responses in formats such as AB stereo, binaural, and 1st, 2nd, and 3rd order Ambisonics, covering over 140 locations across 15 significant spaces.

Keywords: Portuguese acoustical heritage, multichannel room impulse response, convolution reverb

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1 Introduction

The acoustic characteristics of a space are often overlooked. While great attention is paid to its dimensions, its architectural features, how it is furnished and which materials are used, the same cannot be said for sound. When a place is to be studied and preserved for the future its geometry is measured, detailed photographic and videographic records are made, and sometimes even digitally rendered 3D models are created. Yet such efforts are rarely made when it comes to analyzing how sound behaves in that space. A room impulse response (RIR) is a way to describe the unique acoustic fingerprint of a room, a quantitative representation of how sound transforms as it travels between a source and a receiver.

RIRs are already integral in the development of immersive audio and various other soundfield analysis and synthesis methods, but they can also be a powerful way to gain insight into the acoustics of a specific place. Through reverb convolution, for instance, a space's acoustic identity can be realistically simulated.

By establishing a structured and comprehensive database of RIRs of culturally significant places, the REVERBDATA project aims to contribute to the research and development of numerous audio applications while at the same time functioning as an archaeoacoustics heritage repository.

2 RIR Acquisition

Over the past few years, the RIR acquisition process has been continuously refined and streamlined. The procedure employs an omni dodecahedron loudspeaker as the sound source, while three sets of specialized microphones simultaneously record the room's response in high detail. After precise calibration, custom-built software generates an exponential sine sweep, which is then analyzed and deconvoluted using the inverse sine wave signal to construct the impulse response.

The following equipment is used (see Figure 1):

- Source - Lookline DL-303 omni dodecahedron loudspeaker
- Microphones - 2 Earthworks M30 omnidirectional measuring microphones, 1 Binaural Enthusiast B1-E dummy head with BE-P1 microphones, 1 Sennheiser Ambeo VR microphone, 1 Zylia ZM-1-3E 3rd order Ambisonics microphone.

- Audio Interfaces - Steinberg UR44, ESI U108PRE
- Software - Custom scripts and functions in GNU Octave 6.4.0 using double precision FP arithmetic, developed in the last years by the authors. [1] [2] [3]

Figure 1 - RIR acquisition hardware

The dodecahedron loudspeaker was utilized to emit exponential sine sweeps, or synchronized exponential sine sweeps, generated in the Octave software. The duration of each sweep varied depending on the specific case but was never less than approximately 5461 milliseconds (512*1024/96000). The starting and ending frequencies of the sweeps were $f_l = 10$ Hz or 40 Hz and $f_u = 20$ kHz or half the sampling rate used. The sweeps captured by the microphone array were synchronously recorded via an ASIO-compatible audio interface using Octave, which calculated the corresponding impulse responses: stereo, binaural and 1st order A format Ambisonics (when using the Sennheiser Ambeo VR mic). Sweeps recorded by the Zylia mic were registered using its proprietary software (Zylia Studio) on 19-channel A format Ambisonics wave files, and the corresponding impulse responses were also calculated in Octave.

The sweeps recorded through stereo, binaural and 1st order Ambisonics mics were digitized with a sampling rate of 96 kHz, except for the two older acquisitions (ESML Great and Small Hall) where a rate of 44.1 kHz was used; a quantization depth of 32 bits FP was used in all cases. For the sweeps recorded with the 3rd order Ambisonics mic a sampling rate of 48 kHz with a quantization depth of 32 bits FP was employed.

Table 1 - REVERBDATA present spaces and RIRs details

ROOM	Seating capacity	Volume	Date	n. meas audience	n. meas balcony	n. meas stage	Stereo	Bin	Amb	fs	q	Sweep	T_sweep	TR_est	fl	fu	f1	f2	f3
ESELx Grand Hall	300	2672	11/14/2023	3	3		X	X	3rd	96000	32	sync exp.	512*1024/96000	2.5	10	fs/2	20	20000	22050
St. Dominic Convent Church	240	6582	11/21/2023	8	NA		X	X	3rd	96000	32	sync exp.	1024*1024/96000	5.0	10	fs/2	20	20000	22050
St. George Cinema	830	3600	1/19/2022	7 (cinema) 7 (orquestra)	NA		X	X	1st	96000	32	exponential	1024*1024/96000	1.5	40	20000	NA	NA	NA
Lux Frágil Disco	NA	NA	3/16/2023	10 (disco) 8 (concert)	NA			X	1st	96000	32	sync exp.	512*1024/96000	0.5	10	fs/2	20	20000	22050
Coliseu Micaelense	1300	NA	1/27/2022	6	12		X	X	1st	96000	32	exponential	1024*1024/96000	2.5	40	20000	NA	NA	NA
Garrett Hall	694	10690	12/20/2021	6	4 + 1		X	X	1st	96000	32	exponential	1024*1024/96000	2.0	40	20000	NA	NA	NA
ESML Small Hall	56	395	12/7/2021	5 (bare) 5 (w/ curtains)	NA			X		44100	32	exponential	512*512/44100	1.2	10	fs/2	20	20000	22050
ESML Great Hall	448	4527	1/4/2021	9 (bare) 9 (w/ curtains)	NA			X		44100	32	exponential	512*512/44100	2.5	10	fs/2	20	20000	22050
ESML Organ Room	NA	650	12/6/2022	10	NA		X	X		96000	32	sync exp.	512*1024/96000	2.0	10	fs/2	20	20000	22050
Gulbenkian Great Hall	1203	7000	5/7/2022	6 (1st. stalls) 4 (2nd. stalls)	2	5	X	X	1st	96000	32	exponential	1024*2048/96000	1.8	40	20000	NA	NA	NA
Cartuxa Monastery Church	240	4475	5/17/2024	6 (source on altar) 4 (source on Hchoir)	NA		X	X	3rd	96000	32	sync exp.	1024*2048/96000	5.0	10	fs/2	20	20000	22050
Convent of Christ - Charola	NA	NA	6/26/2024	3 (source on altar) 3 (source on Hchoir)	NA		X	X	3rd	96000	32	sync exp.	1024*2048/96000	5.0	10	fs/2	20	20000	22050
Convent of Christ - Refectory	NA	NA	6/26/2024	3 (source on pulpit) 2 (source on floor)	NA		X	X	3rd	96000	32	sync exp.	1024*2048/96000	5.0	10	fs/2	20	20000	22050
Convent of Christ - Cistern	NA	NA	6/26/2024	4	NA		X	X	3rd	96000	32	sync exp.	1024*2048/96000	5.0	10	fs/2	20	20000	22050
Convent of Christ - Claustro D. João III	NA	NA	6/26/2024	4	NA		X	X	3rd	96000	32	sync exp.	1024*2048/96000	5.0	10	fs/2	20	20000	22050

3 RIR Processing

Before the analysis can be carried out, it is necessary to process the raw audio. The Ambisonics responses are converted from the A to the B-format using the proprietary software provided by the manufacturers (Seinheiser's Ambeo A-B Format Converter, v1.2.0 and Zylia's Ambisonics Converter v1.7.0)

Denoising is also necessary because, even though the signal-to-noise ratio (SNR) typically achieved is adequate for the characterization of the spaces according to ISO 3382-1 norms [4], the noise is often still audible when using them for reverb convolution. Thus all responses are truncated utilizing the Lundeby algorithm [5] before the decay reaches the level of the background noise.

The main acoustical parameters, as specified in the ISO 3382-1 standard[4], were then calculated for each acquired RIR and stored in text files, namely signal-to-noise values, reverberation times (EDT, T_{10}, T_{20}, T_{30}, T_{60}), clarity indexes (D_{50}, C_{50}, C_{80}), center times and also IACC values for the binaural responses

4 The REVERBDATA Database

The REVERBDATA Database includes architectural documentation alongside the acoustic measurements and their associated information. Figure 3 illustrates the folder structure of one of the places included in it.

The acoustic measurements include the raw audio files containing the sweeps, the RIRs as recorded *in situ* as well as the versions processed as described in chapter 3.

The RIRs provided are divided into two categories, the first containing the stereo and binaural responses (as 4-channel wave files) and the second containing the Ambisonics responses in both A-format and B-format. In the latter case the responses are available either in the FUMA or in the ACN/AMBIX formats. The stereo-binaural responses are available either normalized to the maximum ±1 value or scaled according to the source-receiver distances.

For convenience, mono RIRs acquired through the ARTA software (v1.9.7) are also available in the Database.

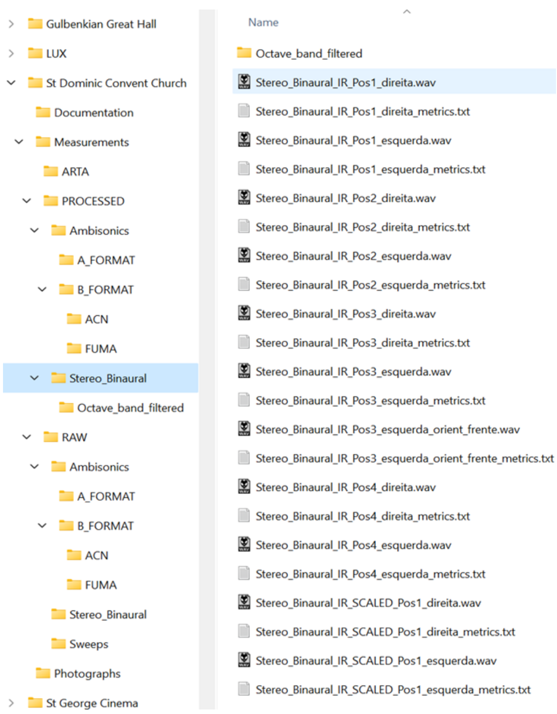

Figure 2 - Screenshot of the Database.

For each post-processed RIR the associated room acoustics main objective parameters (broad-band and octave band values) are available in a .txt file as shown in Figure 3 for one stereo-binaural example.

The REVERBDATA Database currently includes acoustic information of fifteen different spaces in Portugal, which are described below. Detailed information about each space is provided, including the main architectural features, dimensions, typical construction materials and other factors that may influence the acoustics of the venue.

SNR	wide	63	125	250	500	1000	2000	4000	8000	16000	[dB]
ch1	99.7	69.4	78.8	85.8	91.1	96.4	96.9	99.0	104.2	102.9	[dB]
ch2	98.7	69.5	78.9	86.4	91.6	95.9	95.5	98.1	103.1	101.3	[dB]
ch3	91.8	57.6	70.3	78.0	74.8	81.7	94.3	100.5	102.7	96.6	[dB]
ch4	90.9	59.4	71.0	78.7	73.8	79.8	95.3	98.7	100.9	98.9	[dB]
EDT	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	2.16	2.48	2.69	3.03	2.95	2.40	1.96	1.51	0.89	0.38	[s]
ch2	2.17	2.53	2.62	3.15	3.01	2.39	2.16	1.53	0.86	0.43	[s]
ch3	1.54	3.12	2.94	3.41	3.07	2.33	1.89	1.36	0.94	0.44	[s]
ch4	1.57	3.28	2.75	3.02	2.83	2.24	1.96	1.40	1.11	0.67	[s]
T30	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	2.75	3.31	3.18	3.27	3.12	2.37	2.07	1.60	1.09	0.64	[s]
ch2	2.75	3.32	3.20	3.27	3.09	2.40	2.09	1.64	1.12	0.67	[s]
ch3	2.11	3.27	3.19	3.21	3.04	2.29	1.99	1.53	1.18	0.95	[s]
ch4	2.08	3.23	3.21	3.27	3.03	2.37	1.99	1.51	1.22	1.02	[s]
T20	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	2.61	3.20	3.19	3.24	3.11	2.33	2.05	1.57	1.02	0.57	[s]
ch2	2.62	3.20	3.22	3.19	3.09	2.38	2.05	1.61	1.04	0.59	[s]
ch3	1.95	3.20	3.19	3.11	2.97	2.26	1.98	1.49	1.12	0.83	[s]
ch4	1.87	3.13	3.21	3.25	3.02	2.31	1.94	1.47	1.18	0.92	[s]
T15	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	2.48	3.04	3.01	3.20	3.03	2.28	2.04	1.57	0.97	0.54	[s]
ch2	2.51	3.00	3.10	3.20	3.05	2.35	2.01	1.59	1.01	0.57	[s]
ch3	1.84	3.01	3.19	3.20	2.99	2.22	1.94	1.47	1.08	0.77	[s]
ch4	1.77	2.93	3.14	3.21	3.00	2.29	1.91	1.47	1.14	0.86	[s]
T10	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	2.42	3.16	3.01	3.22	2.86	2.26	2.07	1.54	0.96	0.48	[s]
ch2	2.45	3.17	3.09	3.26	2.92	2.34	1.99	1.56	0.97	0.50	[s]
ch3	1.76	3.29	3.30	3.33	2.83	2.15	1.94	1.42	1.06	0.68	[s]
ch4	1.70	3.22	3.12	3.31	3.03	2.29	1.91	1.48	1.11	0.81	[s]
T60	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	3.32	3.67	3.52	3.22	3.46	2.92	2.23	2.01	1.69	1.62	[s]
ch2	3.46	3.69	3.43	3.22	3.27	2.84	2.27	1.96	1.72	1.67	[s]
ch3	3.34	3.63	3.78	3.15	3.00	2.66	2.19	1.83	1.70	1.59	[s]
ch4	3.31	3.63	3.90	3.14	3.30	2.51	2.23	1.84	1.65	1.60	[s]
D50	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	46.30	38.76	36.65	24.71	28.95	39.48	37.27	53.41	74.05	89.45	[s]
ch2	46.39	38.27	39.34	27.91	33.00	42.69	38.48	51.01	72.77	86.75	[s]
ch3	53.02	31.28	29.17	18.89	33.63	44.86	37.28	54.08	69.54	85.64	[s]
ch4	49.49	26.86	19.93	22.47	31.43	39.82	38.54	50.86	62.00	84.09	[s]
C50	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	-0.64	-1.99	-2.38	-4.84	-3.90	-1.86	-2.26	0.59	4.55	9.28	[s]
ch2	-0.63	-2.08	-1.88	-4.12	-3.08	-1.28	-2.04	0.18	4.27	8.16	[s]
ch3	0.52	-3.42	-3.85	-6.33	-2.95	-0.90	-2.26	0.71	3.59	7.75	[s]
ch4	-0.09	-4.35	-6.04	-5.38	-3.39	-1.79	-2.03	0.15	2.13	7.23	[s]
C80	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	0.93	-0.85	-1.13	-2.72	-2.62	-0.18	-0.42	2.22	7.10	13.28	[s]
ch2	0.96	-0.99	-0.56	-2.61	-1.78	0.14	-0.29	2.10	6.82	12.24	[s]
ch3	2.31	-1.89	-0.98	-3.94	-2.16	0.42	-0.43	2.61	5.58	10.67	[s]
ch4	2.02	-2.48	-2.13	-2.37	-2.00	-0.34	-0.04	2.49	4.18	9.83	[s]
Ts	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
ch1	121.63	163.14	162.69	197.93	198.80	142.84	130.84	84.11	39.95	17.57	[s]
ch2	122.39	165.06	154.38	193.31	185.25	138.19	133.43	89.18	42.52	21.86	[s]
ch3	88.02	188.03	180.57	225.66	189.78	129.36	126.00	77.23	49.11	24.22	[s]
ch4	94.55	203.79	198.60	216.28	188.79	139.74	127.19	84.48	59.78	24.47	[s]
IACC A	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
chs	0.150	0.896	0.799	0.575	0.156	0.144	0.082	0.170	0.133	0.338	[ ]
IACC E	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
chs	0.226	0.868	0.766	0.586	0.265	0.253	0.143	0.251	0.193	0.374	[ ]
IACC L	wide	63	125	250	500	1000	2000	4000	8000	16000	[Hz]
chs	0.076	0.917	0.828	0.572	0.088	0.117	0.091	0.060	0.072	0.050	[ ]

Figure 3 - ISO 3382-1 acoustical parameters calculated for a stereo-binaural RIR

Coliseu Micaelense: located in Ponta Delgada city, is the largest entertainment hall in the Autonomous Region of the Azores. Built in 1917, it was purchased, renovated and reopened by the Ponta Delgada City Hall in 2005. It can host a wide variety of events, including shows in a conventional auditorium and shows in a circus arena, even shows such as café-concerts, rock concerts, banquets, casino, congresses, fairs and dance balls.

The Hall has a conventional horseshoe format (see Figure 4) with a seating capacity of 1270, distributed across the 1st and 2nd stalls (440 seats), the 1st and 2nd central and side balconies (350 seats) and across the 80 boxes located at 1st and 2nd levels (480 seats). The central main floor has an area of 260 m^2.

Figure 5 shows the room plan of Coliseu Micaelense with the 18 measurements points shown. The acoustic source was in the center of the stage.

Figure 4 - Coliseu Micaelense - view to the stage from balconies' level.

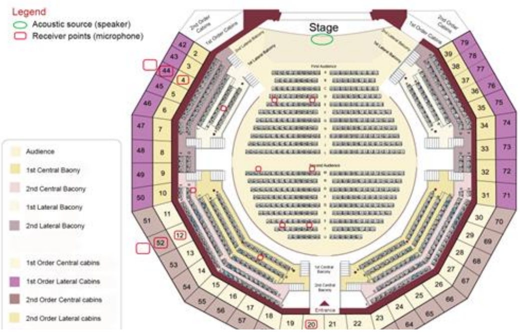

Figure 5 - Coliseu Micaelense – measurement points and source location.

ESELx Great Hall: The Great Hall of the Lisbon School of Education (ESELx), with a floor area of around 300 m^2 and a maximum seating capacity for 300 people, allows a variety of cultural events such as theater, cinema, concerts, and conferences. The hall has a flat audience area, with individual chairs, and a circular shaped balcony, as shown in Figure 6. Figure 7 shows the hall's plan with the locations of the acoustic source and of the 6 measurement points, 3 located in the audience area and 3 located on the balcony.

Figure 6 - ESELx Great Hall – view from the entrance.

Figure 7 - ESELx Great Hall – measurement points and source location.

ESML Great Hall: Also called Vianna da Motta Auditorium is located at Lisbon School of Music (see Figure 8). This room, which was designed by the Portuguese architect Carrilho da Graça and by the Belge acoustician Daniel Commins, has a volume of ca. 4650 m^3 and a seating capacity for 448 people, distributed across 16 rows with 28 seats.
The stage possesses a flat wooden floor on joists, the audience area is tilted approximately 20º in relation to the horizontal plane and has two wooden flights of stairs in between the rows of chairs. The walls surrounding the audience go continuously around the stage in a roughly trapezoidal shape and consist entirely of large-scale shape-optimized reflection phase grating diffusors. Figure 9 shows the locations of the acoustic source on the stage and of the 9 acquisition points in the audience.

Figure 8 - ESML Great Hall – view towards the stage.

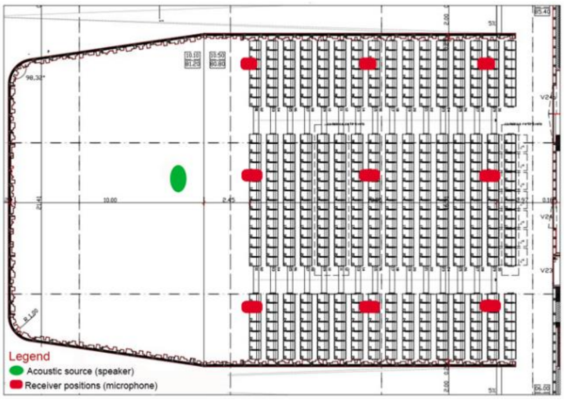

Figure 9 - ESML Great Hall – measurement points and source location.

ESML Small Hall: Located at Lisbon School of Music, this hall was also designed by the Portuguese architect Carrilho da Graça. It has a seating capacity for 58 persons (Figure 10), with features that gives it versatility to host various cultural events, like music, conferences, theater, dance, and cinema. The volume of the entire hall is around 400 m^3, and the audience area, with 39 m^2 and 7 rows, is tilted approximately 20º in relation to the stage, which is horizontal.

Figure 11 shows the plan of the Small Hall with the locations of the 5 measurement points (microphone acquisition on the audience) and the acoustic source.

Figure 10 - ESML Small Hall – view from the stage.

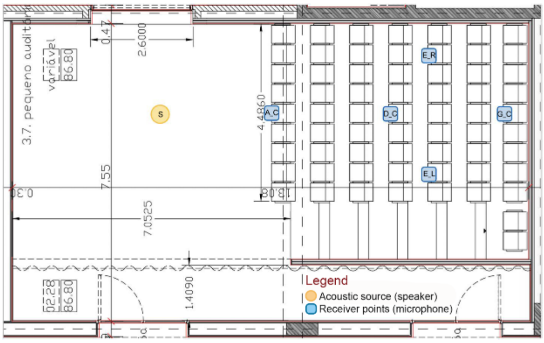

Figure 11 - ESML Small Hall – measurement points and source location.

Garrett Hall: Is the main hall of the National Theatre D. Maria II in Lisbon. The Garrett Hall was designed by the Italian architect Fortunato Lodi in a classic horseshoe shape (see Figure 12) and opened at 13th April 1846. In 1964, the theater was destroyed by a fire, which led to a full reconstruction of the building, inaugurated in 1978. The restoration project focused on providing the best possible acoustic conditions, aiming at a 1 second reverberation time. Nowadays this hall is still mainly used for theater performances, thus maintaining its original purpose.
The present Garrett Hall possesses a volume of 3105 m^3 for the audience and a seating capacity for 694 people. The stage is around 18 m deep, 29 m wide and 17 m high. The total volume of the hall (audience + fly tower) is ca. 12000 m^3.
Figure 13 shows the location of the acoustic source on stage, together with the 10 measurement points located at the audience stalls, at the 1st and 2nd balconies, and at the royal tribune.

Figure 12 - Garrett Hall – view from the stage.

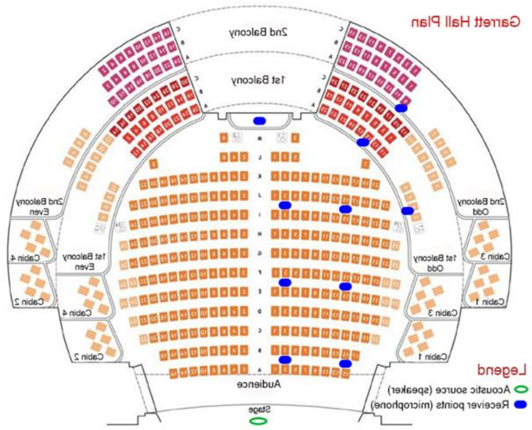

Figure 13 - Garrett Hall – measurement points and source location.

Gulbenkian Great Hall: The Grand Auditorium of the Calouste Gulbenkian Foundation in Lisbon had its inaugural concert on the 3rd of October 1969, the day after the official inauguration of this complex. With exceptional acoustics, its design and construction were aimed at hosting many cultural activities, including symphonic and choral-symphonic music, congresses and conferences, ballet, theater and cinema.

The hall was designed by the Portuguese architects Alberto Pessoa, Pedro Cid e Ruy d' Athouguia and by the British acoustician William Alexander Allen.
Renovated in 2014, with ARUP as acoustic consultant, the Great Hall has a capacity for 1203 people, spread over 36 rows on 3 different levels: 651 seats on the 1st audience stalls, 416 on the 2nd audience stalls and 161 on the balcony. The hall has a floor area of 875 m^2 and a height of ca. 8 m. The backstage is glazed towards the outside garden, and when uncovered it allows for a unique setting. Figure 15 shows the 12 measurement points in the hall and the position of the acoustic source (stage).

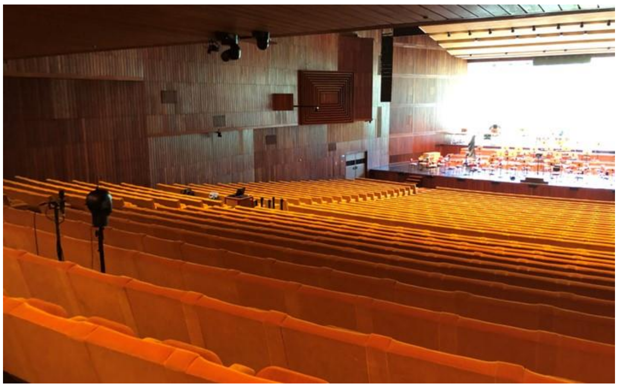

Figure 14 - Gulbenkian Great Hall – view from the back on the right side of the audience.

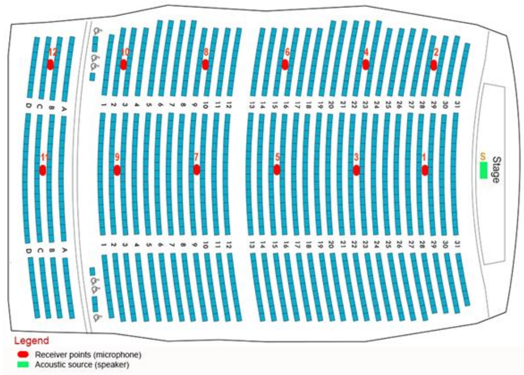

Figure 15 - Gulbenkian Great Hall – view from the back on the right side of the audience.

St. Dominic Convent Church: Inaugurated on the 21st of March 1994 by the Dominican Order as the first male catholic convent built in Lisbon since the last 250 years. Designed by Portuguese architects José Fernando Gonçalves and João Paulo Providência, it is a modern church of sober and minimalist lines, with a rectangular shaped floor measuring 12.5 m x 35.0 m and a considerable height of ca. 15.0 m. The space has a large window that opens onto the inner cloister, the floor is slightly inclined towards the altar and its interior decoration is also very minimalistic, without figures or images (see Figure 16).
Figure 17 shows the acoustic source location, near the altar, and the 8 acquisition points scattered throughout the audience.

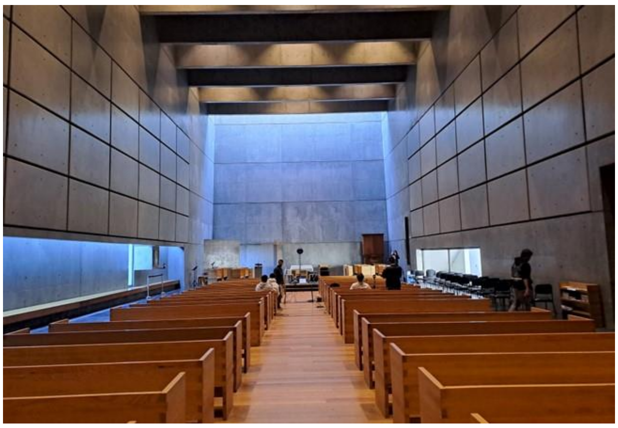

Figure 16 - St. Dominic Convent Church – view from the main entrance.

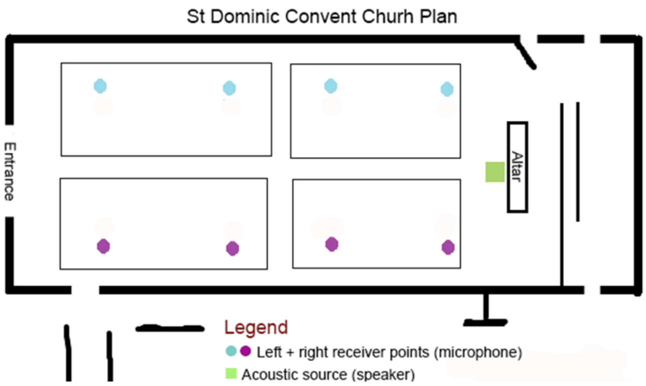

Figure 17 - St. Dominic Convent Church – source location and measurement points.

St. George Cinema: The main hall of this cinema in Lisbon is called Manoel de Oliveira (after the famous Portuguese filmmaker). The cinema opened in 1950 and was remodeled several times, the last refurbishment took place in 2001. It is a hall with a seating capacity for 830 persons divided into 3 audience stalls with respectively: 160, 364 and 324 seats (see Figure 18). Figure 19 shows the 7 measurement points' location scattered throughout the 3 levels of the audience stalls and the acoustic source placed centered on the stage.

Figure 18 - St. George Cinema – Manoel de Oliveira Hall, view from the back of the 3rd audience stall.

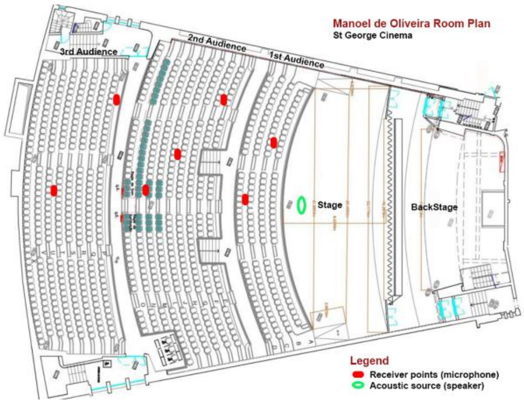

Figure 19 - Manoel de Oliveira Room – source location and measurement points.

Lux Frágil: A famous nightclub located in Lisbon that opened on the 29th of September 1998. Lux Frágil, besides being a bar and disco, has hosted concerts, performances, exhibitions, book presentations and recordings and was even on the set of many television programs. The disco has a floor area of ca. 270 m^2 (16.0 m x 17.0 m) and a mean height of ca. 8.0 m. Figure 21 shows the 10 acquisition points, 7 of them were also used for SPL measurements. The resident surround sound system was used as an acoustic source.

Figure 20 - Lux Frágil – view of the disco room.

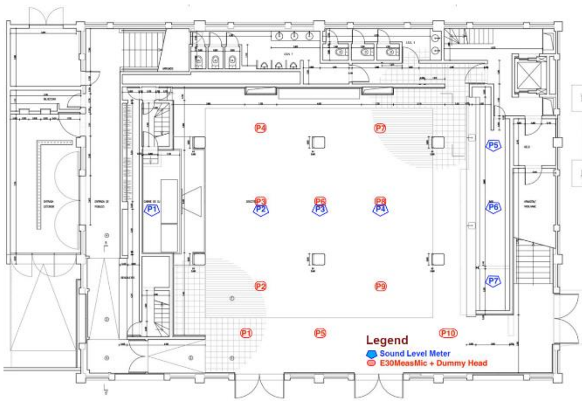

Figure 21 – Lux Frágil – measurement points with a sound level meter, microphone, and dummy head.

Convent of Christ: a UNESCO Heritage of Mankind monument complex in the city of Tomar, continuously built between the 12th and 16th centuries. Known for its Templar history and diverse architectural styles, it is of undeniable cultural and archaeological importance. Nowadays it is open

to the public and occasionally hosts educational and artistic exhibitions as well as cultural events such as concerts and plays.
Acquisitions were done in the Charola (Round Church), High Choir Nave, Main Cloister (D. João III), Refectory and Small Cistern, allowing for a rather complete and unique preservation of the monument's acoustics.

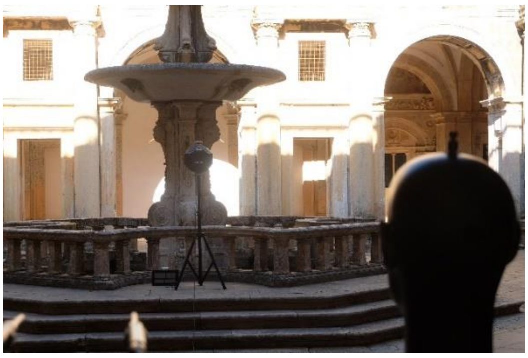

Figure 22 - Convent of Christ - Main cloister

Figure 23 – Convent of Christ - Refectory

Figure 24 - Convent of Christ - Charola

Figure 25 Convent of Christ - Small cistern

5 Conclusions and Future Work

REVERBDATA establishes a structured and comprehensive database of RIRs acquired through state-of-the-art high resolution multi-channel techniques in significant Portuguese spaces. RIRs are available under different formats (AB stereo, binaural, 1st, 2nd and 3rd order Ambisonics), presently corresponding to more than 140 locations registered for 15 distinct significant spaces. Future work envisages the addition of many more significant Portuguese spaces to the existing ones. The REVERBDATA Database and Project is available freely at www.reverbdata.org.

6 Acknowledgements

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7 References

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