Measured Reverbs for Ambisonics and VR

Convolution Reverbs for Ambisonics

Dr Bruce Wiggins

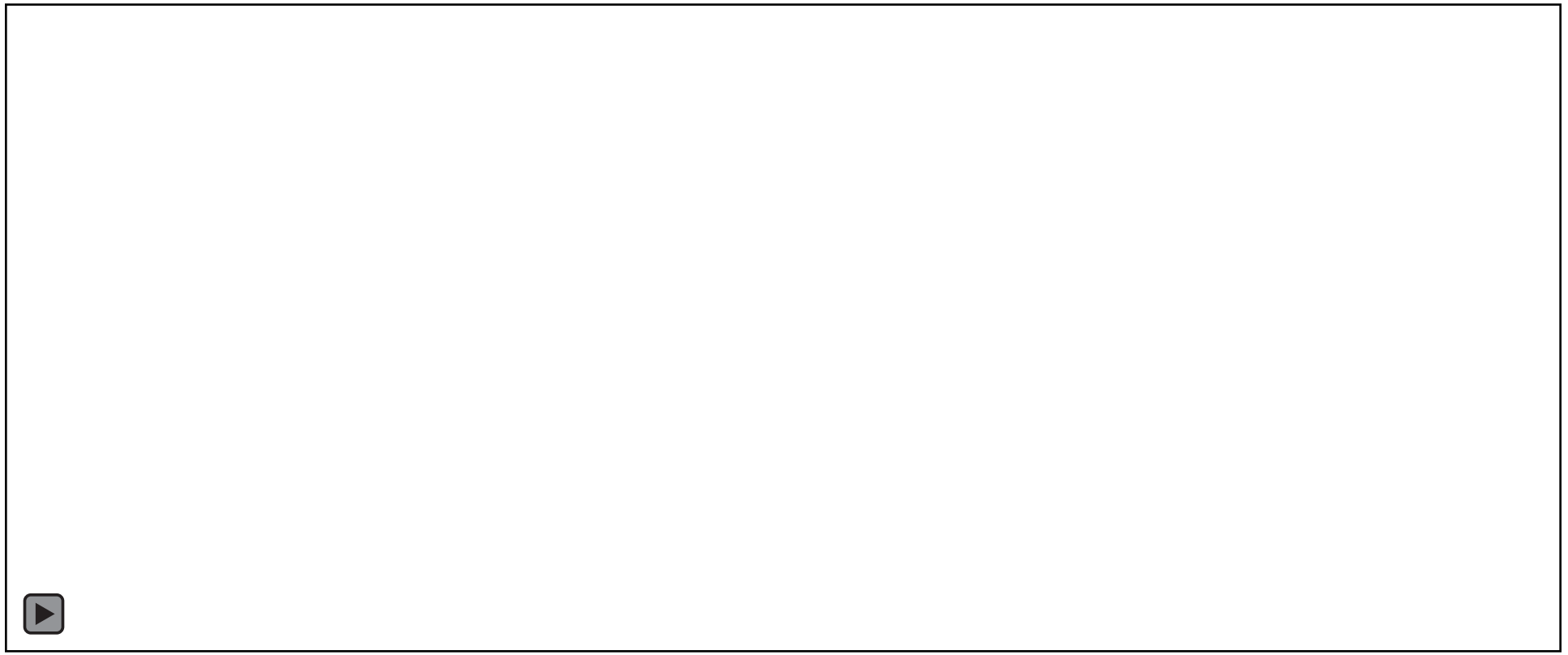
b.j.wiggins@derby.ac.uk

Introduction – What is Reverb?

- All rooms contain surfaces which are neither perfect reflectors nor perfect absorbers of sound.
- Thus the sound from a sound source may bounce around the walls and surfaces of a room many times before its sound pressure level (SPL) has died to inaudibility.
- Reverb is nearly always associated with indoor situations….
- …however, ALL situations in which sound is heard, contains some form of reverberation (even if it's just a floor reflection!).

Reverberation

- Reverb is EVERYWHERE!



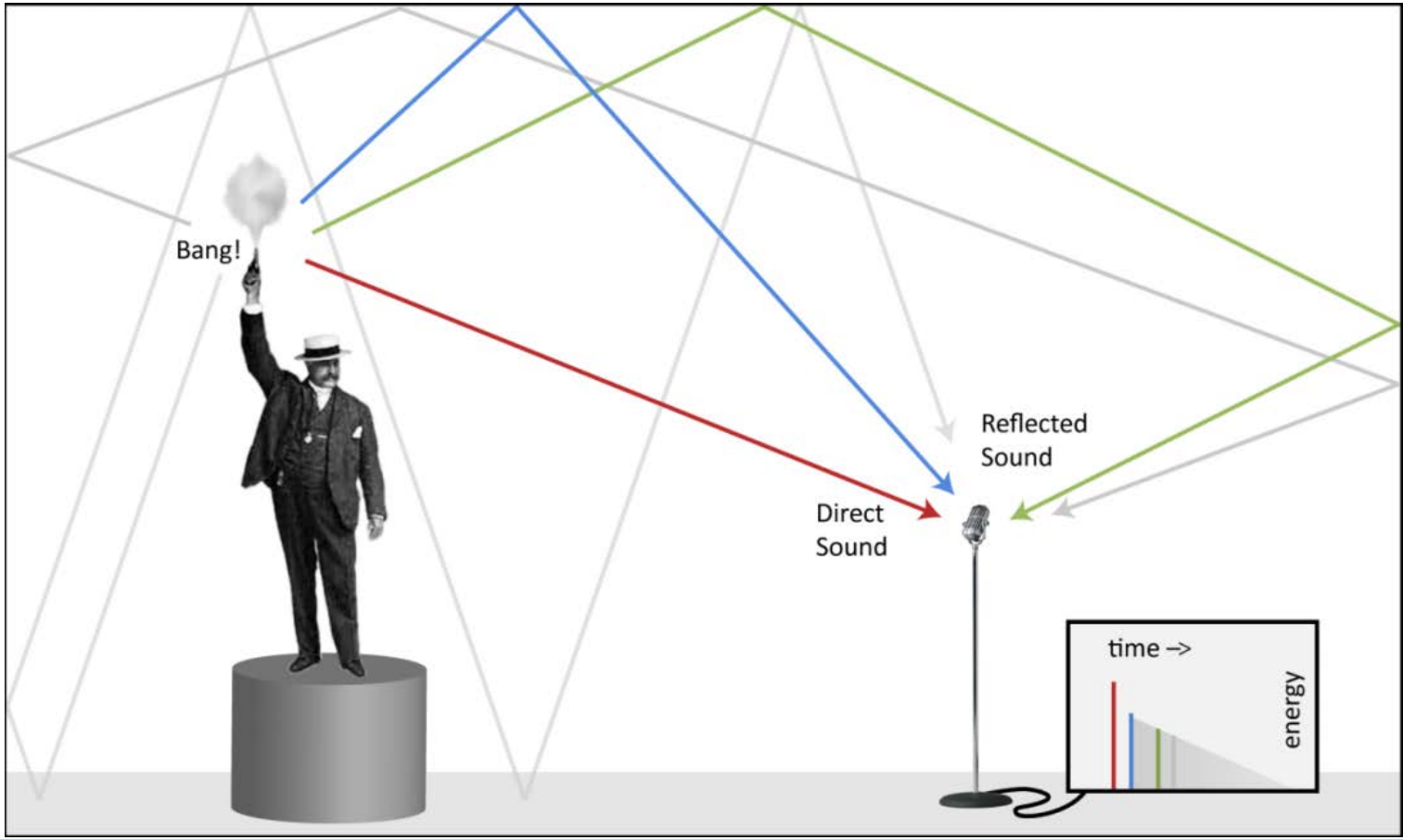
Video of The Wikidrummer from https://www.youtube.com/watch?v=mY-f68J5PPo

Three Main Types of Reverb

- Simulated/Modelled – Convolution Reverb
  - i.e. a room is mathematically modelled or measured.
  - Modelling could use the ray tracing (such as Ease/ears).
  - Measured could use MLLSA to measure the impulse response using a microphone, and implemented using a long FIR filter.
- Empirically derived
  - Small ‘building blocks’ used in series and parallel to form a reverb engine that sounds like it could be a real place.
- A combination of the two
  - Modelled early reflections using the image source method.
  - Combined with an empirically derived diffuse tail.

Convolution Reverb - Measured

- Simple theory
- Drive the room with an impulse
- Record what comes back



http://www.prosoundweb.com/channels/live-sound/what_is_an_impulse_response/

Examples

Large Hall

Troy Music Hall

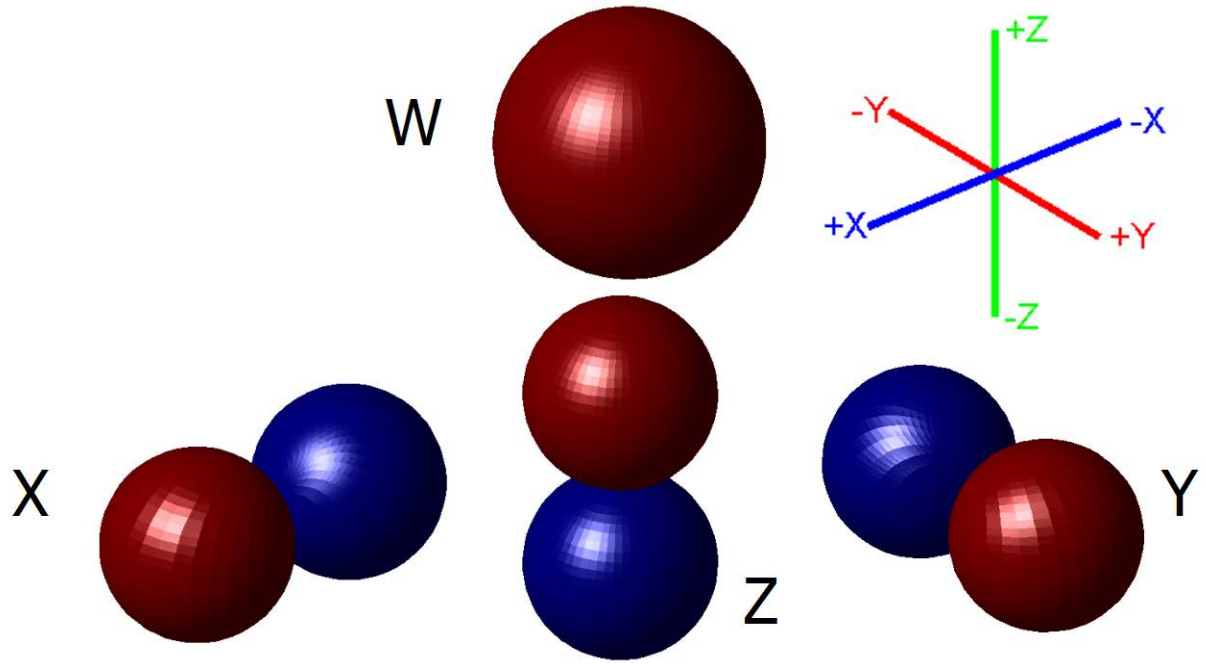
Car Park

Hillside

Convolve the Result

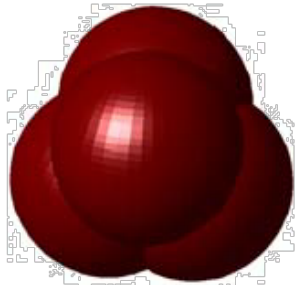
- If we convolve (filter) audio with the desired impulse response
- We have reverb!
- What about Ambisonic Reverb?
  - Record room response with Ambisonic mic:

B-Format →

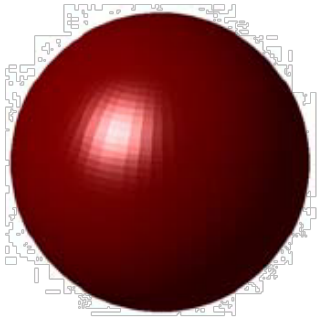


What about B-Format Reverb?

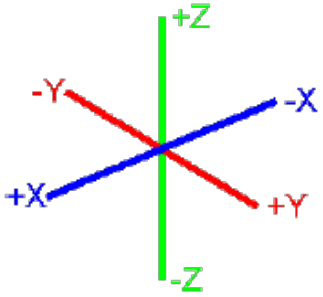
- Take inspiration from the SoundField Microphone
- Derives general polar patter (spherical harmonics) from directional signals
- Near-coincident version called **A-format**
- Coincident version known as **P-format** (Spatial PCM Sampling)

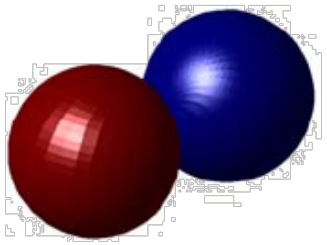


P-Format

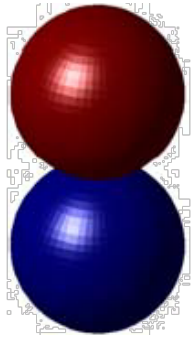


W from P

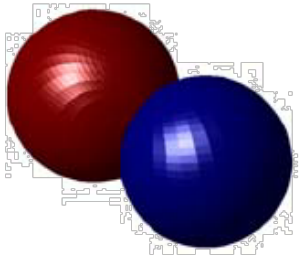




X from P

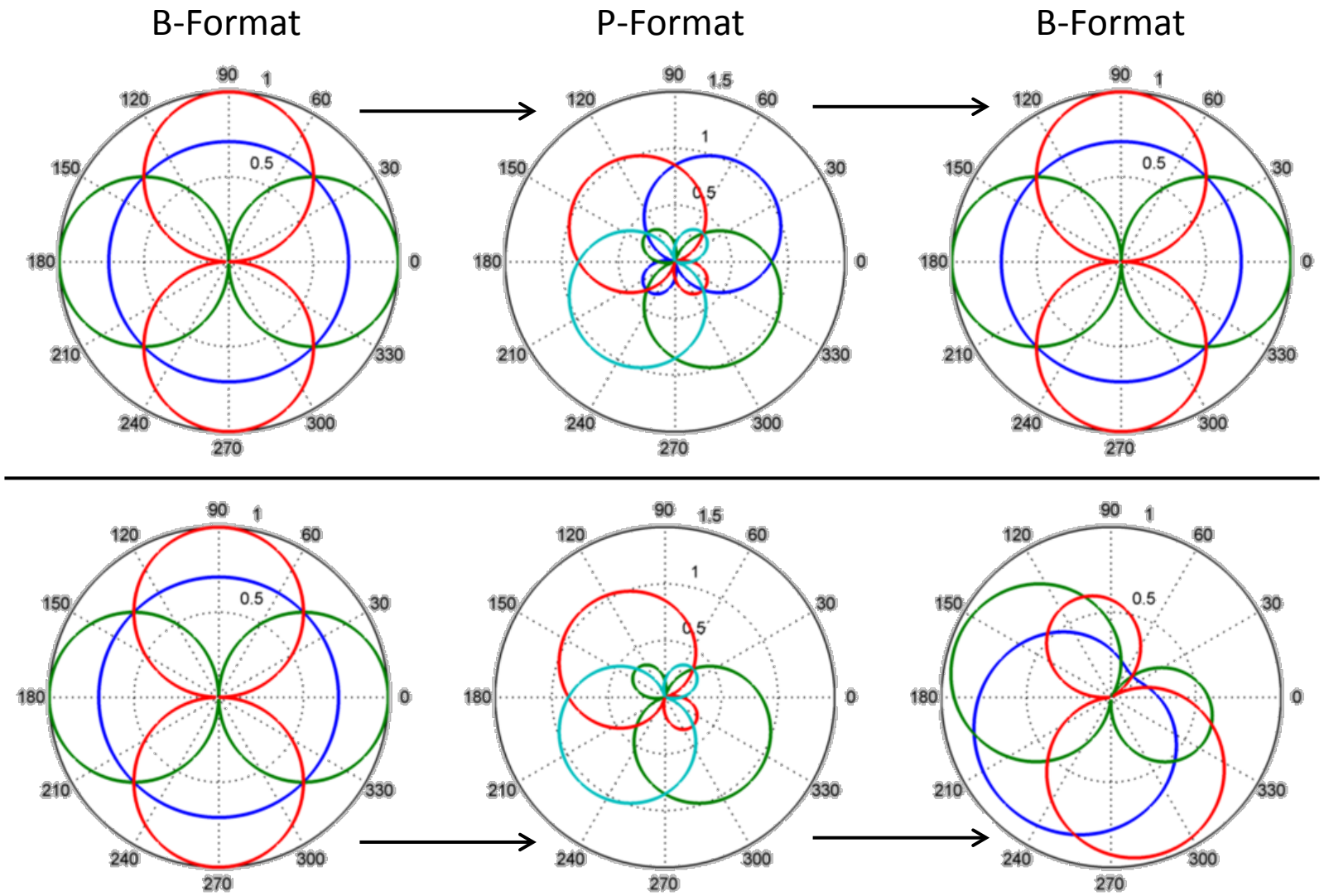


Z from P

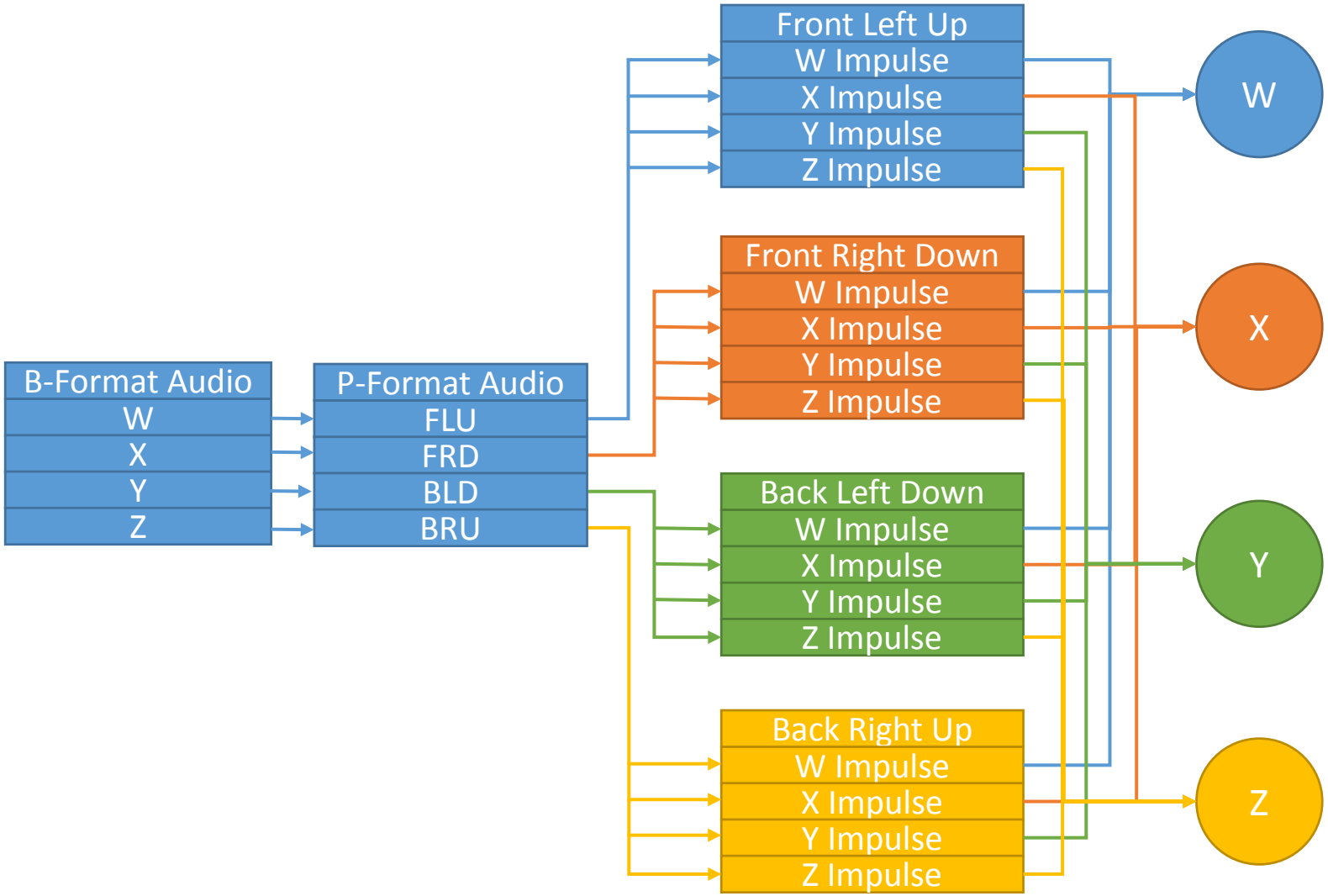


Y from P

P-Format

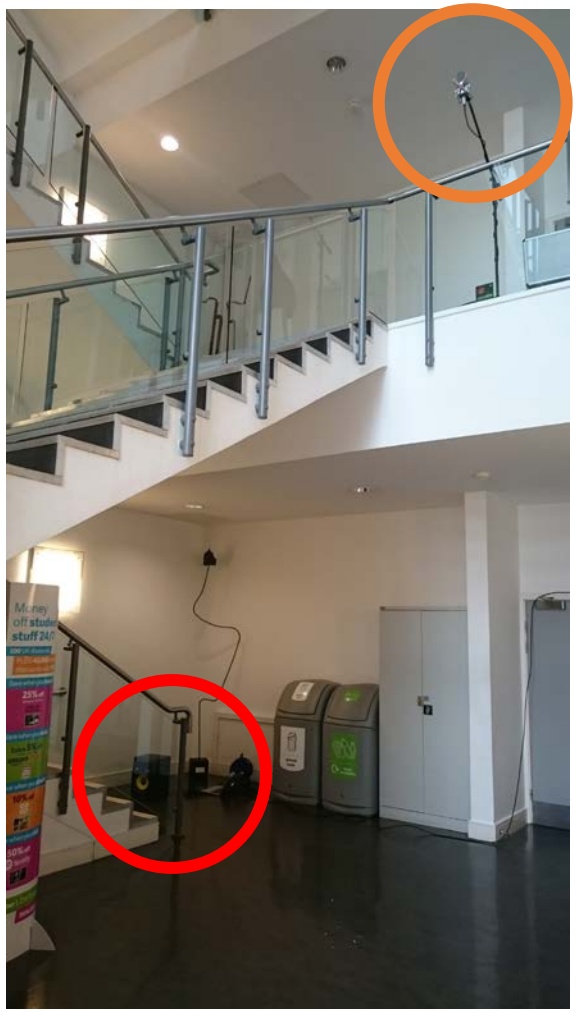

B-Format
P-Format
B-Format
90
120
60
150
30
180
0
210
330
240
300
270
1
0.5
1.5

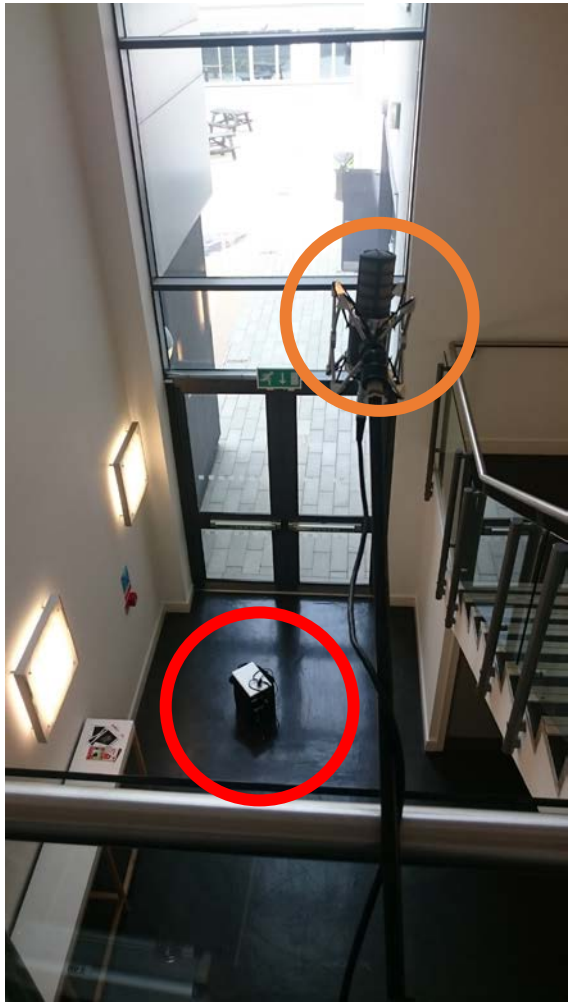
What's Needed?



Example – Stairwell at UoD Markeaton Street!

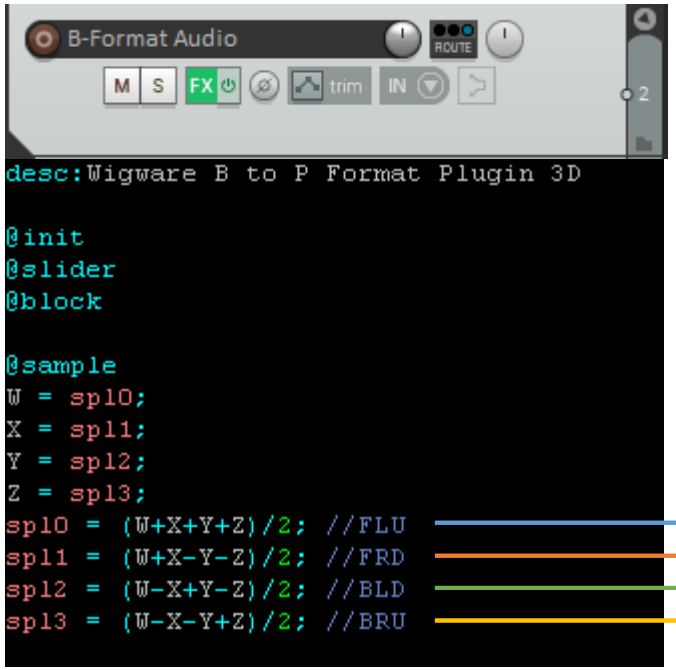
- Tall, thin, very reverberant

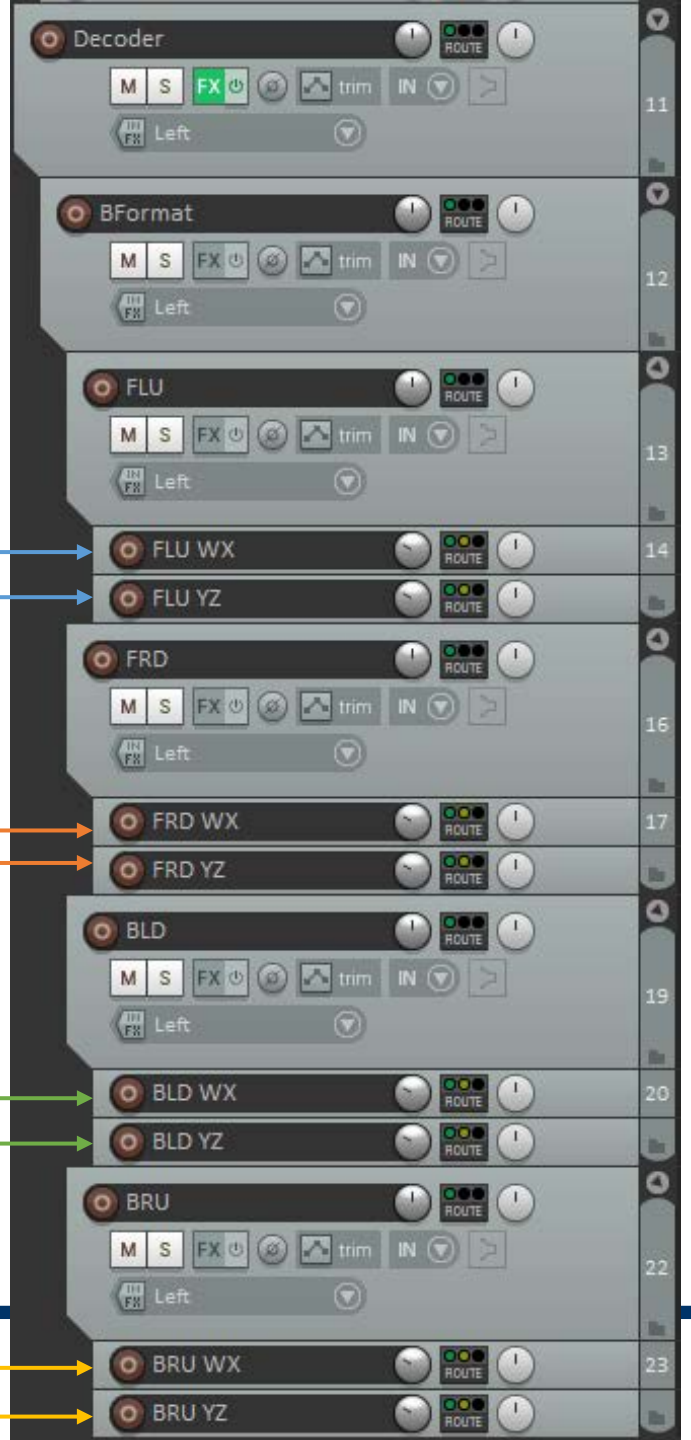


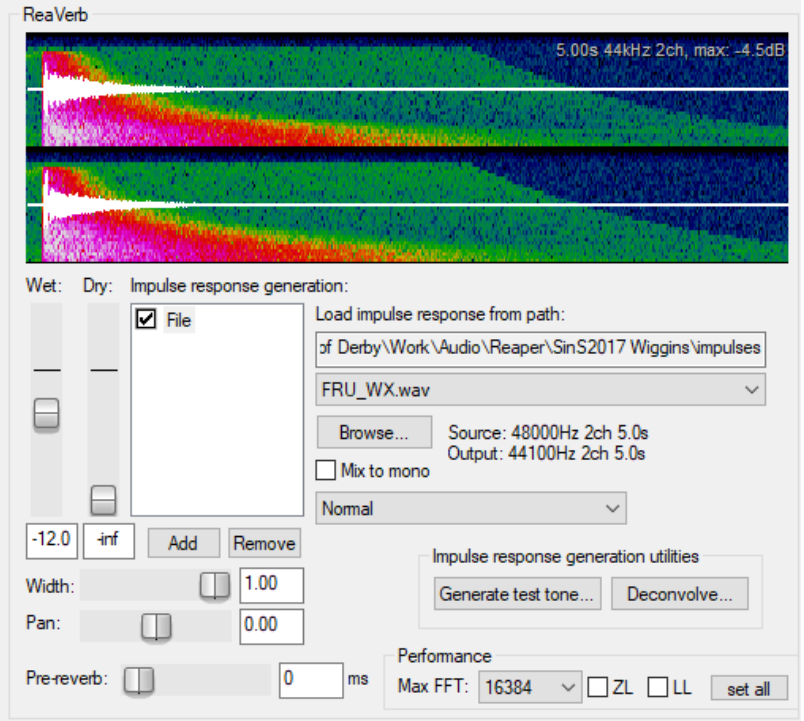


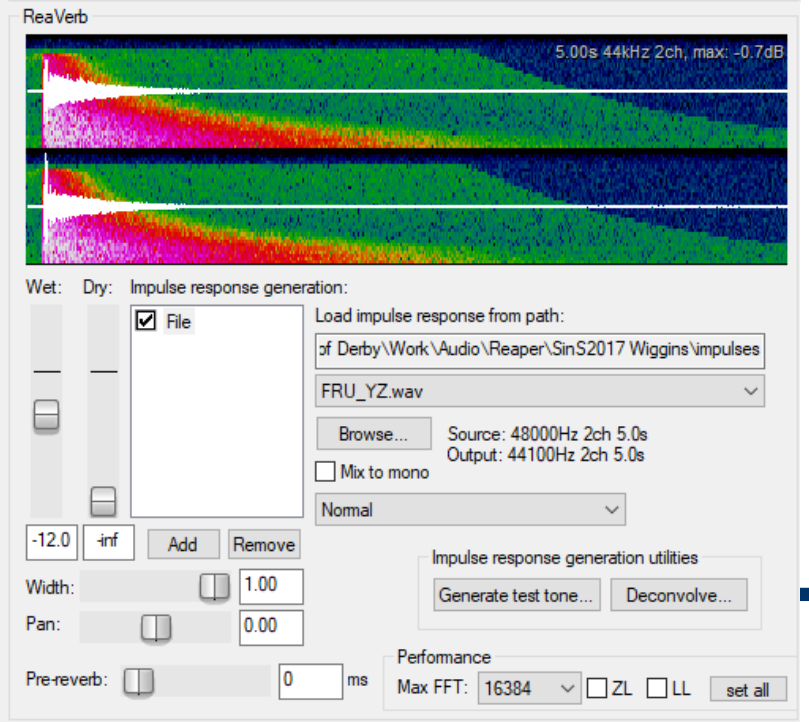
Implementation

- Small script
- Reaverb plug-in









Demonstration

- Here’s one I made earlier…

Questions?