

How to perform 'Waves' - a physics piece for up to Eight Church Bells, from 'Pendulums: Music for Bellringers, Improvisers and Electronics' by Andrew Woodhead

This piece forms the central part of my album 'Pendulums' and features eight church bells recreating the effect of a [Pendulum Wave](#) in sonic form, using eight metronome tracks phased incrementally in tempo.

[Here is a video of the piece performed by the ringers of St Paul's Church Birmingham led by Richard Grimmett](#)

You will need:

- A laptop/computer
- REAPER software ([available here on a 30-day free trial](#))
- The REAPER file and wavs which most closely match your tower's tempo (see below for more details - [link to Google Drive folder here](#))
- An audio interface with at least 8 outputs ([Gigaport eX](#) is currently cheapest option to buy new, [Gigaport HD](#) is cheaper still if you can find one on ebay)
- 8x [Phono to 3.5mm Jack Adaptors](#) (if using Gigaport)
- 8x [headphones with at least 5m cable](#) (over-ear closed-back types recommended)

Optional extras, if using other interfaces/shorter headphone leads etc:

- (If using another interface which sends 6.3mm jack out eg Focusrite 18i20 with a Headphone Amp, you'll need 8x [6.3mm to 3.5mm Jack Adaptors](#) instead)
- (If headphones have shorter leads, you could use 8x [headphone extenders](#) instead)

I have one Gigaport HD with Phono Adaptors which I'm happy to lend out to any tower which would like to try the piece, should the cost of buying one seem a bit too steep. Please note there may have to be a waiting list/honour system for this if it proves popular...

Finding your tower's tempo

This piece hinges on knowing the speed in beats per minute that you can comfortably turn over the heaviest bell. The easiest way to do this is to have a ringer turn over the bell, whilst somebody else taps the tempo into a [free metronome app](#) on a smartphone.

I recommend tapping 4 beats for every strike of the bell (ie the bell strike is beat 1 of a bar of 4/4 time) - this ensures accuracy and also makes it match the tempos of the metronome tracks, which are also in 4/4. If you tap just once per strike, multiply that number by 4 to find the corresponding BPM for your tower.

The tempos currently available (corresponding towers for info/weight reference) are: 83.6BPM (St Peter Mancroft, Norwich), 98BPM (St George's, Jesmond) and 120BPM (St Paul's Birmingham, Sacred Trinity Salford, St John's Ranmoor).

For now I would recommend choosing the one which most closely matches your tower and giving it a go - I can make bespoke files on request but please be aware it may take some time... Contact me [via my website](#) if you have a specific request for metronome tracks and I will do my best!

Downloading the files

The files are located in [a Google Drive folder here](#) - please ensure you download the complete folder for each tempo which should include:

- A REAPER .RPP file
- A .RPP -bak backup file
- 8 or more wav files
- 8 or more .repeaks analysis files

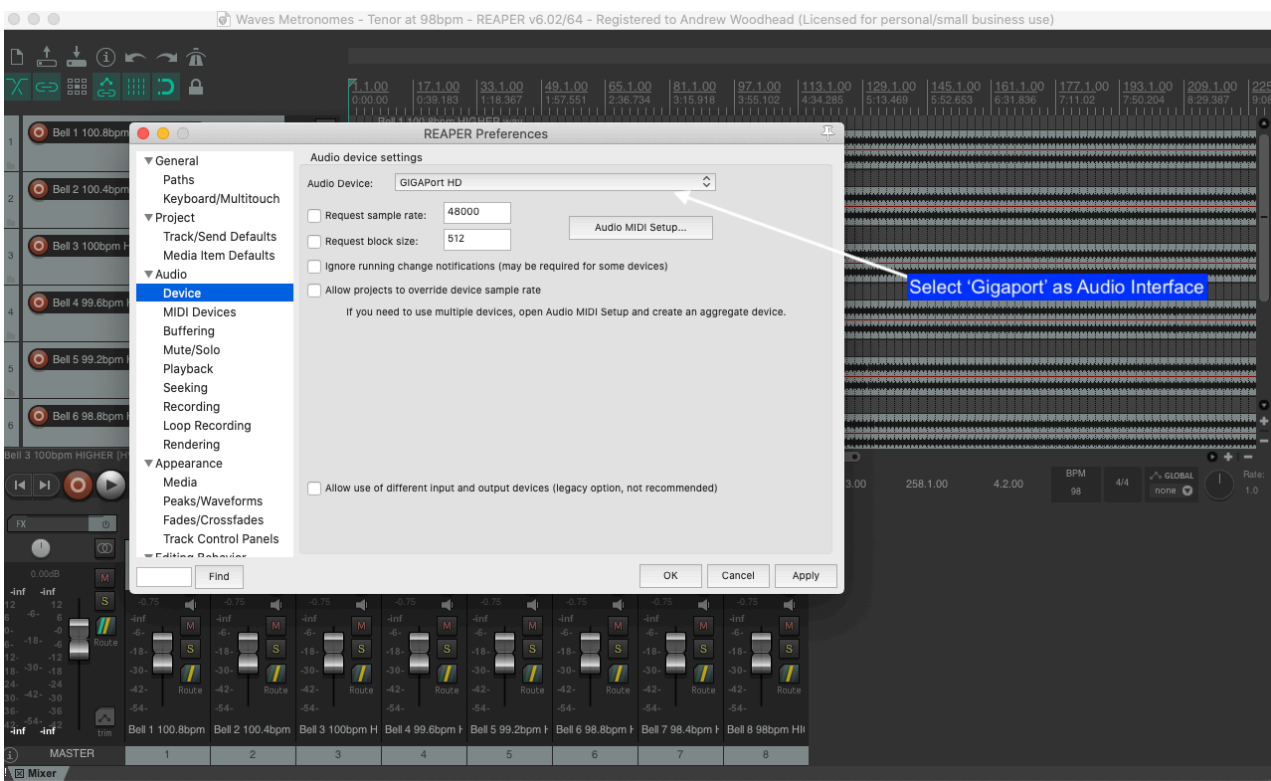
Setting up the interface and REAPER

Plug your interface (Gigaport) into your computer via the USB cable. A light on the Gigaport should indicate that it is connected, this may vary with other interfaces.



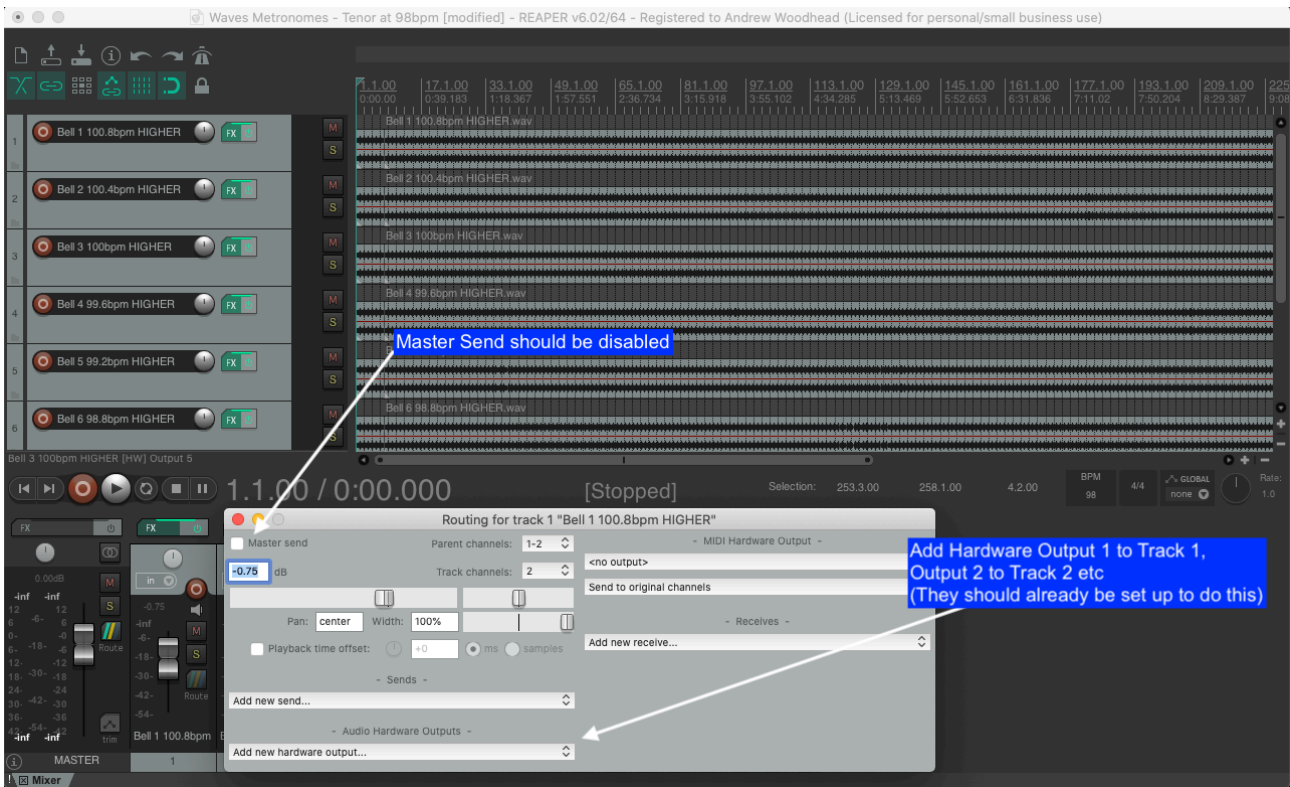
Connect the 8x Phono adaptors to the 8x outputs on the Gigaport, turning them into 8x 3.5mm jack adaptors. Plug your headphones into these, with Output 1 corresponding to the Treble, 2 to the second bell, etc down to 8 for the Tenor.

Open the .RPP file which should boot up REAPER. You should see a screen which looks like this. Note the playback controls, track volume sliders and 'Routing' buttons.

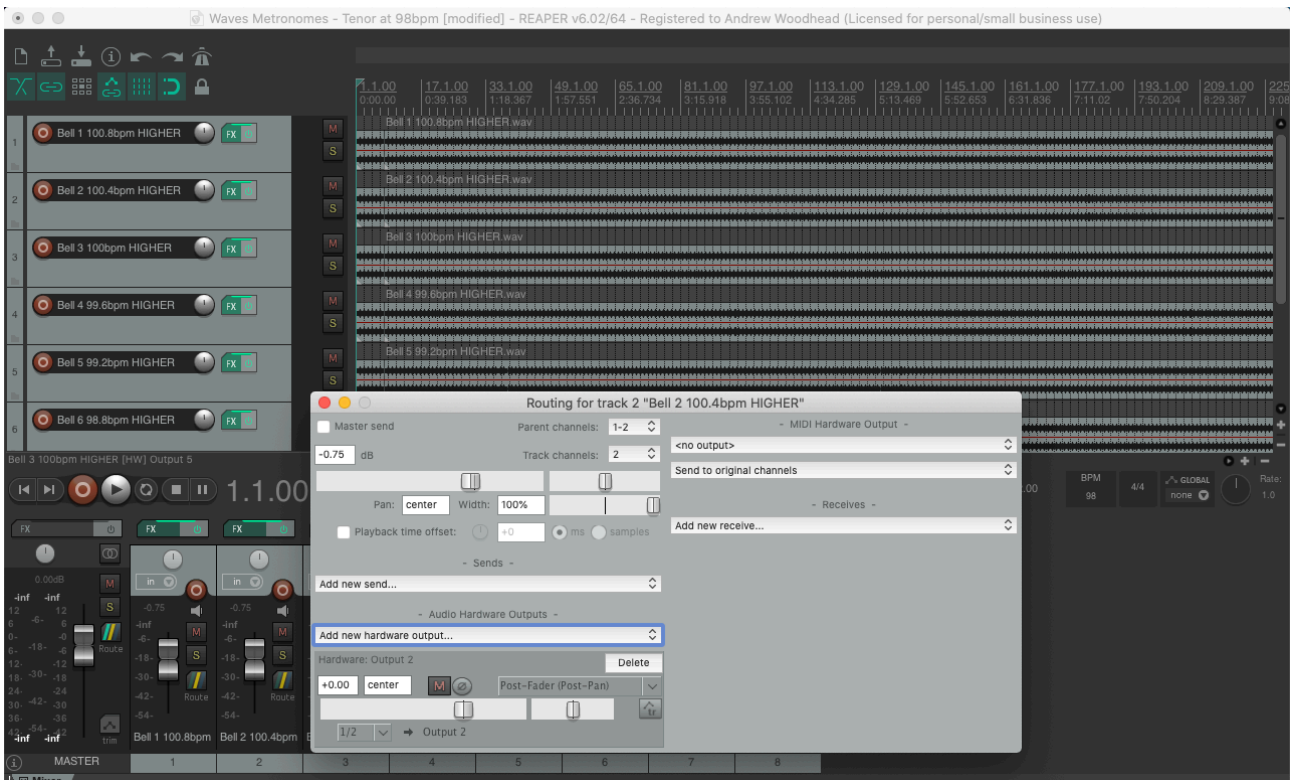


Ensure that the Gigaport is selected as the Audio Interface in REAPER's Preferences/Settings.

Ensure that each track is routed to the corresponding Hardware Output via the 'Routing' button. Track 1 to Output 1, Track 2 to Output 2 etc up to Track 8. This should be already done for you in the files as they were saved, but do check this if you are having problems.



If set up correctly, it should look like this. NB route the tracks to Mono outputs on the Gigaport (ie Output 1, Output 2 etc) and not to Stereo outputs on the Gigaport (ie Output 1/2, Output 3/4 etc)



Playing the files

Use the playback controls on the left hand side to play, stop and reset the tracks.

The sliders on the mixer section can be dragged up and down to adjust volumes for different ringers as required. Don't worry if these go yellow/orange as they go past 0Db - for the purposes of this exercise it doesn't matter if they are "clipping"

Overview of the piece/what it should sound like!

You will hear clicks which have a higher frequency on beat 1 of the bar, then a lower frequency on beats 2, 3 and 4. Something like BIP-BOOP-BOOP-BOOP. The goal is to strike your bell precisely on the first beat (the higher BIP) of each bar. **See Hints and Tips below for more pointers if attempting this for the first time!**

To perform the piece, hit play on REAPER, wait and count for 3 bars (or more if you like), then all fire together on beat 1 the 4th bar, following your individual metronome closely from there on. In the 8th bar, all bells except the Tenor will notice their tempo quicken ever so slightly, don't be alarmed! They will also notice their track slow down by the same amount 16 bars from the end of the piece. During these last 16 bars, when all bells are firing again, the leader should call to stand.

Here is a breakdown of what's going on/what you will notice:

There are 7 bars at the start where the tracks are all in unison (ie after 3 bars rest, all bells will be firing for 4 bars), then all but the Tenor split off into faster tempos from bar 8 onwards. The Treble has the fastest tempo and the first thing you hear after the firing will be the bells pulling away into very fast rounds. Eventually the strike of the Tremble catches up with the Tenor and they fire together before moving apart again. Pairs of bells will begin to fire together and the outside observer will hear evolving rhythms and time signatures come out of the patterns.

At the mid-point of the piece, all the odd numbered bells will be firing, with the even numbered bells firing on the opposite stroke. The sequence then plays out in reverse, eventually leading to reverse rounds which pull back into firing. When the bells come back together into firing, the tempos reset to the original speed with every track in unison for 16 bars. During this time the leader can call to Stand - if everyone has followed their metronome track closely, half of the bells will stand at Backstroke and half at Handstroke.

Hints and Tips

- Try having each ringer practice solo with just their metronome track to get a feel for how to achieve a clean strike on Beat 1 of the bar. Depending on the weight of the bell this will mean actually thinking of pulling off on beat 2 or 3 (or somewhere in between) of the previous bar
- Practice firing without metronomes to get this aspect of the piece as clean as possible at the start and end
- The initial firing should be led by the Tenor and can be judged by rope-sight, then once the first stroke has happened, focus back in your metronomes.
- Seeing other ringers' ropes during the piece can be distracting as several familiar patterns emerge - try facing away from each other to focus on your own metronome and bell
- Playing the metronome tracks slightly quieter can help differentiate between the high and low clicks - they become a bit more indistinct at higher volumes.
- If you get lost, stand your bell, listen back to the metronome for as long as you need and then come back in when ready.

And Finally...

I'd love to see any videos and/or photos if you do have a go at this in your tower - my social media handles are @AWoodheadMusic on [Facebook](#)/[Twitter](#)/[Instagram](#) if you'd like to tag me in!