That Which Pulls

HD video with stereo sound

The audio and video content of *That Which Pulls* is generated using *harmonic shuffling*, a data remixing technique derived from John Whitney's use of differential motion in his animations. Harmonic shuffling redistributes data points within a source array at harmonically related distances, creating new relationships based on reconfiguration of the original structure. While the technique has its origins in experimental animation, it can be applied to a wide variety of media from audio samples to images to musical scores.

That Which Pulls applies this technique to a single sample of a wind chime note and a single image of a car light to generate the audio and video content. The audio part builds in rhythmic and timbral complexity by layering progressively shuffled iterations, becoming increasingly distorted as the process preserves less and less of the continuities of the original structure. The video part is derived by constantly shuffling the image over the course of the piece, timing the alignments of the pixels at various harmonic nodes to emphasize or contradict the moments of tension and release in the audio. By constructing the piece around these points of alignment, a counterpoint emerges between the sound and image as the two streams alternately contradict and enhance one another.

The score on the following page outlines the large-scale structure of the audio and video parts, highlighting the moments where resolutions in the video generation are aligned with important events in the sonic layering.

Alexander Dupuis, 2013

Brief notes on harmonic shuffling:

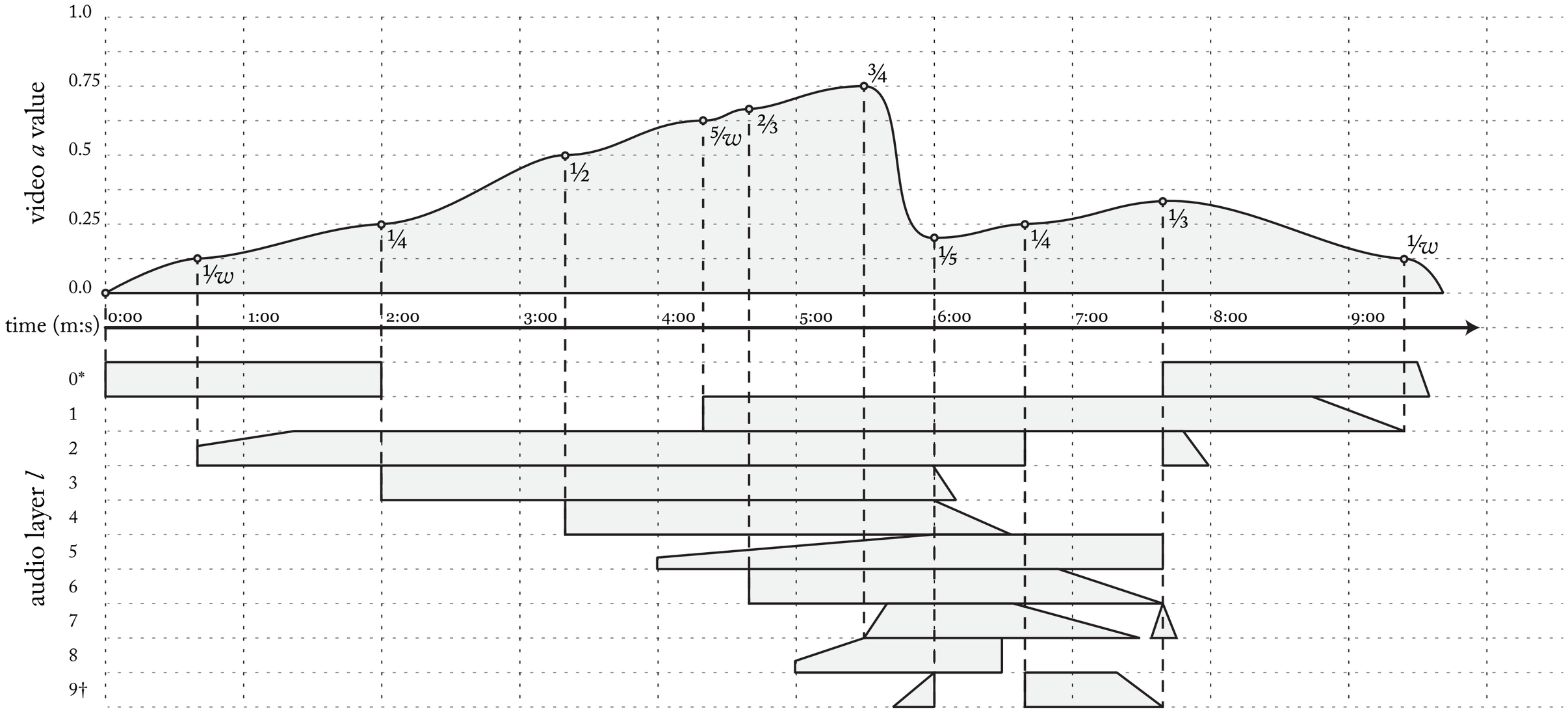
We define harmonic shuffling as follows: assume a source data array S of length L, and a target array T of equal length to hold the shuffled data. For each element S_i, where i is the index from 1 to L, generate a target index j using the following formula:

$$j = i \cdot (aL + b) \pmod{L}$$

Following these evaluations, set T_j to S_i for all elements to complete one shuffle.

The variables a and b, both non-negative real numbers, represent the points of control over the shuffling process. As the value of a approaches a simple integer ratio, the values of the resulting target array T will align along equally spaced harmonic nodes, with the number of nodes being equivalent to the denominator of a. The variable b determines the spread of the resulting data, with lower values clustering the data around the harmonic nodes and higher values spreading the data out. Incrementing values of a and/or b by small amounts to approach or leave these nodes generates points of harmonic resonance, with the specific perceptual effects varying based on the medium and source.

A more thorough explanation of the harmonic shuffling technique and its role in this piece will be detailed in the forthcoming paper, "Harmonic Shuffling: Waveform and image resynthesis in *That Which Pulls*."



Video part:

The video animation is generated by shuffling the source image on each frame, using the momentary a value and setting $b = 0$.

The variable w represents image width in pixels: its value therefore changes based on image settings.

Audio part:

Each audio layer l is shuffled on each repeat r using an a value of $r \cdot 2^{-l}$ and a b value of 2^{2-l}. Layer height indicates approximate layer amplitude over time.

∗The 0th audio layer is the source audio, generated using the values $a = b = 1$.
†The 9th audio layer is a copy of the 2nd layer, played with slowly increasing speed.