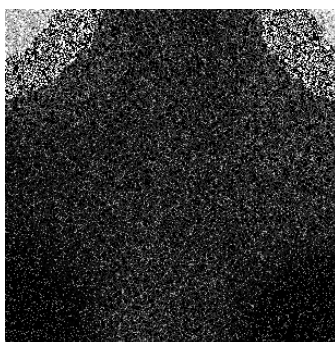
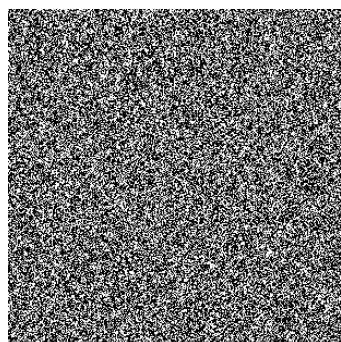


Numeration

for cello & live electronics
Kier Hall



Numeration

for cello and live electronics Duration: c. 10 minutes

Electronic Equipment Required

Microphone, Computer with Pure Data (vanilla) installed, *Numeration* electronic resource folder. Pure Data will require the following extensions: list-abs, maxlib, cyclone and freeverb.

Patch Preparation

- Connect microphone to Pure Data.
- Position microphone at the cello's bridge
- Load *numeration.pd*.
- Enable audio processing (DSP on) in PD.
- Press the footswitch to start.

Cello Techniques

- M.S.P. = Molto sul pont
- S.P. = Sul pont
- Ord. = Ordinario
- S.T. = Sul tasto

Note: the microphone signal should also be directly routed to the speakers so there is an equal balance between the unmanipulated cello sound and the sound of the patch.

How to Play Numeration

This piece has four sections. The pace of the first two sections are precisely dictated by the patch using 'streamers' that scroll across the screen to illustrate progress.

Section 1: *Descent*

The eight parts to this section are numbered on the score and patch. The streamer on the screen will scroll through the duration of each of these eight parts (which are all the same length). Each part requires the score material within the corresponding box to be played through, but if the streamer advances to the next part before the performer has completed that box, the next box should be started to remain in sync with the patch. Likewise, if a box is completed by the performer before the patch has completed that box, the performer should improvise by repeating gestures from that box.

Section 2: *Ascent*

As with Section 1, this section uses streamers for coordinating the performer and patch. However, each box in Section 2 has a set of pitches from which the performer should freely improvise. The pitches can be transposed to any octave. The performer should try to match the character of the electronic material; start slow and lethargic and advance towards chaotic material as the section proceeds. This section should start arco with very little pizzicato. As the section advances, the performer should shift to using mostly pizzicato techniques.

Section 3: *Stasis*

The pace of this section is dictated by the performer. The patch will be quiet at the start of this section. The performer should play the opening phrase as notated and upon reaching the final note, the patch will automatically start playing a pulsing pattern that will continue throughout the section. Throughout this section the performer should improvise pizzicato phrases that somehow reference the graphic notation. There is an on-screen streamer that will advance very slightly with each note the performer plays (monitored through the microphone). When the section is about to end, the performer will see each note they play advance a 'higher-resolution' streamer on the screen so they can synchronise their final note with the start of the next section.

Section 4: *Quiet*

The performer is only required to play two notes in this section – one at the start and one to end the piece. The final note can be played at any time within the 'End Window' streamer. This will cut all sound from the patch and conclude the piece.

Stage Configuration

Speaker
on tall stand



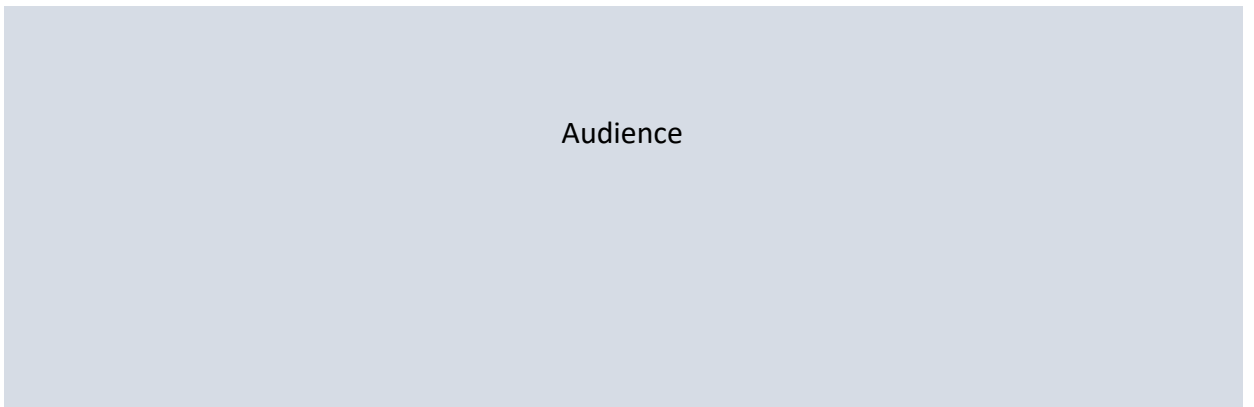
Cello and laptop
(facing one another, side-on to the audience)



Speaker
on tall stand



Audience



Programme Note

Numeration explores themes of dialogue and agency in an ensemble comprising a human and a computer. Timbres ranging from warm cello to sterile sine waves are presented to the audience through varying treatment of granular textures; pointillistic washes of sound cascade around the auditorium and over the course of ten minutes, the 'human voice' is 'assembled' by the ensemble.

The opening bars of the 1934 Vernon Duke standard, *Autumn In New York*, were used to map the ten-minute composition; changes in chords and modes informing granulation pitches for the ensemble to explore through both pre-conceived and improvised methods are coordinated with millisecond accuracy. A 1954 Billie Holiday recording of the opening bars of the standard is used by the electronics to help 'assemble' the voice, alongside a cello adaptation recorded prior to this performance which is also manipulated through multifarious granulation techniques.

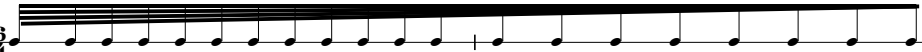
Numeration

Descent

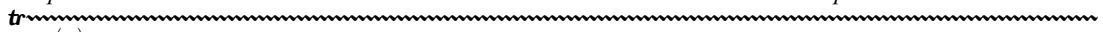
Kier Hall


1

♩ = 120

Patch $\frac{6}{4}$  patch continues

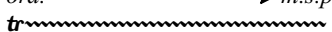
m.s.p. \longrightarrow *ord.* \longrightarrow *s.p.* \longrightarrow *ord.*

tr 

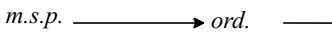
Cello  *gliss.*

fff \longrightarrow *p* \longrightarrow *mf* \longrightarrow *f*

ord. \longrightarrow *m.s.p.*

tr  *gliss.*

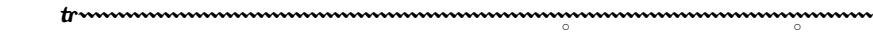
m.s.p. \longrightarrow *ord.* \longrightarrow *m.s.p.*

tr 

mp

2

m.s.p. \longrightarrow *ord.* \longrightarrow *s.p.* \longrightarrow *s.t.*

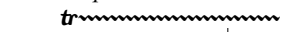
tr 

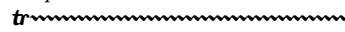
m.s.p. \longrightarrow *ord.*

f \longrightarrow *mp* \longrightarrow *f* \longrightarrow *fff*

III

3

m.s.p. *tr* 

m.s.p. *tr* 

pizz.

fff \longrightarrow *pp* \longrightarrow *mp* \longrightarrow *fff* \longrightarrow *p* \longrightarrow *mf*

4

(arco) ord. \longrightarrow m.s.p. (arco) s.t.

IV (#s) *p* *f* *mf* *p*

5

ord. pizz. (arco) m.s.p.

IV *mf* *f*

6

pizz. (arco) m.s.p. \longrightarrow ord. m.s.p. \longrightarrow ord. pizz.

mp *f* *mp* *f* *mp*

7

(arco) ord. \longrightarrow s.p. pizz.

f *f* *mp*

8

tr. s.p. pizz.

ff *mp* *f*

Ascent

Improvise melodies using these modes, pitches can be played in any octave.

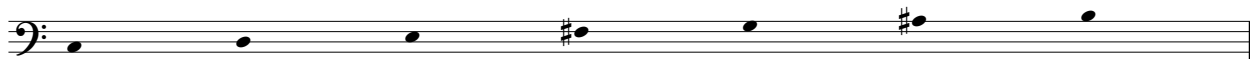
Each mode number is sequentially advanced by the patch, communicated via a streamer and punch on screen. Vary non-notated components such as tempo, dynamic and articulation but maintain an overall upward trend so the music gets busier as the section proceeds.

Try to match the character of the electronic material; start slow and lethargic and advance towards chaotic through the section.

Start arco and begin to introduce pizzicato as the section proceeds.

Within each mode, treat the earlier pitches as having more 'importance' than the later pitches. Interpret this however you wish.

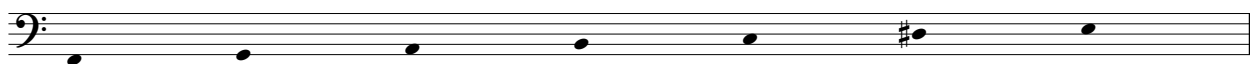
1



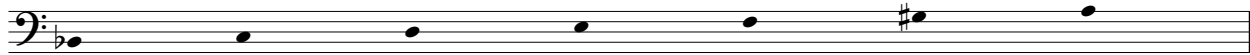
2



3



4



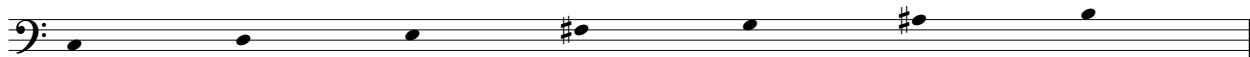
5

6

7



8



Stasis

$\text{♩} = 160$

pizz.

p

5"

5"

Improvise pizzicato phrases following the pattern in the box. Develop ideas as the section proceeds, always referencing the boxed pattern in some way. Keep repeating until *Quiet*.

Quiet

Slap strings

f

2'30"

8"

p

Slap strings to end piece at any point within the 'End Window' streamer.

Appendix A: Patch Notes Interface

The interface for this patch provides all setup controls and information required to perform Numeration. The performer will need to see this screen throughout the piece to coordinate events with the patch. The 'count in' at the top left of the screen provides four consistent flashes with which the performer can synchronise their first entry (1). Even though there isn't a steady pulse or a quadruple metre at the start of this piece, the four consistent flashes proved the easiest to interpret for performers in practice. After the count in the streamer along the top of the screen provides progress information for the first two sections (2). The streamer function is used to visually represent progress and duration in many sections of the piece. After clicking start (3), the cellist doesn't have to click anything else for the duration of the piece and interacts with the patch musically from thereon.

The interface is divided into several main sections:

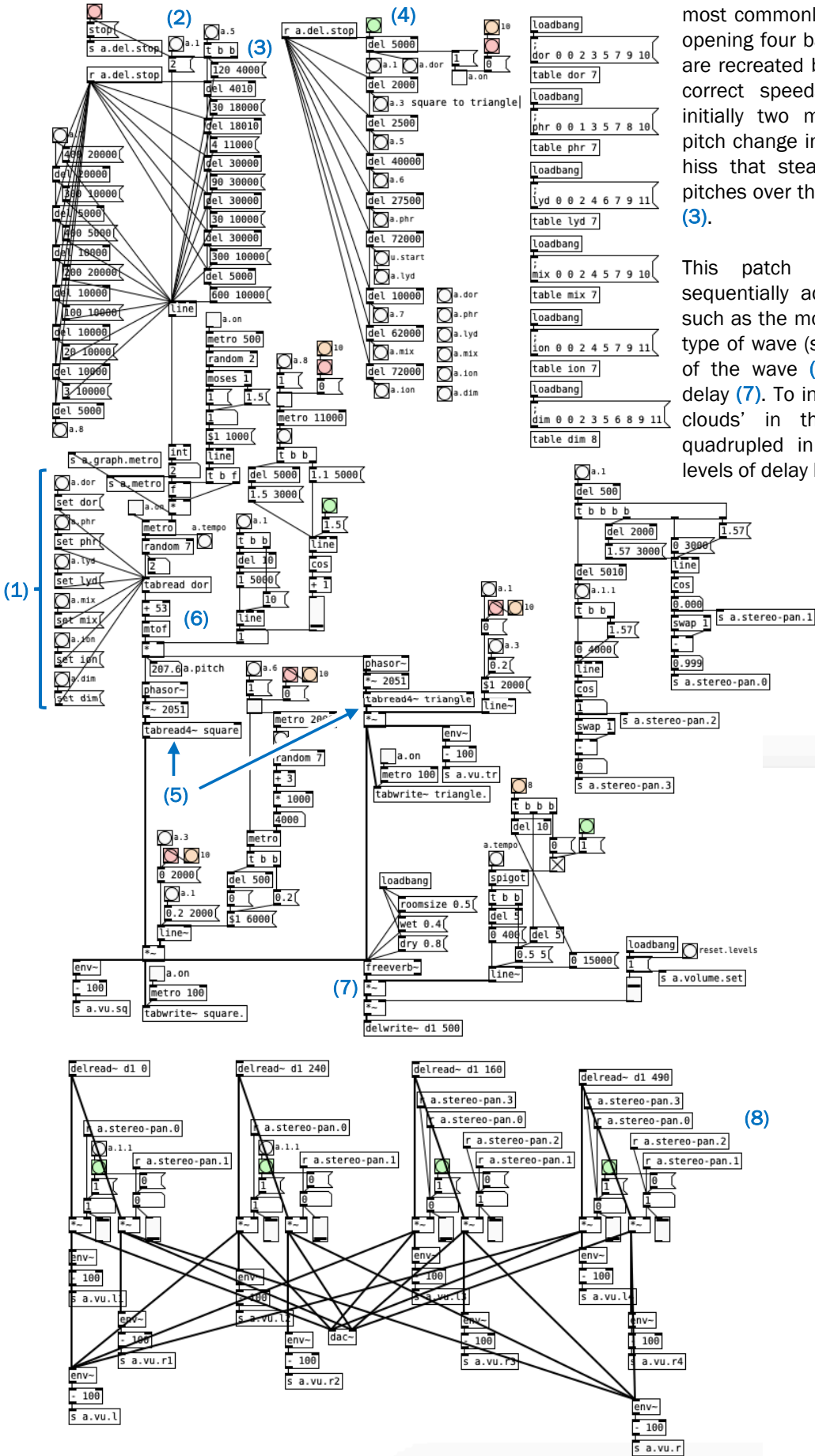
- Count In (1):** A horizontal bar with four numbered boxes (1, 2, 3, 4) for synchronization.
- Descent (2):** Contains waveforms for 'square.' and 'triangle.', a 'pd mic1' label, and level meters for L1-L4 and R1-R4. It also features 'L R Sq Tr Mic' meters and 'Pitch' and 'Tempo' sliders.
- Ascent:** A vertical list of mode numbers 1 through 8, each with a 'Mode duration' bar. It includes 'L R' meters and a 'Tempo' slider.
- Stasis:** Shows a 'Sample location' waveform, a 'pd stasis' button, and manual start/stop checkboxes. It features multiple 'L R' and 'L+R' meters.
- Quiet:** Includes a 'Coda' section, an 'End window (10 seconds)', and 'L R' and 'Mic' meters. It also has 'Tempo', 'Grain Length', and 'Reverb' sliders.

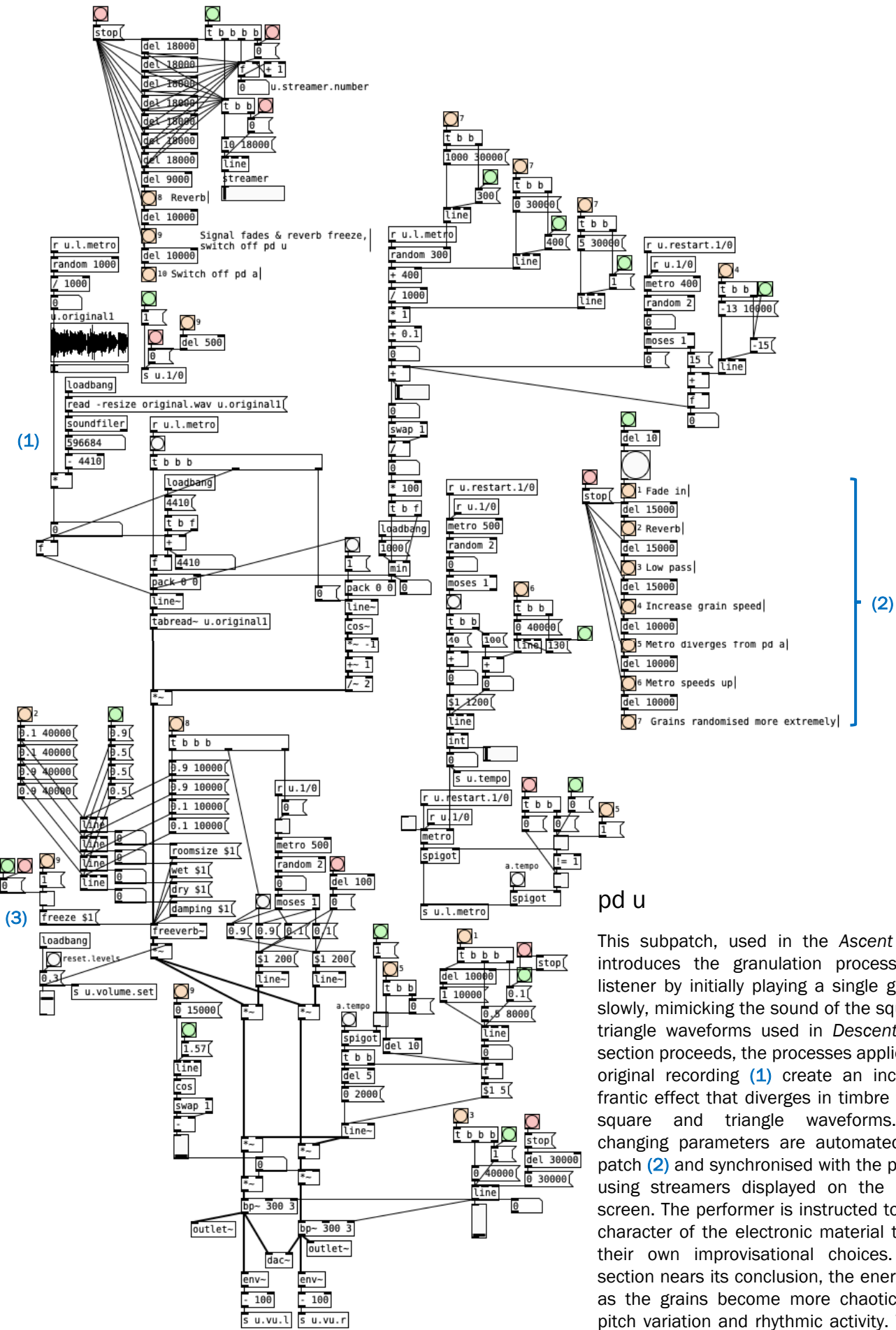
On the left side, there are three circular buttons: 'start', 'stop', and 'reset levels', along with a small numeric display showing '3'. On the right side, there is a 'CPU' control with a square icon, and a vertical stack of patch-related controls: 'pd mic', 'pd cpu', 'pd controls', 'pd waveforms', 'pd test_patches', and 'pd graphs'.

pd a

Throughout the piece, modes that would be most commonly used for improvising over the opening four bars of 'Autumn in New York' (1) are recreated by playing a square wave at the correct speeds for each pitch. There are initially two milliseconds (2) between each pitch change in the piece creating a static-like hiss that steadily slows to become audible pitches over the first four seconds of the piece (3).

This patch provides the instruction to sequentially adjust parameters in the piece such as the mode that the patch uses (4), the type of wave (square or triangle) (5), the pitch of the wave (6), and effects of reverb and delay (7). To increase the density of the 'grain clouds' in this subpatch, the output is quadrupled in the final stage, with varying levels of delay being applied to each signal (8).



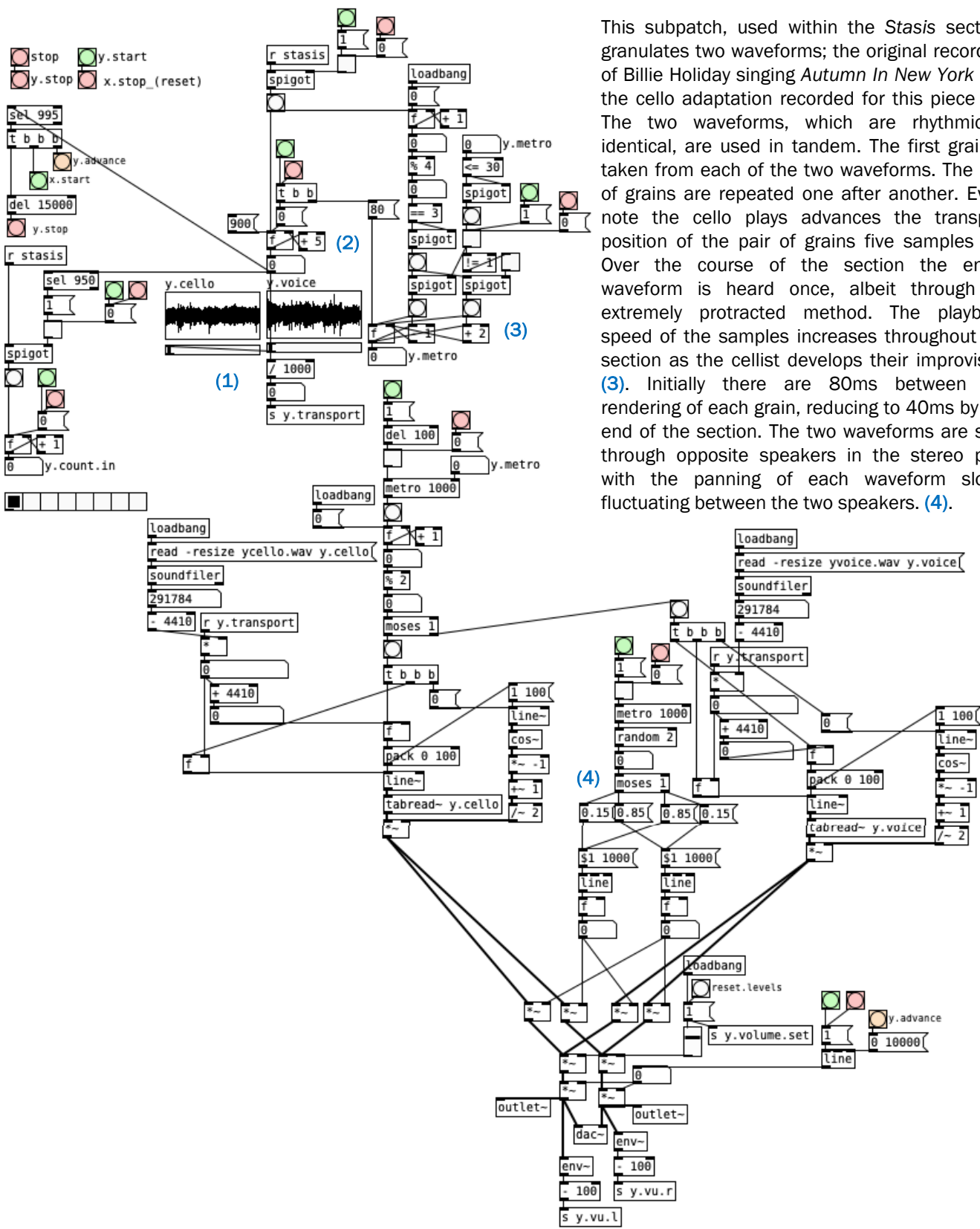


pd u

This subpatch, used in the *Ascent* section, introduces the granulation process to the listener by initially playing a single grain very slowly, mimicking the sound of the square and triangle waveforms used in *Descent*. As the section proceeds, the processes applied to the original recording (1) create an increasingly frantic effect that diverges in timbre from the square and triangle waveforms. These changing parameters are automated by the patch (2) and synchronised with the performer using streamers displayed on the interface screen. The performer is instructed to use the character of the electronic material to inform their own improvisational choices. As the section nears its conclusion, the energy builds as the grains become more chaotic in their pitch variation and rhythmic activity. The final seconds of the section culminate in a reverb freeze and fade out (3).

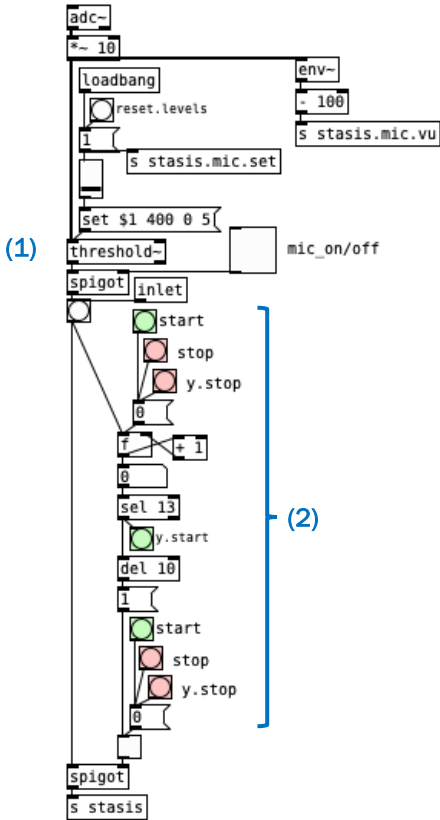
pd y

This subpatch, used within the *Stasis* section, granulates two waveforms; the original recording of Billie Holiday singing *Autumn In New York* and the cello adaptation recorded for this piece (1). The two waveforms, which are rhythmically identical, are used in tandem. The first grain is taken from each of the two waveforms. The pair of grains are repeated one after another. Every note the cello plays advances the transport position of the pair of grains five samples (2). Over the course of the section the entire waveform is heard once, albeit through an extremely protracted method. The playback speed of the samples increases throughout the section as the cellist develops their improvising (3). Initially there are 80ms between the rendering of each grain, reducing to 40ms by the end of the section. The two waveforms are sent through opposite speakers in the stereo pair, with the panning of each waveform slowly fluctuating between the two speakers. (4).



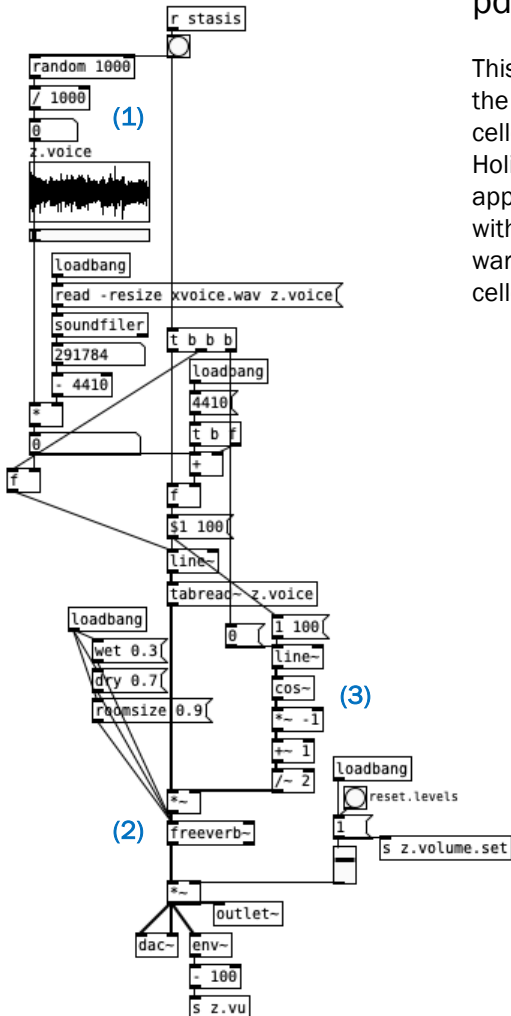
pd stasis

This subpatch converts the microphone signal into *bang* impulses within the *Stasis* section of *Numeration* (1). It also monitors the cello playing the phrase at the start of *Stasis* and only activates **pd y** and **pd z** on the final note of the phrase (2).



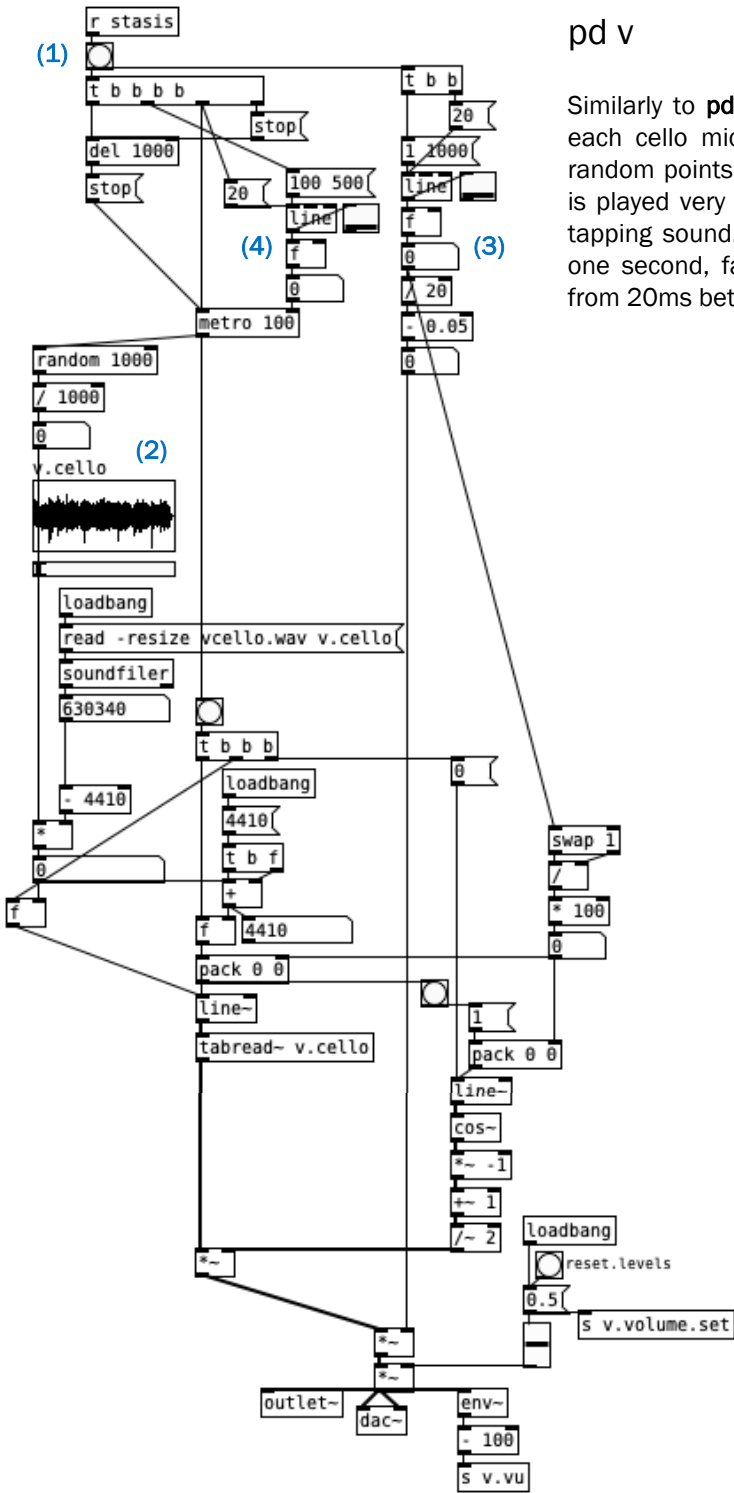
pd z

This subpatch is used alongside **pd y** within *Stasis*. Each impulse from the microphone triggers a single grain rendered in unison with the cello's pizzicato note. The grain is randomly selected from the Billie Holiday sample (1). In addition to a large amount of reverb being applied to each grain (2), the playback of the grains fades in and out within a few milliseconds (3). Both of these processes add a timbral warmth to the electronic material; subtly blending the sound with the cello's improvisation.



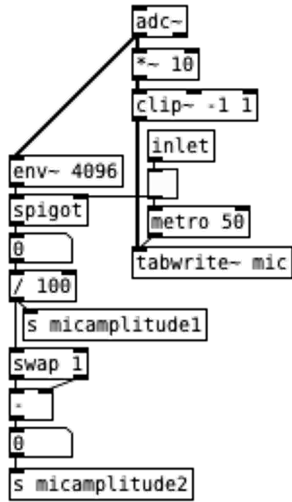
pd v

Similarly to **pd z**, this subpatch activates a 'one-shot' gesture with each cello microphone impulse (1). Twenty grains are chosen at random points within the cello adaptation waveform (2). Each grain is played very quickly, heightening the pitch to create a percussive tapping sound. The twenty grains are rendered over the course of one second, fading out in a linear fashion (3). The gesture slows from 20ms between each grain to a 100ms gap (4).

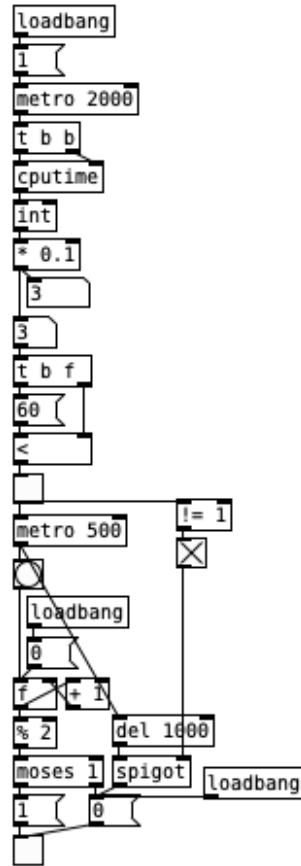


The four subpatches on this page provide setup and monitoring information for the patch.

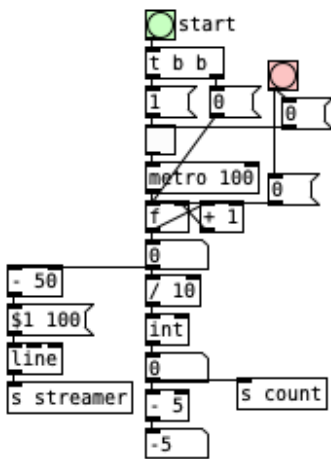
pd mic



pd cpu



pd controls



pd waveforms

