

MIMÉTISME

for percussion, live electronics and live video processing.
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for Victoria Sparks and Jonny Axelsson.

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Mimétisme

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Mimétism explores the relationship between visual and aural stimuli and how they affect our perception of music. The live electronics work as an extension of the percussion instruments and responds to every stroke and roll. At times the electronic part goes beyond what the percussionist plays and becomes a virtual double that seems to obtain its own life.

Three cameras capture the performance, which becomes the base for the video projections. Sometimes the video is closely linked to the live performance, but occasionally it breaks loose to support the electronic part. In this way, it blurs what is performed by the percussionist and what is purely generated by the electronics.

Mimétism (Mimicry in English) refers to how organisms and plants are able to mimic another species in order to for example protect against predators. It may also refer to the unconscious reproduction of gestures of others.

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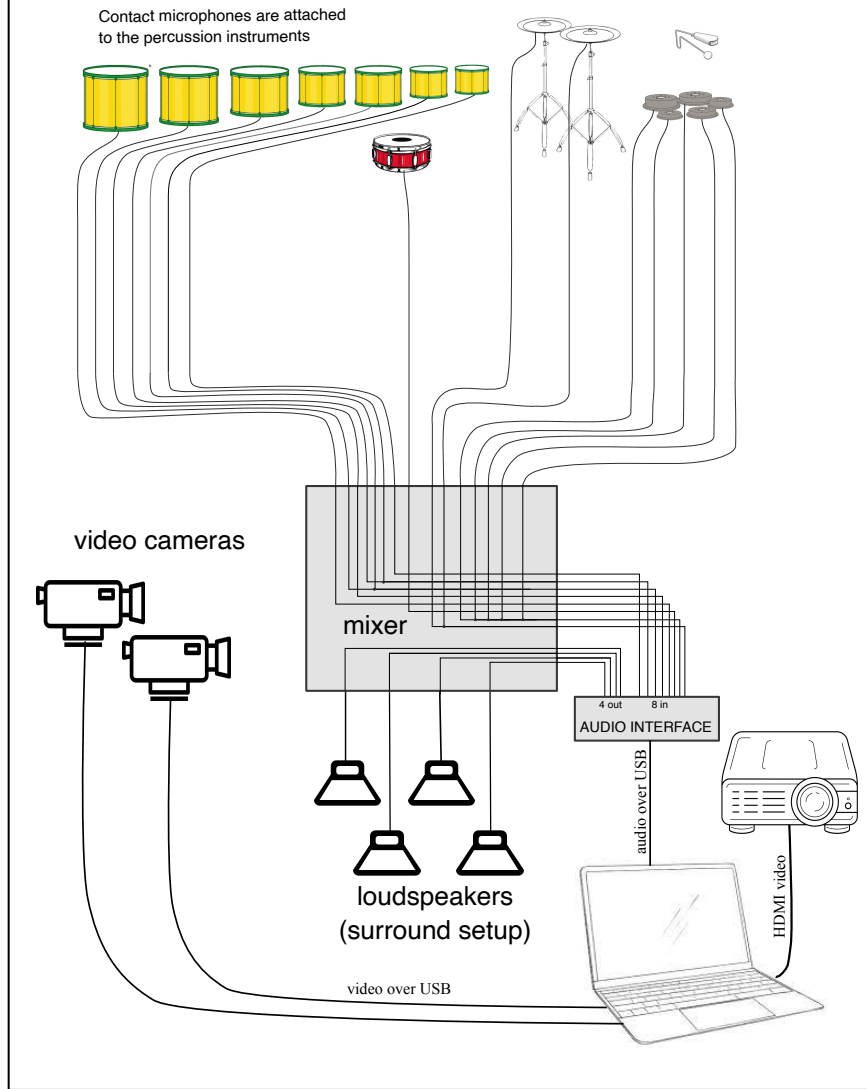
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REQUIRED EQUIPMENT

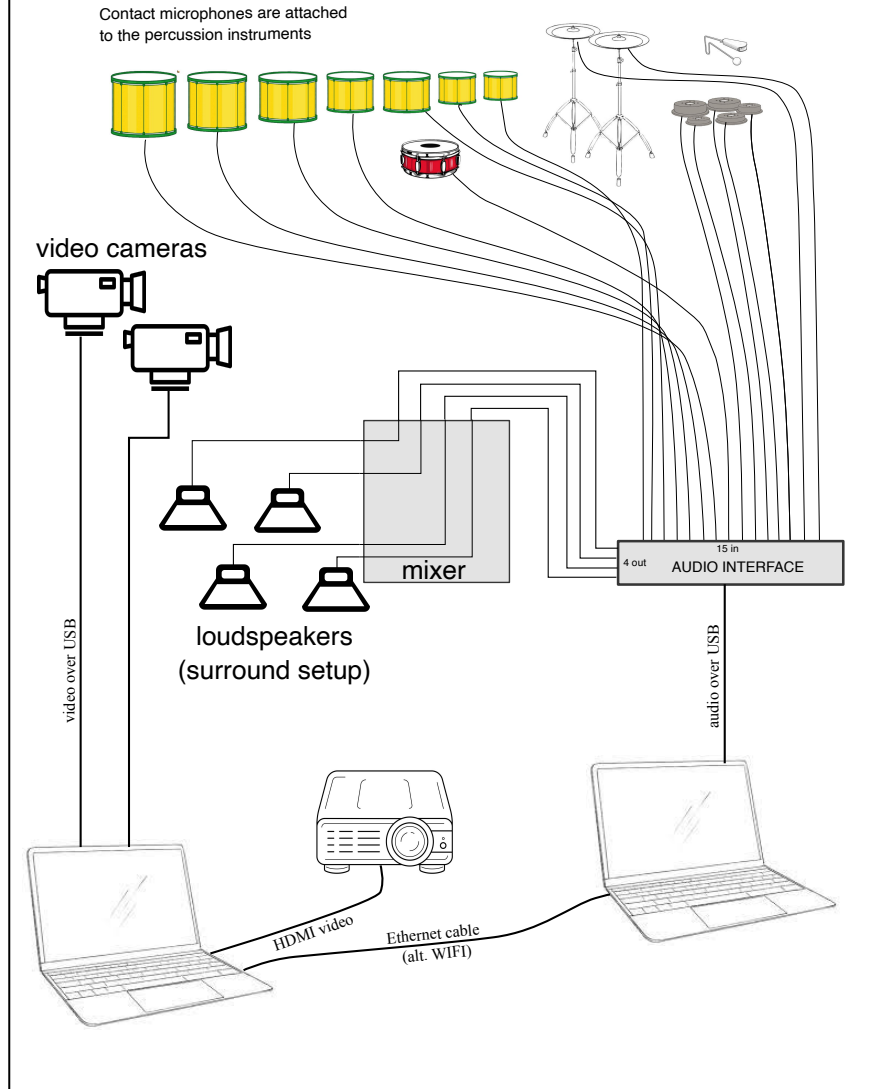
- **4 loudspeakers**
- **15 contact microphones.** The contact microphones are used as sensors to detect how the percussion instruments are performed. The sound quality is not crucial, but a low noise level is to prefer since it will make the detection cleaner and more reliable. Balanced contact microphones are therefore a better choice than unbalanced.
- **1 mixing console.** The minimum requirement for the mixer depends on the number of inputs on the chosen audio interface. It varies from 19 in / 12 out (this is the recommended solution: inputs: 15 contact microphones + 4 from the computer, outputs: 8 to the computer + 4 loudspeakers) to 4 in/ 4 out (if the contact microphones are connected directly to the audio interface).
- **1 or 2 computers.** If a fast enough computer is used, it is possible to run both the audio and video patches on a single computer. It is also possible to use two computers, one for audio and one for video. This will put less demand on each computer. It will be necessary to connect them via an ethernet cable or computer-to-computer Wi-Fi network. To run the live electronic part, a copy of the Max software version 8 or later from <http://www.cycling74.com> is necessary.
- **1 audio interface.** The interface needs to receive the signals from the contact microphones and to send the 4-channel live electronic sound to the mixer / loudspeakers. If the contact microphones are connected and downmixed via a mixing console, it is enough to have 8 line inputs on the audio interface (this is the recommended solution). If the microphones are connected directly to the interface, it needs to have minimum 15 inputs with pre-amplifiers. Some manufactures will allow you to increase the number of inputs by using two interfaces in parallel. Regardless of which configuration you chose to use, you will need 4 output channels.
- **3 streaming video cameras.** The cameras film the performance and connects to the computer. They do *not* need to have recording capability but be able to stream the video signal to the computer. Connecting the video cameras via USB is recommended. High end web cameras are a good choice (3 Logitech Streamcam Plus were used at the premiere). You might also need 3 camera stands. It is possible, but not recommended, to only use two cameras.
- **Video projector.** The projector will project the processed video during the performance. It might be necessary to use a projection screen: the esthetic look of the screen is important. In some cases, it might be preferred to project on a white wall behind the performer. A semi-transparent screen in-front of the performer can also be an option.
- **Cables** for all the above equipment, potentially also including extension cables for the cameras and the video projector.

The percussion instruments are not amplified. All reverberation is done inside the computer patch and should not be added in the mixing console.

SETUP FOR ONE COMPUTER AND AN AUDIO INTERFACE WITH 8 IN/ 4 OUT



SETUP FOR TWO COMPUTERS AND AN AUDIO INTERFACE WITH MINIMUM 15 IN/ 4 OUT



Even though the explanations in this documentation are detailed and somewhat long, using the computer patches is quite straight forward. After the gear is setup and connected, you need to trim the levels for the detection of the contact microphones, and you need to select your video cameras in the patch. Beside this, there are a few details to set, but then you are ready to go. I recommend that you study this manual to understand how the parameters you set affect the system, and how to run the patches.

LIVE ELECTRONICS

The live electronics and live video processing are generated by three Max patches. You need to open each one to run the piece.

1. The audio patch generates all sounds. Both audio and video are controlled from this patch during the performance.
- 2, The contact microphones detection patch. This patch analyzes the incoming audio signals from the microphones and generates control messages that will be received by the audio patch. This patch and the audio patch need to be on the same computer. You need to keep both patches open.
3. The video patch processes the incoming video signals from the video cameras and generates the video that will be displayed. Except for the setup of cameras, the settings of one general video filter and the UDP communication with the audio patch, there are no controllers to adjust in this patch. The video patch is controlled remotely from the audio patch. It can either run on the same computer as the audio patch, or on a separate computer.

Regardless of if one or two computers are used for the piece, the audio and video patches communicate via the UDP protocol. If the computers are connected to the same network, UDP allows communication on any distance. To avoid significant latency, a direct link between the computers should be established, either via an ethernet cable or by creating a computer-to-computer WIFI connection. Avoid connecting via a hub or an internet connection. If the patches are on the same computer, you do not need to touch these settings.

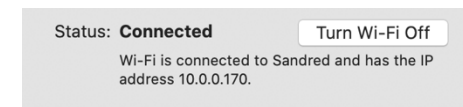
It is possible to run the piece without video: simply do not open the video patch, and checkmark the “no-video” box in the audio patch (if you forget to do this, some sounds that are controlled via the video patch – at event 1-5 and event 21 - will not be triggered).

USING ONE OR TWO COMPUTERS

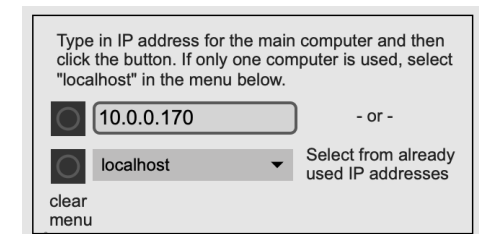
The choice of using one or two computers for the piece depends on the speed of the the computer you are using is fast enough. When creating the piece, a MacBook Pro 2.3 GHz quad cores (Intel i7) computer could run the audio and video patches simultaneously. The advantage of using one computer is a more compact setup. There might be an advantage of using two computers if you want to avoid long video cables (the video computer is controlled remotely during the performance and can be placed close to the cameras).

If two computers are used, they need to be connected via an ethernet cable or a computer-to-computer local WIFI network. The patches are made to make the connection easy to setup. For the UDP communication to work between the computers, you need to indicate the IP addresses of the computers in both the audio and video patches.

Setup your local network between the computers before looking for the IP addresses. On a Macintosh computer, you will find the IP address of your computer in the System Preferences under Network (see the figure to the right). Note that if you don't set the IP address of a computer manually, it might change the next time you connect to the network. A local network will make it possible for you to set the IP address manually and to make sure it remains the same next time you connect the computers (see the manual for your computer how to do this).



The audio and video patches have identical tools for indicating the IP address of the other computer: in the audio patch, set the IP address of the computer where the video patch is, and vice versa. If both patches are on the same computer, choose localhost from the pop-up menu (this is the default setting). You can save the patch with the IP address (they will be stored in the drop-down menu until it is cleared). Make sure that the menu selection corresponds with the IP address (or "localhost" setting) – it is the choice in the menu that determines what is selected.



CONTACT MICROPHONES

Every percussion instrument except for the vibraslap needs to have a contact microphone attached to detect its sound. The sound will not be used as an audio source, why the sound quality is not crucial. However, hum or other noises could interfere with the detection, why a balanced contact microphone is to be preferred. It is not possible to replace the contact microphones with

microphones that capture the sound via the air: the sound bleed between instruments would make the triggering of events impossible. Some bleed between contact microphones will still occur due to vibrations in the instrument stands, or to the fact that a loud sound in the air will make all drumskins vibrate, which will be picked up by the contact microphones. The patch is programmed to do its best to ignore this type of bleed (see further down).

There are two versions of the patch for the detection of the contact microphones; one that requires an interface with minimum 15 audio inputs and one that make it possible to use an interface with only 8 channels line input. Note that each audio input needs to have a pre-amp to give the contact microphones an acceptable input level.

Alternative 1

To make it possible to use a standard audio interface with only **8 channels line inputs**, the audio signals from the 15 contact microphones can be mixed down to 8 signals before sent to the interface. The contact microphones should then be combined as follows:

Channel 1: high tomtom 1
Channel 2: tomtom 2 and mid tomtom 4
Channel 3: mid tomtom 3 and low tomtom 6
Channel 4: mid tomtom 5
Channel 5: low tomtom 7
Channel 6: snare drum
Channel 7: brake drums 1 - 5
Channel 8: cymbal 1 and 2

Alternative 2

An audio interface with **15 input channels** will allow each contact microphone to have its own input channel. If the interface has pre-amps for each input, it will make a mixer unnecessary.

Channel 1: high tomtom 1
Channel 2: high tomtom 2
Channel 3: mid tomtom 3
Channel 4: mid tomtom 4
Channel 5: mid tomtom 5
Channel 6: low tomtom 6
Channel 7: low tomtom 7
Channel 8: snare drum
Channel 9 – 13: brake drum 1 – 5
Channel 14 – 15: cymbal 1 – 2

Tomtom 1, 5 and 7 have important roles to trigger crucial events in the piece. The cymbals trigger the sub-events at event 17. All other instruments trigger the detailed action in the music within an event (which is also true for tomtom 1, 5 and 7). The piece will work well even if some beats on tomtom 2, 3, 4 and 6 are not captured. The more crucial beats on tomtom 1, 5 and 7 need however to be reliably captured.

DETECTION AND LATENCY

It is crucial that the computer responds to the detected attacks without significant latency. In/out audio buffer sizes for the contact microphone detection patch are crucial and have to be small - however a very short buffer size increases the demand on the speed of the CPU and might therefore not be possible. The first noticeable issue with a too short buffer size is that clicks will be audible in the audio output.

An acceptable i/o buffer size at 44.1 kHz sampling rate is 256 samples. With a MacBook Pro 2.3 GHz quad-core Intel i7 processor (2020 model) running both audio and video patches, a buffer size of 128 samples created clicks and could not be used (256 samples worked). If the used computer is not fast enough and the CPU speed becomes an issue, a simple solution is to use a second computer for the video processing patch. A standard laptop should be able to run the audio patch alone without problems.

Except for the sound from the brake drums, the patch detects the *attacks* of the sounds from the percussion instruments. In most cases, this is a fairly reliable technique, but in fast passages the resonance from one drumbeat might bleed into the following drumbeat, making it harder to identify the second attack.

Rolls are either not detected or detected as one event.

SETTING THE PARAMETERS FOR THE DETECTION

The detection of the signals from the contact microphones is taking place in the contact microphones detection patch. The main audio patch does not need to be open for this patch to work.

The input levels from the contact microphones should be adjusted to a good level on the mixing console (loud, but not distorted) before adjusting the parameters in the patch. Once the levels are set on the mixer, they must not be changed (if they are, you need to redo all your settings in the patch).

A – TOMTOMS AND SNARE DRUM

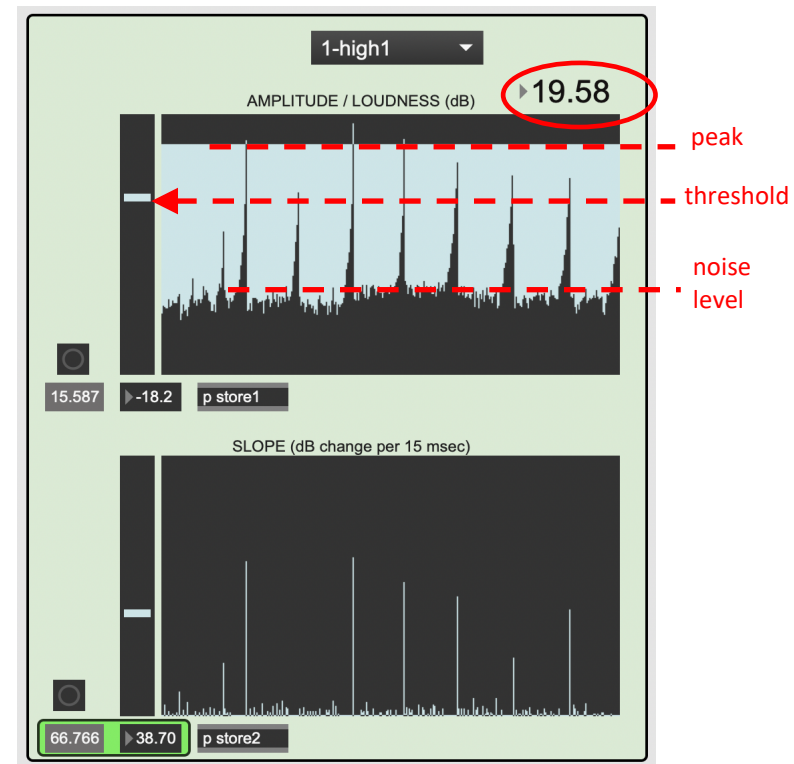
The attacks of each instrument are detected in three steps:

1. The amplitude of the input signal must exceed a threshold to be considered.
2. If the amplitude is above the threshold, the slope of the amplitude curve is measured: if the slope goes above a threshold (measured as the increase in dB per measuring cycles), an attack is detected.
3. If more than one instrument has an attack simultaneously, only the loudest will be considered (the others are assumed being acoustic bleed between the contact microphones). Loudest means here relative to the threshold set for each drum, see below. This will make the system work even if some bleed exists between instruments.

Before performing the piece, the thresholds for the amplitude detection (1. above) and slope detection (2. above) must be set for each input channel to the patch.

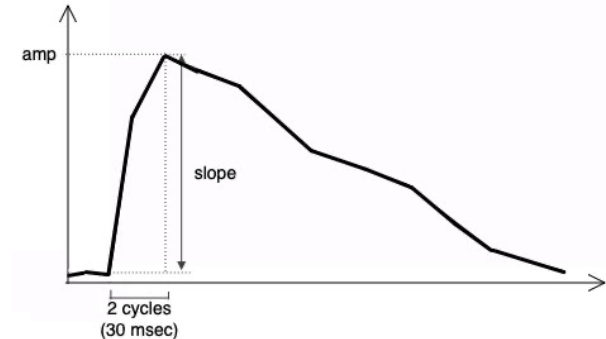
- Turn on the audio in the contact microphone detection patch
- From the pop-up menu at the top (see the figure to the right), select the input channel.
- Watch the amplitude curve from the contact microphone in the graph and adjust the threshold with the slider to the left of the graph. The slider should be below the level where an attack occurs, but well above the noise that can be seen when there is no performed sound. The number to the right above the graph (19.58 in the image to the right) indicates how many dB the peak of the attack exceeded the threshold. You should aim at setting the threshold so that this number is the same for every instrument/microphone when played at the same dynamic. Around 20 dB for a forte dynamic is a good setting. A too low value (i.e. the slider high up) will make softer dynamics ignored. A too high value (i.e. the slider down) will make the detection so sensitive that background noise will give false triggers. If the thresholds for all microphones are set correctly, some bleed between instruments can be tolerated.

Occasionally the graph does not accurately display a peak. The numerical display (15.587 in the image) is however always accurately displaying the peak in dB (reset the value by pressing the button above it).



- Watch the curve in the attack / slope diagram. Set the threshold below the peaks when an attack occurs. Note that the graph does not always plot fast-moving events and occasionally misses to display an attack even though it is detected. You may rely on the more accurate number display in the green box for a precise value: the left value is the peak value detected (reset it with the button above the number box). The right value is the value of the set threshold (adjust with the slider). The values are also printed in the Max Console, which makes it easier to compare several attacks.

The graph to the right illustrates how an attack and its slope is measured. To reliably detect the effective slope, it is measured over 2 consecutive measuring cycles (i.e. 30 milliseconds). The extended measuring interval will not slow down the system since the measuring cycle for the slope starts *before* the peak amplitude is reached.



Repeat the above method for each drum and cymbal.

B – CYMBALS

The threshold should be set high, relatively close to the loud peaks. While the cymbals bleed significantly into the drums, the bleed from the drums into the cymbals is low and can easily be removed by having a high threshold.

C - BRAKE DRUMS

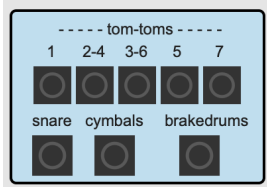
The brake drums are detected by their amplitude (the slope of the attack is ignored). Their sustain is also detected.

The threshold should be set above the noise level but below the level measured when a roll is played on the instruments. Select the brake drums from the pop-up menu and use the graph to trim the setting.

Note that the brake drums are detected independently of the other instruments. The detection will only be considered between event 6 and 11 in the score. It is not a big concern if the drums bleed into the detection of the brake drums. Brake drums trigger events based on a sustained sound (maintained via rolls), and a bleed from a short impulse like a drumbeat has no impact on the analysis.

In the piece, the brake drums must be sustained (with a roll) for 1.5 - 2 seconds to be considered an event. Small gaps between each beat in the roll are accepted as part of the roll.

CHECKING THAT IT WORKS



After the parameters are set, you can check that all instruments can be detected: in the contact microphones detection patch there are 8 buttons that will indicate if an attack is detected. Note that only one drum attack can be detected at a time. If two drum attacks occur simultaneously, the one that was the loudest relative to its threshold will be indicated (the other will be ignored).

SETTING UP THE AUDIO PATCH

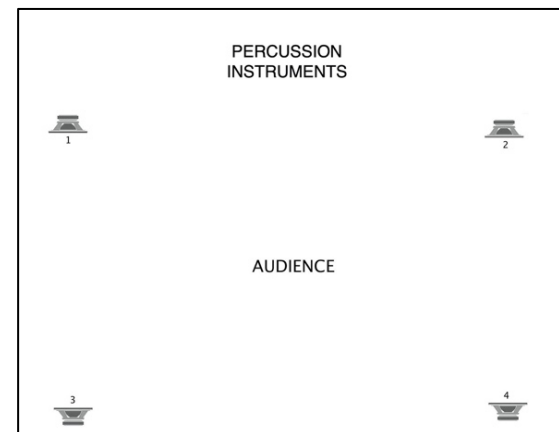
Once the detection patch is setup, leave it open and open the audio patch. There are only two settings that need to be done in this patch before you can use it:

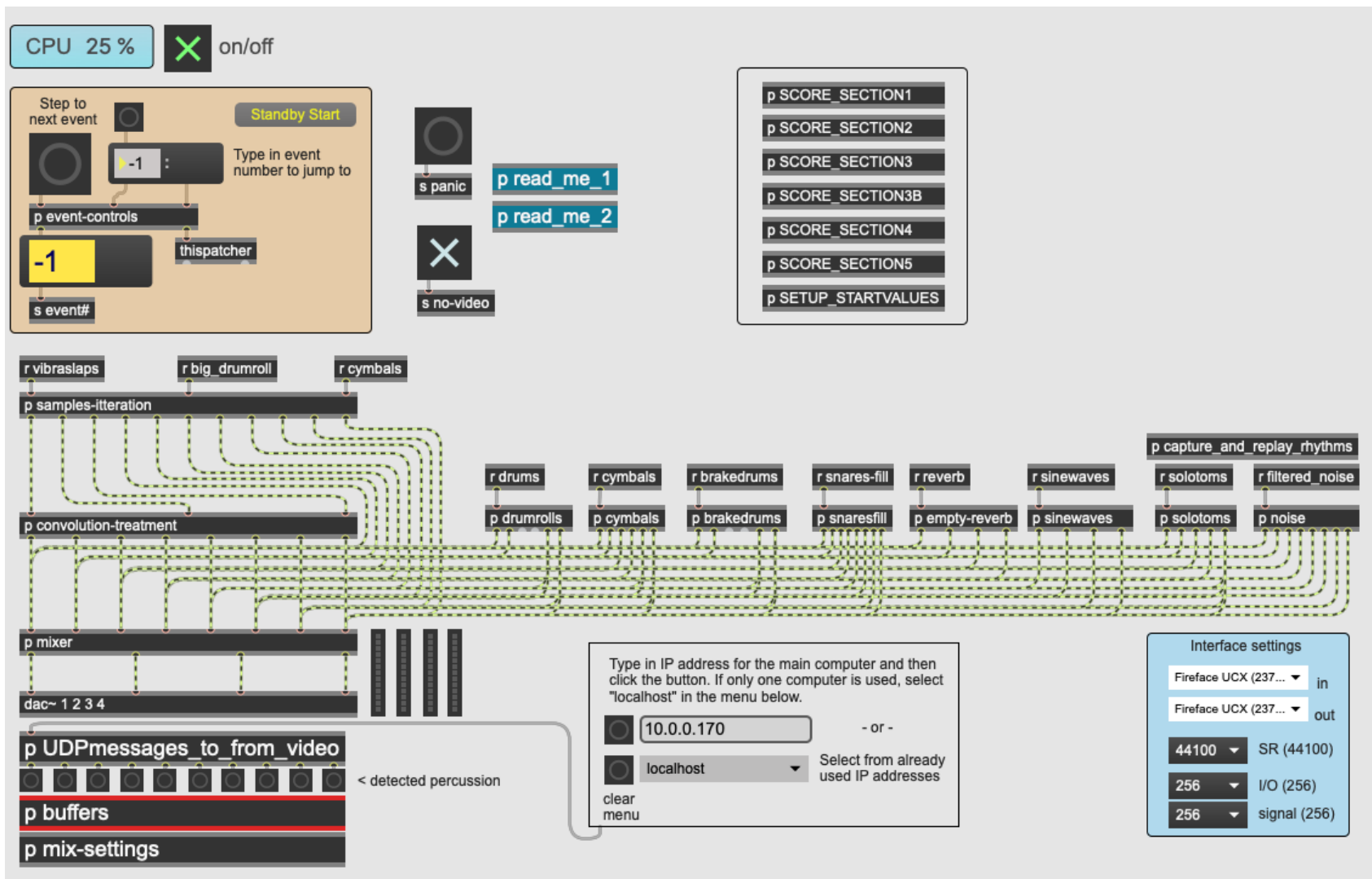
- If you will not use video, check mark the box “no-video”. This will make the audio patch in charge of all events, also those that otherwise would have been triggered from the video patch. It is important NOT to have the video patch open if this is check marked.
- If you use video, you need to type in the IP address of the computer where the video patch is. If it is on the same computer, select “local host”. See under “USING ONE OR TWO COMPUTERS” above).

The piece will be controlled from the audio patch during the performance (see under “RUNNING THE ELECTRONICS” below).

LOUDSPEAKERS

The live electronic sounds are played over 4 loudspeakers in a surround setup. The front speakers are to the left and right of the percussionist, and the rear speakers are at the back of the hall (behind the audience). The percussion instruments should not be amplified.





The user interface in the audio patch. You can turn on/off audio in the top left corner. The events can be triggered with the space bar or by clicking the button above the number display (here the patch is at event -1, which is the stand-by for starting the piece). The audio output levels are displayed on the meters close to the `dac~` object. The sample rate and buffer sizes for the audio interface can be set in the lower right corner. There is no need to change any settings inside the sub-patches. See further in the text on the previous pages.

0-off

AMPLITUDE / LOUDNESS (dB)

0. > -45.7 p store1

SLOPE (dB change per 15 msec)

0. > 33.96 p store2

Interface settings

MacBook Pro Micr... in

MacBook Pro Spea... out

44100 SR (44100)

256 I/O (256)

256 signal (256)

Audition

Play a sound when a drum is detected (output muted)

----- tom-toms -----

1 2-4 3-6 5 7

snare cymbals brakedrums

p LEDs_LARGE_DISPLAY < open to display larger indicators

save detection settings

p READ_ME-Contact_mic_setup

p MIDI-only_for_testing

The user interface in the contact microphone detection patch (the version for an audio interface with 8 input channels). The setup tools are mainly in the green area to the left (see the text on the previous pages). This patch needs to be open on the same computer as the audio patch.

LIVE VIDEO PROCESSING

The piece is intended to be performed with a live video projection synchronized to the live electronics. The video is generated live during the performance and is based on the images from the cameras and the action of the performer. It is however possible to run the piece without video. The music will in both cases be identical.

VIDEO CAMERAS

Three video cameras are necessary for the video part (it is possible but not recommended to only use 2 cameras). They need to be able to stream the video signal to the computer. High-end web cameras are good choices.

The cameras capture the percussionist's action from three different angles. They should be aimed to capture the action of performing the instruments more than the instruments themselves.

- The first camera should have a good view of the tomtoms and snare drum. Especially the highest tomtom has a significant role for the video during the first 5 minutes of the piece. A low camera angle can be a good choice.
- The second camera should have a good view of the five brake drums and how the mallets are used when playing rolls on the instruments. It should also be possible to see the low tomtoms (especially #5) in the camera. A high camera angle facing down at the brake drums can be a good choice.
- The third camera should have a good overview of the performance of all tom-toms and snare drum.

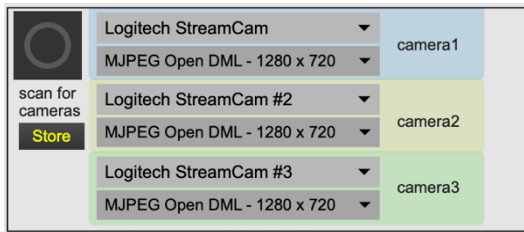
VIDEO PROJECTION

The video that is generated should be displayed close to where the percussionist is positioned. Options include behind the performer, slightly above the performer, or on a semi-transparent screen in front of the performer. The projection should be large enough to have an impact on the experience of the piece. A small display is not an option.

It is technically possible to expand the visual part by doubling the video components: the audio patch can send commands via UDP to more than one computer running independent video patches. The extra video computer would then need independent video cameras and its own projector.

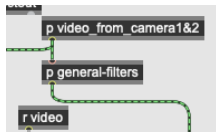
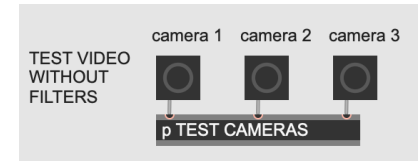
SETTING UP THE VIDEO PATCH

Connect the video cameras to the computer and open the video patch. You will need to indicate which one is camera #1 (used until event 6), which is #2 (used between event 6 and 16) and which is #3 (used from event 17):



Select camera 1, 2 and 3 from the pop-up menus and choose the resolution you want to use. A higher resolution is preferred, but it will also put a higher load on the computer's CPU. When working on the piece, 1280x720 was used. It is preferred to use the same resolution for both cameras. If a connected camera does not show up as an option, press the "scan for cameras" button. When you are done, press the "Store" button. The settings can now be stored with the patch.

You can test if the three cameras are recognized by clicking the "TEST VIDEO WITHOUT FILTERS" camera1, camera2 and camera3 buttons. The video from the cameras will be projected without going through any video processes.



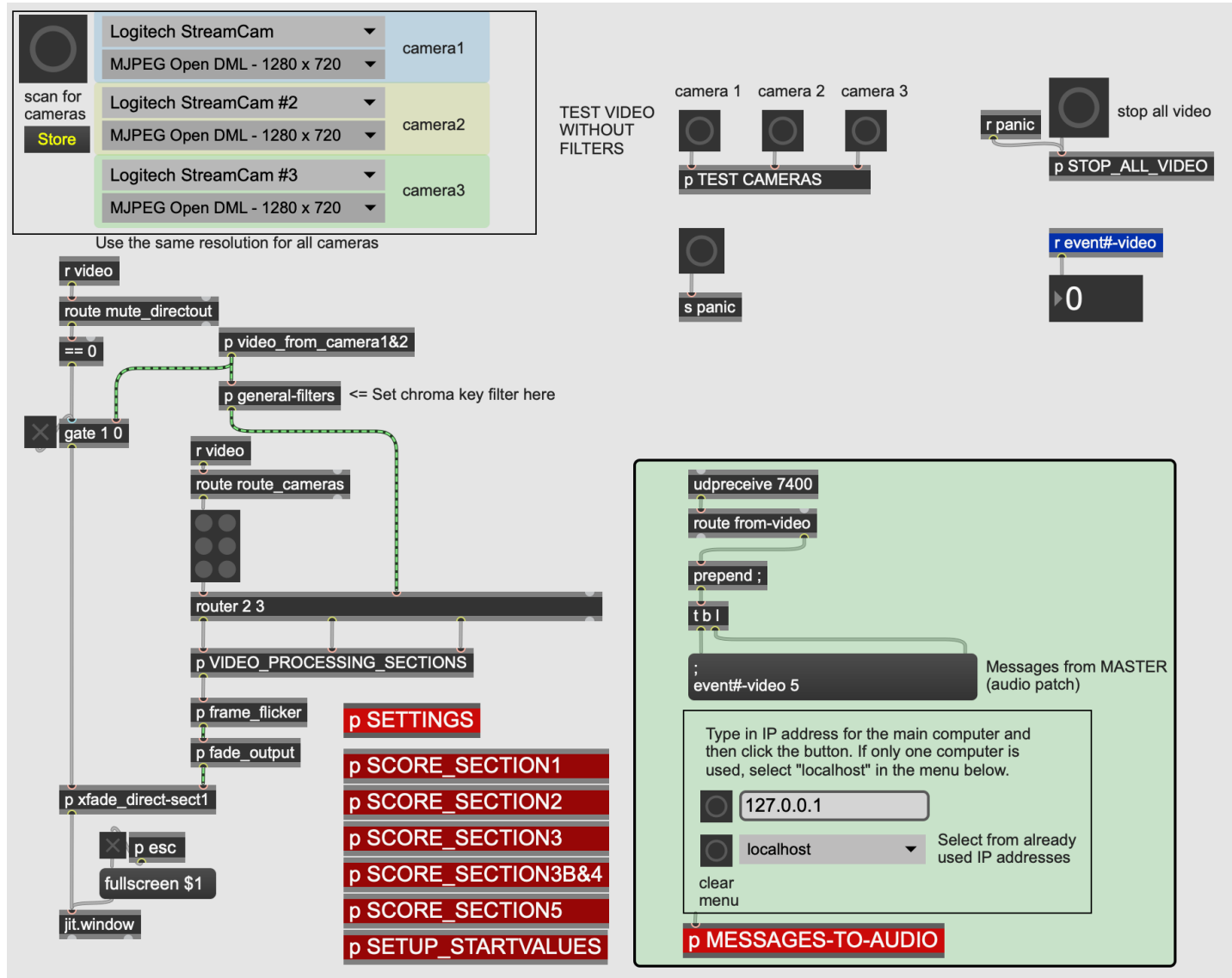
During the performance, the video will go through two general filters before being further processed. The first of these filters need to be adjusted before the performance: Open the "p general-filters" sub-patch by double clicking on it.

The first filter affects the colors in the projected video. All colors in the image will be slightly paler except for one color of your choice. This could for example be a color dominant in the performer's outfit. Click on the color in the displayed image in the sub-patch (the color selector tool will also show the chosen color). The setting can be stored with the patch. You can now close the sub-patch.

Finally, you need to type in the IP address of the computer where the audio patch is located. If it is on the same computer, select "local host". See under "USING ONE OR TWO COMPUTERS" above.

The video patch needs to be open to work. During a performance it is remotely controlled from the audio patch.





The user interface in the video patch. This patch is remotely controlled from the audio patch during a performance, but there are a few settings that need to be done before the performance. See the text on the previous pages.

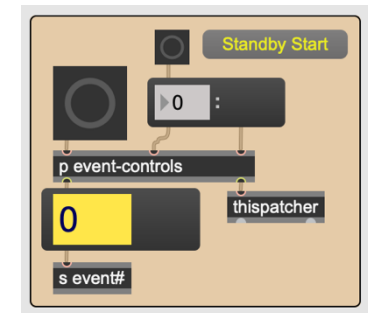
RUNNING THE ELECTRONICS

There are 21 main events in the piece (event 17 has 8 sub-events). The event numbers are indicated in the score and displayed in the audio patch. Events can be understood as short “scenes” where the computer responds to the performer’s actions. These events need to be triggered in the audio patch, either by pressing spacebar or (if the performer is triggering the events) via a MIDI pedal. The performer should not trigger the events from the computer keyboard.

Note that event 0 is without sound but needs to be carefully performed as notated in order for the video to work.

In the audio patch, you can see the number of the event that is active in the yellow number box. When you start the piece from the beginning, press “Standby for start”. This will cause event -1 to be active, and the video to project camera 1 without processes. This is the state of the video projection before the piece begins.

When a new event is triggered, nothing will happen until the percussionist plays an instrument: Triggering an event only puts the patch in a stand-by mode for the next action. The timing of pressing the pedal or space bar is therefore in most cases not crucial. There are three exceptions: Triggering the events 6, 7 and 9 will immediately set off the "large drum roll" in the live electronics and need to be musically timed to the performance.

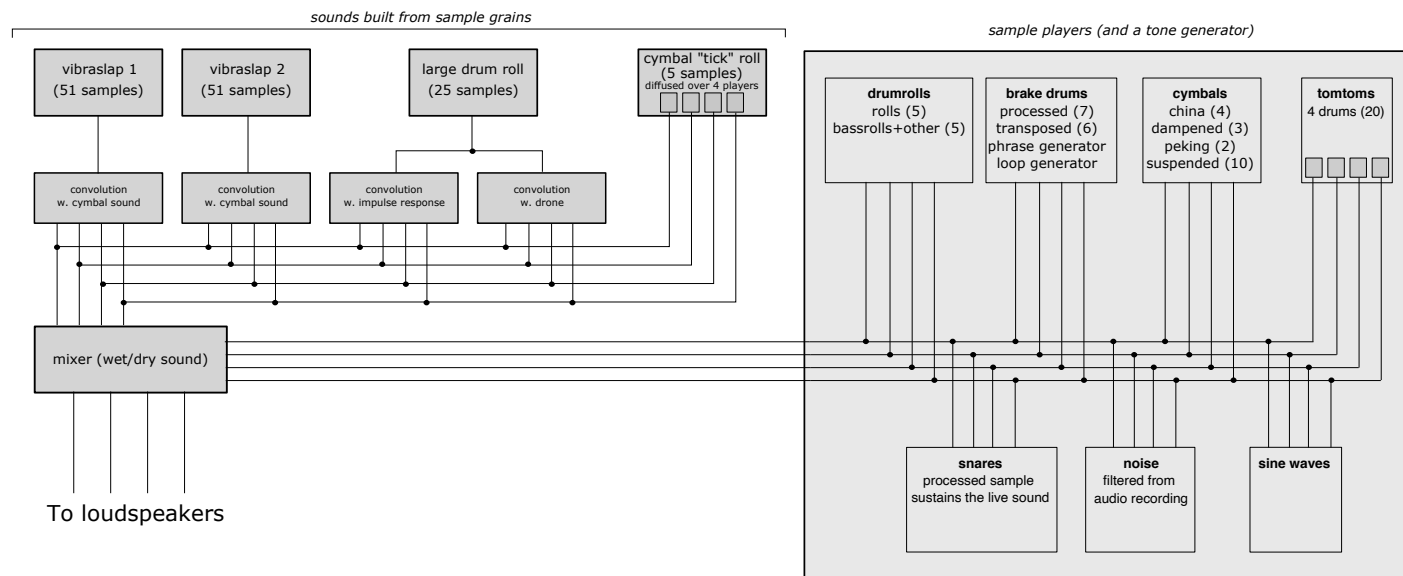


Within an event, the interaction between the percussionist and the live electronic is controlled by sensing the performance through the contact microphones. This interaction is instantaneous, and timing is crucial: When a drum is played, the computer detects this and immediately responds. Every interaction between the performer and the electronic part is indicated in the score with a small arrow. The computer patches are preprogrammed to respond in the correct way.

During a rehearsal, it might be desired to start the piece from an arbitrary position in the score. You can jump to any event number (including the sub-events at event 17) in the electronic parts by typing in the number in the gray number box under the “Standby Start” button. This will put the audio and video in standby at that position in the score.

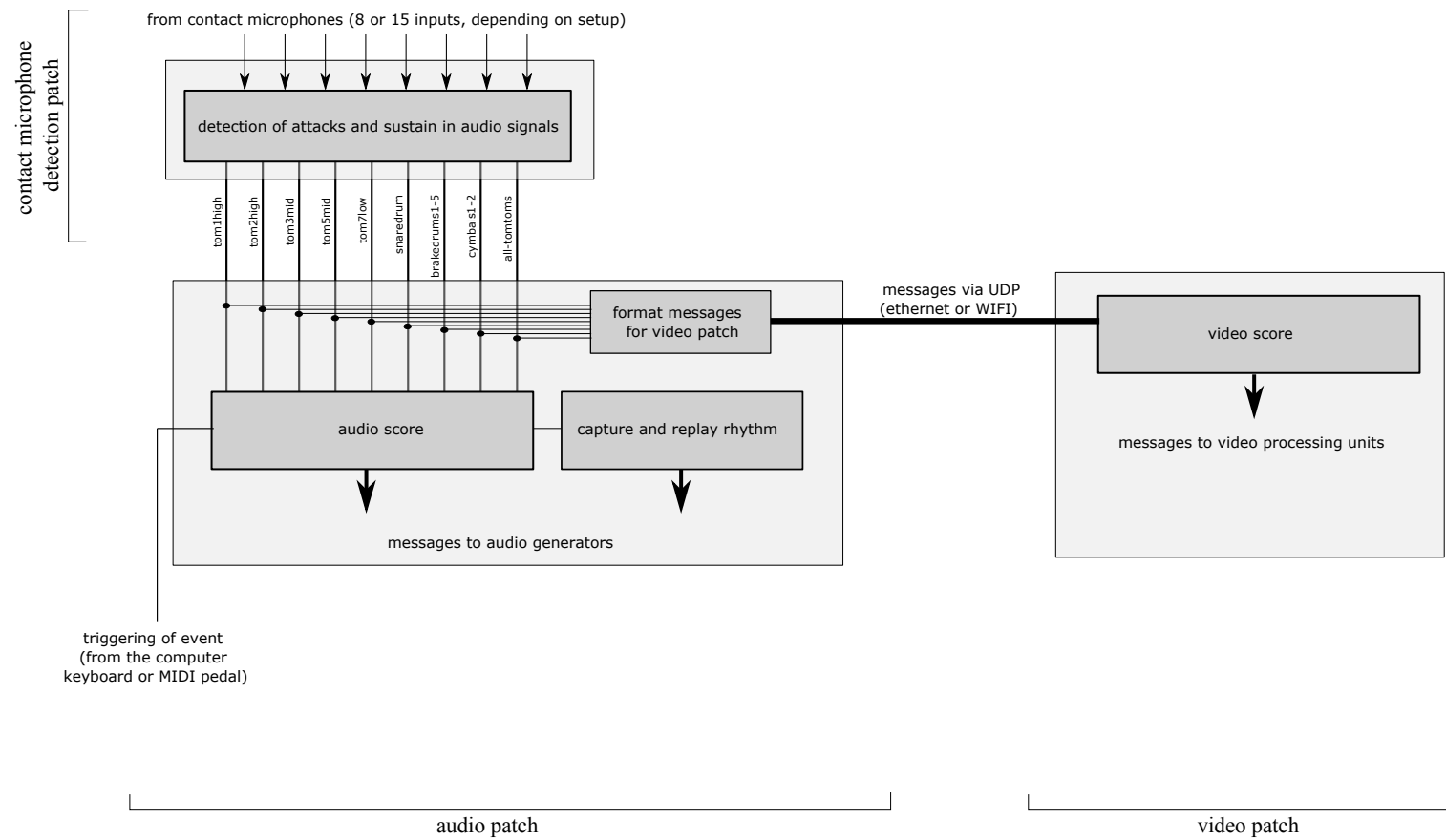
APPENDIX A – Diagrams

Diagram for the sound generation in the audio patch (simplified)



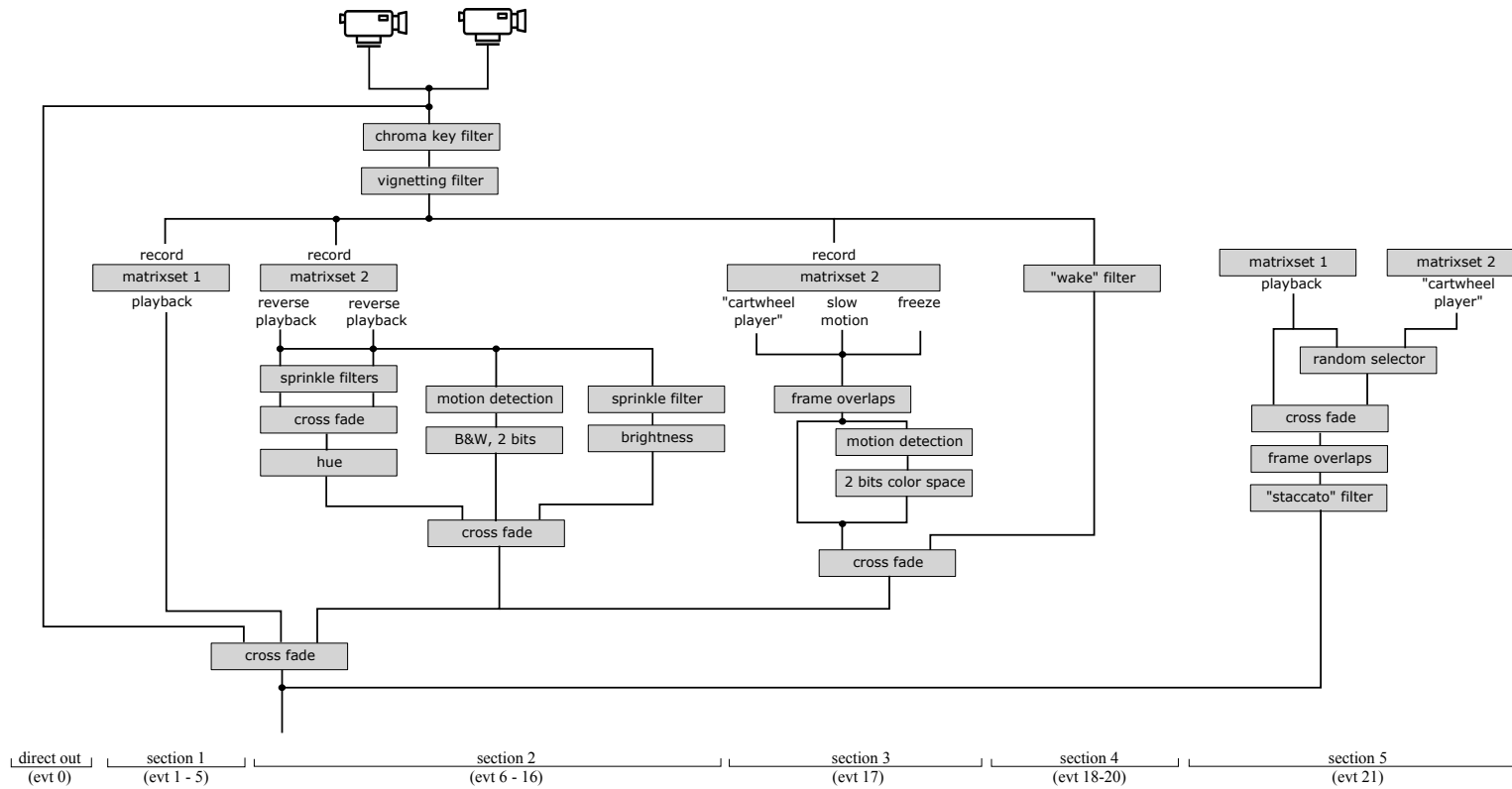
- The routing of control messages is not shown in this diagram.
- The phrase generator generates short phrases from 5 brake drum sounds.
- The loop generator generates loops from 5 brake drum sounds.
- The "snares" are synchronized to the snare drum and sustains the sound of the snares.

Diagram for contact microphone detection and message routing



The detection of tomtom 4 is sent on the tom2high bus, and tomtom 6 on the tom3mid bus

Diagram for the video processing in the video patch (simplified)



APPENDIX B – STORED PARAMETERS

You can store parameter settings if you save your patches after the settings are done. Each patch must be saved separately. The following settings can be saved:

In the audio patch:

- The menu options for IP addresses (but the patch will always open with “localhost” selected).
- The “no video” setting.

In the contact microphone detection patch:

- The threshold for the amplitude and slope of the attacks for each input channel.

In the video patch:

- The menu options for IP addresses (but the patch will always open with “localhost” selected).
- If you clicked the “store” button before saving the patch, the settings for camera 1 and 2 will be saved.
- The selected color for the chroma key filter.

APPENDIX C – MOUNTING THE CONTACT MICROPHONES



Contact microphones should have a tight fit to the object it is registering. Use adhesive putty (the type you can use to mount posters on the wall) between the contact mic and the instrument, and secure with a tape. The contact microphone on the cymbal can be mounted on the underside, close to the bell.



APPENDIX D – VIDEO EVENTS

The video part is not indicated in the score, but it is an essential part of the piece. All images are based on the live stream from the two video cameras. Below is a brief description of what is displayed in the projections.

Event -1: The unprocessed image from camera 1. The percussionist's actions are projected without any filters.

Event 0: The piece begins. The unprocessed projection continues. The percussionist performs the silent gesture with the drum stick on tom-tom 1. The percussionist should end the gesture at the identical position as it begun. The gesture is being recorded (this does not affect the projection at this point).

Event 1: The video projection freezes. The percussionist continues the gesture by performing the first beat on tom-tom 1. The beat triggers the replay of the recorded gesture from event 0, stretched to exactly 30 seconds. The image quality changes to include the default filters (the chroma key and vignetting) as well as frames are marked by slightly varying the brightness for each frame: these filters are always on from this point in the piece. The sequence with the performer beating the drum will trigger the sound of the large drum roll. When the percussionist beat tom-tom 5, the projection fades out.

Event 2 – 5: The first beat of tom-tom 1 triggers the replay of the gesture from event 0. The replay of the gesture is stretched (or cropped) to 19 seconds (event 2), 11 seconds (event 3), 5 seconds (event 4) and 1 second (event 5). At event 4 and 5, beating tom-tom 1 will trigger the reverse playback of the recorded gesture (if you beat the tom-tom fast, not every beat will trigger the gesture – this is intentional).

--

Event 6: A gesture from above is immediately replayed a last time and faded out.

Camera 2 will now be used from this point. Each brake drum beat will trigger a reverse playback from the point where the beat happened. A roll will thus cause a series of playback sequences (most of them very short), and when the roll stops, the reverse playback will include the playback of the whole roll. The longer the roll is, the more the sprinkle filter will distort the image (the effect is that the image becomes fuzzy). When a second roll is performed, it will behave as the first roll (i.e. reverse playback and the use of the sprinkle filter) and be crossfaded with the first roll. Each reverse roll playback will fade out shortly after it is over.

When tom-tom 5 is beat, the image becomes black with only the motion detection filter drawing gestures that are in motion. A new brake drum roll will make the image go back to the brake drums as described above.

Event 7 – 10: The video continues the behaviour from event 6. When tom-tom 1 is beat, the image will switch to a bright yellow character with sprinkle effect and fade out (starting at event 8).

Event 11 – 16: The brake drums are not used anymore, and the image continues to switch between the effect on beating tom-tom 1 and tom-tom 5 (see above).

--

Event 17: The video scrambles frames from the previous 100 msec (the exact time window will vary from subevent to subevent). The effect is that the displayed movements become more intense. There is also an overlap between frames: 2 frames are overlapped at the beginning of the section, increasing to 4 frames towards the end. This also contributes to the intensity.

When tom-tom 7 is beaten, the playback switches to slow motion, and the image is based on motion detection: motions are preserved, static objects removed. The color scheme is here dark, with a blue-ish color space.

When the snare drum is beaten, the image freezes (each beat makes the video jump to a fresh frame).

At subevent 17:8, the camera input is muted and playback is based on what was recorded at subevent 17:3. The effect is that when the percussionist stop playing, the video continues with maximum intensity. The snare drum freezes the image and puts the color space back to the one based on motion detection.

Event 18-20: The snare drum triggers and turns off the pulsating tom-tom sound. The frames in the video are triggered by the same pulse. When the tom-tom pulse is not playing, the image fades into the “wake” filter, where static objects are emphasized, and motion is erased.

--

Event 21: The performer sets off an interpolation from the chaotic playback in 17:8 to the gesture replayed from event 1. The gesture sets off the large drum roll, and the frame rate follows the pulses in the roll: when the roll stops, the frames stop. Each frame is only exposed for a few milliseconds.

APPENDIX E – COMPUTER FILES

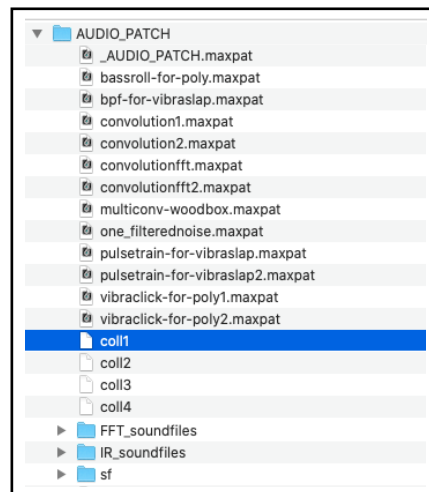
There are three main patches for the electronic parts, divided into three subfolders. Each main patch needs to be open (you need to open them separately) for the electronics to work (if video is not used, you don't need to open the video patch):

- `_AUDIO_PATCH.maxpat`
- `_CONTACT_MIC_DETECTION.maxpat`
- `_VIDEO_PATCH.maxpat`

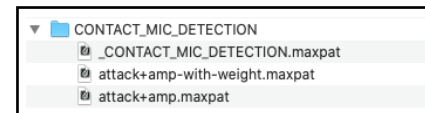
All other patches are opened from inside these patches. All used Max objects are standard objects, and no 3rd part externals are necessary. When creating the patches Max version 8 for Macintosh was used.

The information about the files and folders is only given as reference, in case the patches would not play correctly (you can then check if any file is missing).

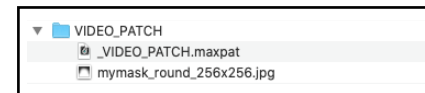
The audio patch folder



The contact microphone detection patch folder

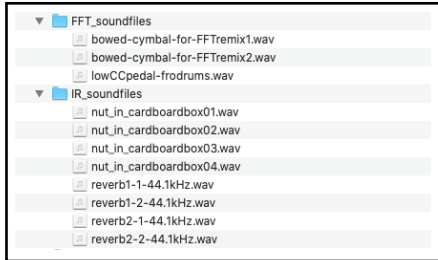


The video patch folder

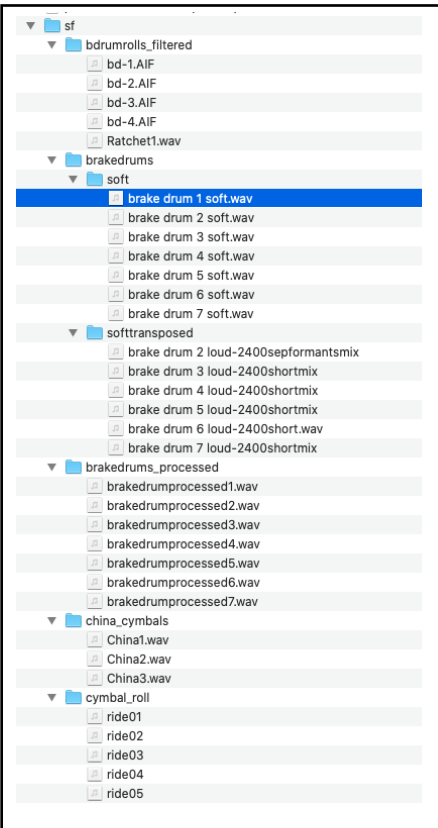


Subfolders inside the audio patch folder

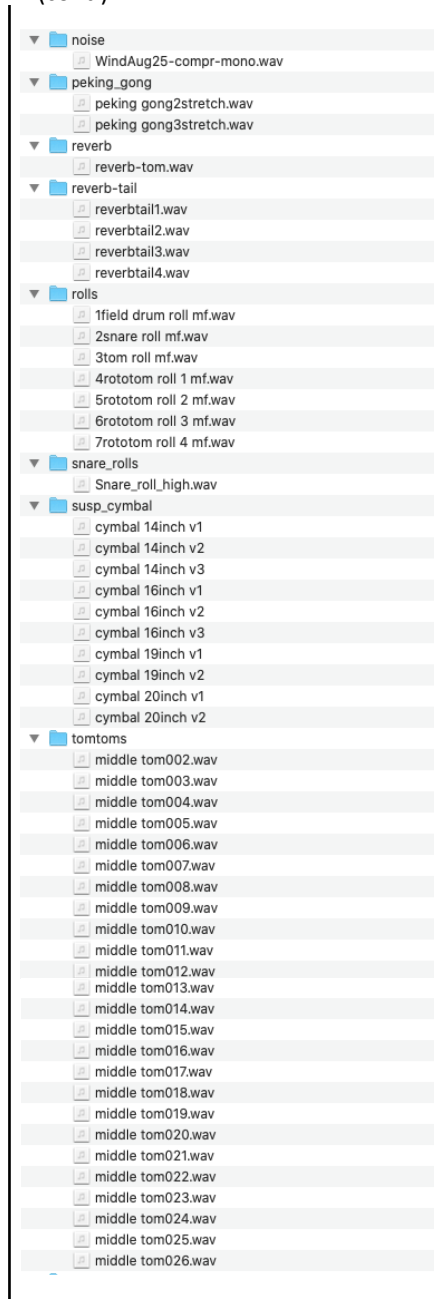
The FFT_soundfiles and IR_soundfiles folders



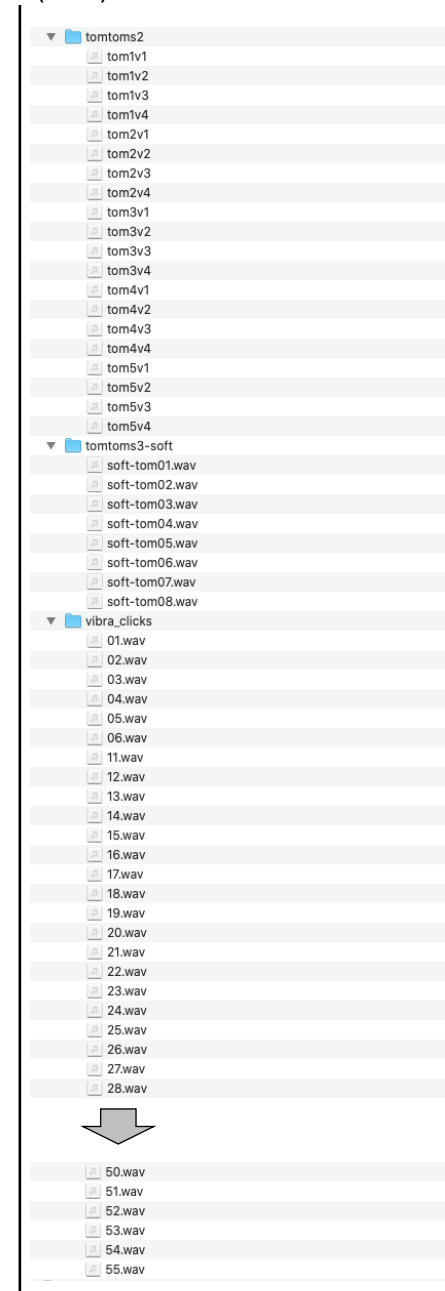
The sf folder



(cont.)



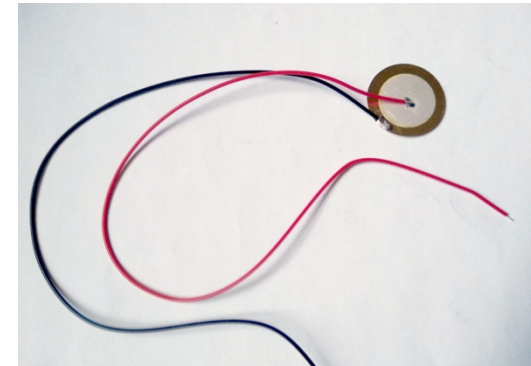
(cont.)



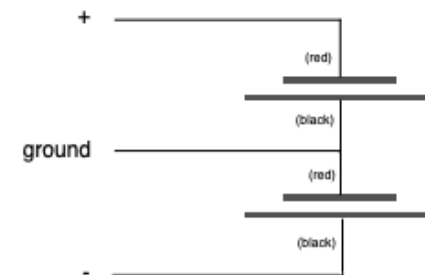
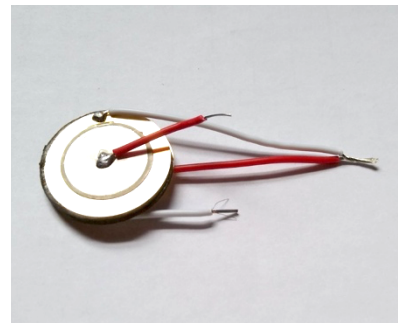
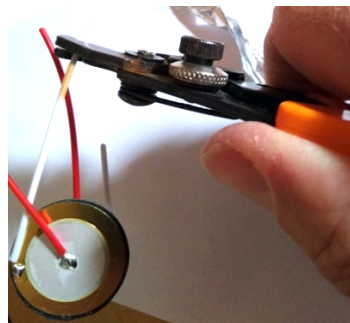
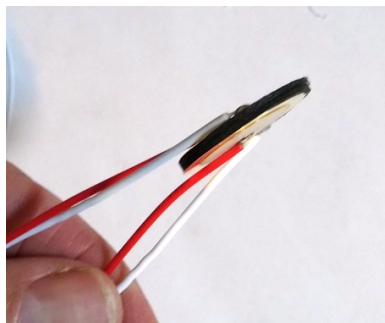
APPENDIX F – DIY: How to build a balanced contact microphone

While contact microphones can be purchased, they are very cheap if you make them yourself. If you have some experience in soldering, it is not very hard. The main component is the piezo disc that convert vibrations into an electrical signal. They are sold in bags of 6 – 20 for less than \$1 each. I use 27 mm discs.

You will also need a cable and a connector. I recommend XLR connectors since they are by default balanced, they connect to most mixers and audio interfaces and they are easy to extend as needed (an XLR snake is often used to extend cables at concerts).

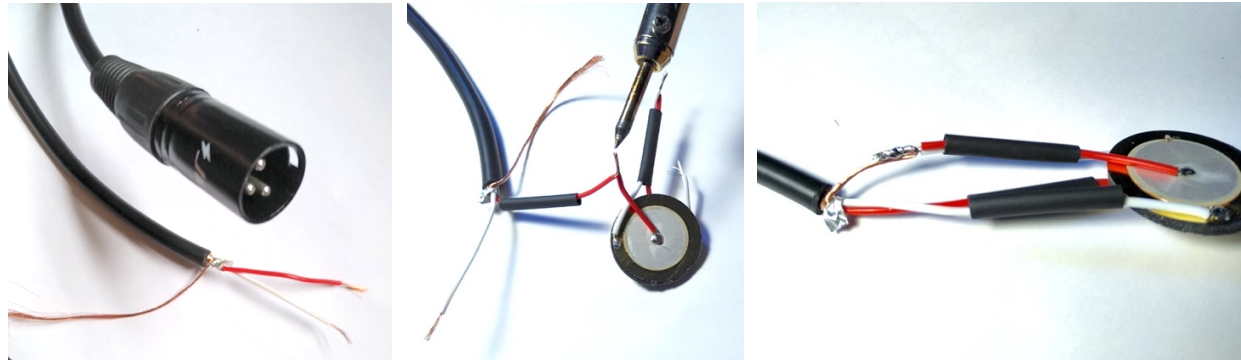


To make the contact microphone output a balanced signal, you will need two piezo discs. By nature, contact microphones are noisy. An unbalanced contact microphone can pick up significant extra hum and noise, and its sound quality can considerably improve by making it balanced. The trick is to “sandwich” two piezo discs so that the discs vibrate together, creating electric signals of opposite polarities. It is crucial that the metal discs don’t touch each other (it would create a short circuit). You can use a tape to create an electric isolator between them, and then use glue to make them stick together. You create a ground signal by connecting one cable from each piezo together: you need to combine one “hot” with one ground (combine the red cable with the black or white cable). Use piezo elements from the same manufacture to avoid differences between them.

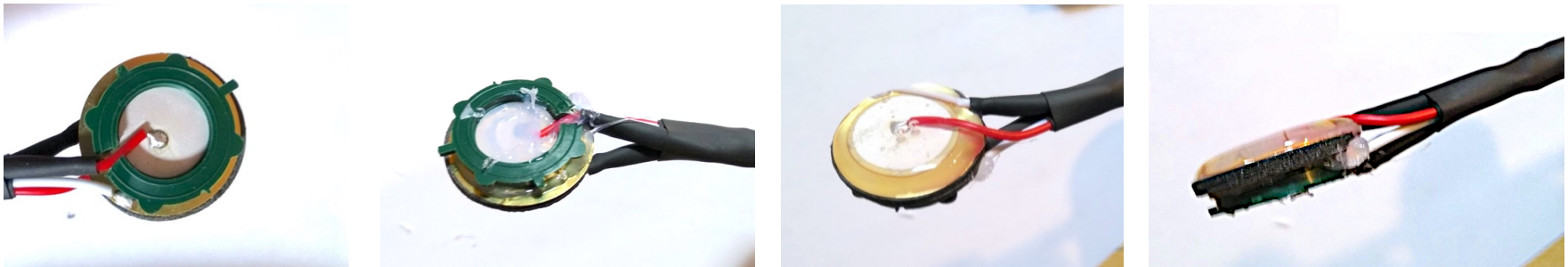


Note that the right image illustrates how the piezo discs are wired, not how they are glued together (the large metal discs should be glued against each other – with an isolator in-between).

Solder the two piezo discs to the cable with the XLR connector. Use shrink tube to cover and isolate the joints.

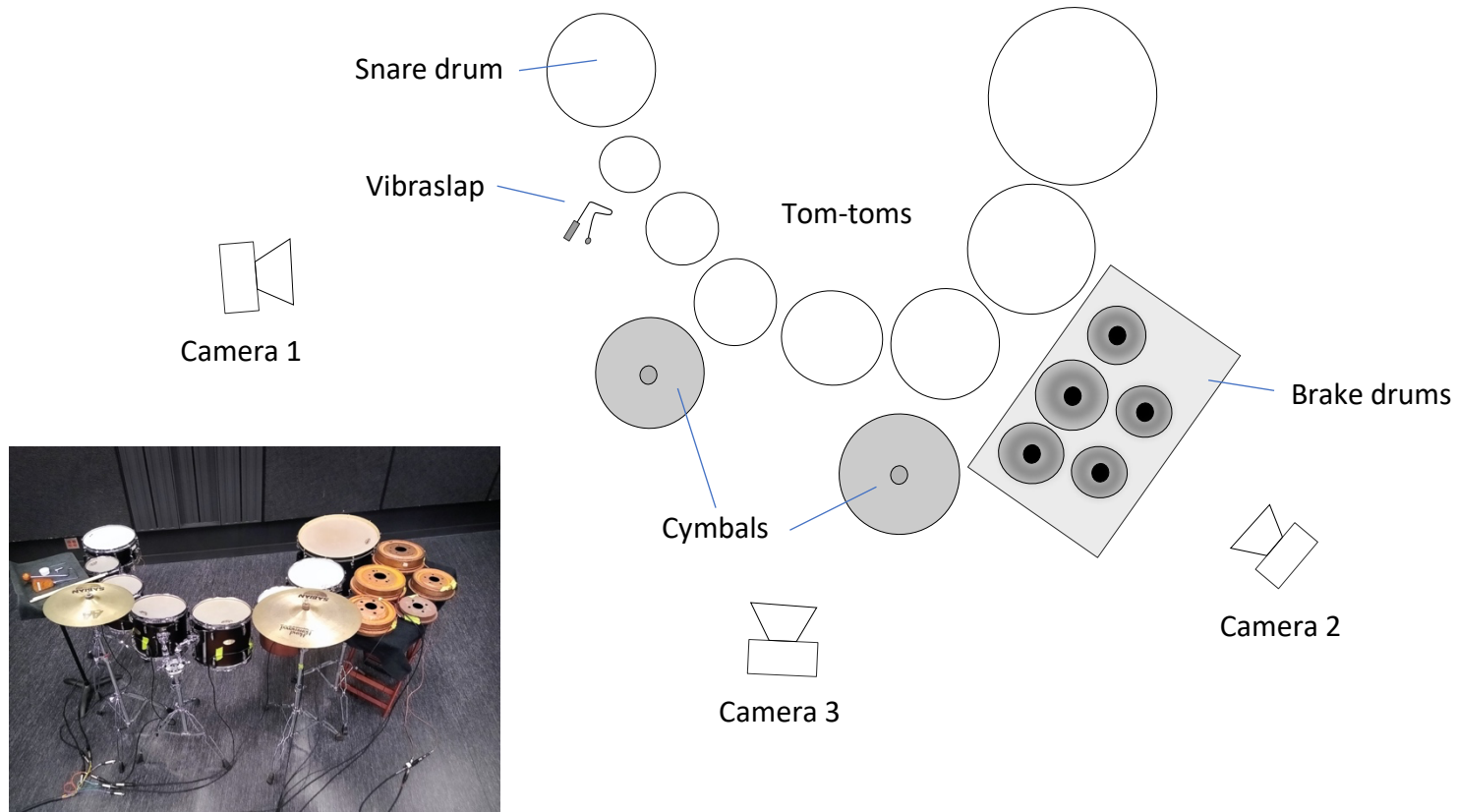


Use a glue gun to attach a plastic washer to create a surface that can be pressed at the object that should be detected. Secure all connections with a thin layer of glue. Avoid adding too much extra weight to the microphone.



INSTRUMENTS

7 tom-toms
 1 snare drum
 2 suspended cymbals
 5 brake drums
 1 vibraslap
 Drumsticks, soft mallets (for brake drums) and brushes

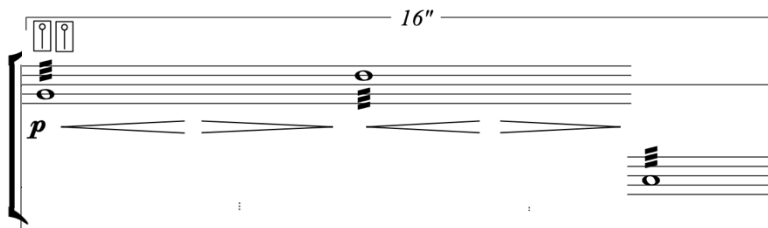


EXPLANATIONS TO THE SCORE

The rhythm in the score is either notated “traditionally” metric or using chronometric indications. The metric notation is always exact, while the chronometric indications are approximations. Try to stay close to the chronometric indications, but do *not* use a stopwatch.



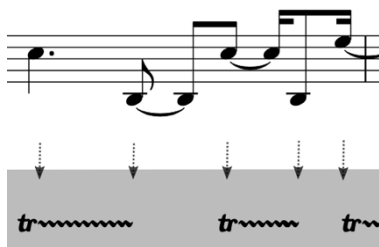
In the example to the left, the first gesture is performed according to the note values (the tempo is always MM=132 in the piece), then there is an 8-second rest before the final quarter note is played.



In this score example, the percussionist performs 3 rolls. The first two rolls (on brake drums) are each slightly longer than the third roll (on tom-tom). The total length of all three rolls is 16 seconds.



Event numbers are indicated in gray squares. An event is triggered from the computer or via a MIDI pedal. An event does typically not immediately trigger a sound but steps the piece forward and waits for the percussionist’s action. Event 6, 7 and 9 are exceptions and will immediately trigger a sound.



The percussion instruments have contact microphones attached to them. These will detect when an instrument is played. In this way, the performance will trigger actions in the live electronic parts (both audio and video). When an action affects the electronics, it is indicated by an arrow in the score. In the tom-tom example to the left, each note is either triggering or turning off a sound in the live electronics. Note that the electronic part adapts to the performer (the performer does not need to be concerned about synchronisation beyond musical phrasing, etc).

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Victoria Sparks and Jonny Axelsson.

MIMÉTISME

for percussion, live electronics and live video processing.

Örjan Sandred (2021)

♩ = 132

0 **1**

10"

vibraslap

2 suspended cymbals

5 brake drums

snare drum

7 tom-toms

move stick without touching the drum

return to initial position

30"

t-toms

live el.

f

"vibraslap"

mf

10"

19"

2

f

5

"large drum"

f

reverb (gesture continues)

2

t-toms

30"

f

"vibraslap"
tr
mf

"large drum"
f

6" 6" 13"

f 5 *f* *mp*

"vibraslap"
tr
mf

reverb

3

20" 4"

f *f* *f*

tr
mf

tr
f

tr

6" 8" 11"

f *f* *mp*

tr

tr

reverb

4

t-toms

9" 9" 4"

f *f* *f* 5 *f*

mf *f*

tr *tr* *tr*

14" 11"

f *f*

5

tr *tr* *tr* *tr*

reverb (gesture continues)

5" 6"

f *f* 5 *f*

mf *f*

tr *tr* *tr* *tr* *tr* *tr*

4" 9" 3" 6" 5"

f *f* *f* *f* *f*

tr *tr* *tr* *tr* *tr*

reverb

brake drums

t-toms

6

6"

16"

6"

pp

f

"cymbal ticks"

p

f

tr

reverb

mp

mp

3"

21"

6"

pp

f

reverb

mp

mp

mp

7

24"

8

pp

f

sine waves

reverb

mp

mp

mp

p

p

p

brake drums

t-toms

(♩ = 132)

2" 2" 3.5" 2"

p *p* *p*

f *f* *p*

sine waves

reverb

mp *mp* *mp*

"cymbal ticks"

2" 5" 3" 4"

p *p* *f* *pp*

mp *mp* *f*

reverb (gesture continues)

arco

12" 16"

10

p *p* *pp*

f *f* *pp*

sine waves

reverb

mp *mp*

sine waves

brake drums

t-toms

7"

2"

2"

2"

f

p

f

p

p

pp

"cymbal ticks"

p

mp

reverb

mp

t-toms

7"

3"

3"

5"

4"

6"

4"

11

12

13

f

f

pp

f

f

pp

f

f

pp

sine wave

"cymbal ticks"

p

reverb

reverb

reverb

14

7"

8"

9"

15

16

17

f

f

pp

"cymbal ticks"

p

reverb

reverb

reverb

t-toms

fill with various drum rolls

This system shows a single staff for t-toms. The notation consists of a series of eighth notes with beamed stems, grouped by slurs. Below the staff, a shaded area contains a wavy line representing a drum roll. A double bar line with a fermata symbol is placed at the end of the drum roll. Three arrows point from the text 'fill with various drum rolls' to the drum roll. The word 'tr' is written twice, with arrows pointing to the end of the drum roll.

cymb.

t-toms

f

f

5

This system features two staves. The top staff is for cymbal, showing a single note with an accent (>) and a dynamic marking of *f*. The bottom staff is for t-toms, with a series of eighth notes and a dynamic marking of *f*. A five-measure rest is indicated by a '5' above the staff. Below the t-toms staff, a shaded area contains a wavy line representing a drum roll. A double bar line with a fermata symbol is placed at the end of the drum roll. A bass clef and a single note are shown below the drum roll.

t-toms

3

This system shows a single staff for t-toms. The notation consists of a series of eighth notes with beamed stems, grouped by slurs. A triplet of three eighth notes is marked with a '3' above it. Below the staff, a shaded area contains a wavy line representing a drum roll. A double bar line with a fermata symbol is placed at the end of the drum roll. A small drum kit icon is shown at the end of the drum roll.

t-toms

tomtom fills

This system shows a single staff for t-toms. The notation consists of a series of eighth notes with beamed stems, grouped by slurs. Below the staff, a shaded area contains a wavy line representing a drum roll. A double bar line with a fermata symbol is placed at the end of the drum roll. Below the drum roll, a series of vertical lines and small drum kit icons are shown, labeled 'tomtom fills'.

cymb. *f*

t-toms *f* 5

tr

v *ff*

various roll (drums and more)

cymb. *f*

snare d. *ff*

t-toms *f*

tr

snare d.

t-toms

This system contains the first four measures of the drum part. The snare drum part (top staff) has rests in measures 1, 2, and 3, with a quarter note in measure 4. The tom-tom part (middle staff) features a rhythmic pattern of eighth notes in measures 1 and 2, followed by a quintuplet in measure 3 and a triplet in measure 4. A large slur covers the tom-tom part from measure 3 to the end of the system. Below the tom-tom staff is a piano keyboard diagram with a wavy line indicating a tremolo effect on the right side.

This system contains measures 5 through 8. The snare drum part (top staff) has a quarter note in measure 5, a quarter note in measure 6, a quarter note in measure 7, and a quarter note in measure 8. The tom-tom part (middle staff) has a quarter note in measure 5, a quarter note in measure 6, a quarter note in measure 7, and a quarter note in measure 8. A large slur covers the tom-tom part from measure 5 to the end of the system. Below the tom-tom staff is a piano keyboard diagram with a wavy line indicating a tremolo effect on the right side.

cymb.

snare d.

t-toms

This system contains measures 9 through 12. The cymbal part (top staff) has a cymbal crash in measure 9, a cymbal crash in measure 10, and a cymbal crash in measure 11. The snare drum part (middle staff) has a quarter note in measure 9, a quarter note in measure 10, a quarter note in measure 11, and a quarter note in measure 12. The tom-tom part (bottom staff) has a quarter note in measure 9, a quarter note in measure 10, a quarter note in measure 11, and a quarter note in measure 12. A large slur covers the tom-tom part from measure 9 to the end of the system. Below the tom-tom staff is a piano keyboard diagram with a wavy line indicating a tremolo effect on the right side.

snare d.

t-toms

the tomtom rhythm tails the snare drum

(sim.)

tr

tr

tr

tr

cymb.

snare d.

t-toms

tr

tr

tr

tr

tr

f

ff

3

the tomtom rhythm tails the snare drum

cymb.

snare d.

t-toms

cymb.

snare d.

snare d.

snare d. **18** snares off 10" 4" 6" 4" 5"

t-toms *tr* *mf* *p* *tr* *mf* *p*

filtered noise 5.6 kHz

p

mf

mf 20" wait until the vibraslap sound stops

mp

rit

p

19 12" 4" 3" 5"

tr *mf* *mf*

p

"cymbal ticks"

filtered noise 150-300 Hz 150-750 Hz

14

snare d. *arco* 5" 4" 3" 11"

brake drums *mp*

t-toms *p*

150-750 Hz 300-1350 Hz 750-2550 Hz

20

snare d. *mf* 10" 10" 4"

brake drums *mf* vibraslap l.r.

t-toms *mp* *p*

1.3 - 4.9 kHz 2.5 - 4.9 kHz

21

brake drums 8" 6" 6" 10"

t-toms "cymbal ticks" 4.9 - 9.7 kHz

t-toms

hit with brush

40"

f

"opera gong"

f

"bass drone"

f

tr

Detailed description: This musical score is for a pair of tom-toms. The notation is on two staves. The first staff has a treble clef and a single note with a brush icon above it, labeled "hit with brush". The second staff has a bass clef and a note with a gong icon above it, labeled "opera gong". A dynamic marking *f* is placed below the first staff. A bracket groups the "opera gong" and "bass drone" sections. The "bass drone" is represented by a wavy line on a bass staff with a dynamic marking *f*. A tremolo line labeled "tr" is positioned between the two staves. A duration of 40 seconds is indicated above the second staff.

30"

"large drum"

f

Detailed description: This musical score is for a large drum. It consists of two staves. The first staff has a treble clef and a wavy line above it. The second staff has a bass clef and a note with a drum icon above it, labeled "large drum". A dynamic marking *f* is placed below the second staff. A duration of 30 seconds is indicated above the second staff.