Introductory Note

This suite uses interactive electroacoustics to enhance the relationship between the body of the performer and the sounds it produces. Through attaching a gyroscopic sensor to a solo violinist's bowing arm and using the data to control parameters of digital effects in real time, the movement of the performer is able to determine the electroacoustic processing of the musical sound produced by the violin. This augments the process of performance, linking the visual, physical, and acoustic. To enable this, I used Max/MSP to build an application called TiltFX. This application allows the gyroscope date from an iPhone (strapped to the bowing arm) to control parameters of reverb and delay effects. More information on the software and how to use it is included in this submission, alongside video and audio recordings of the suite in performance.

The musical material is designed to provoke certain physical movements in the performer. In order to ensure the full range of movement is covered, the motivic material is often written to encompass all four strings (as can be seen in the opening gesture and core motivic material of No.1). The open strings are treated with particular important as they allow a greater freedom of movement. The harmonic construction is such that there is always a gravity towards the open strings – this can be seen in b.14-17 of no.2, where the sequential rising of a whole tone motive always arrives at an open string on the first beat of the bar. Movement is also indicated in the notation. Where an arrow is moving upwards, this indicates a raising of the wrist and lowering of the elbow, and generally provokes movement of the bow towards the higher strings. Where an arrow is moving downwards, this indicates the opposite.

No.1, titled 'Reflections', uses the tilt sensor to control the reverb size and delay feedback. This creates a shifting spatial effect that is constantly changing in density. The development of the main motivic figure (introduced b.7) gradually intensifies the electroacoustic processes controlled by movement. At b.25, the motive is altered to incorporate pizzicato, which necessitates a more pronounced movement at a higher angle. This is then complemented by the extension of the first note from bar 27, which uses movement notation to make the lower angles more pronounced. This allows the range of the effect parameters to expand over the progression of the piece.

No.2, titled 'Singularity', controls the delay time. The changing of this parameter in real time means that the tempo of the affected audio changes with the angle of the arm, growing faster towards the higher register. As a movement primarily concerned with rhythm, extended techniques (such as playing below the bridge and tapping the body of the violin) are used as percussive effects. Every time the repeated figure (b.3-4) returns, it is rephrased to incorporate the rhythmic content of the preceding material.

No.3, titled 'Depletion', uses three parameters of tilt (controlling reverb mix, delay mix, and blend) to create three sonic areas: reverberant, reflective, and clean. This results in the affected signal constantly changing, and cutting in and out. The piece becomes an effort to regain the spatial assurance of No.1, making greater use of double stopping techniques to seek compromises between different angles.

1. Reflections

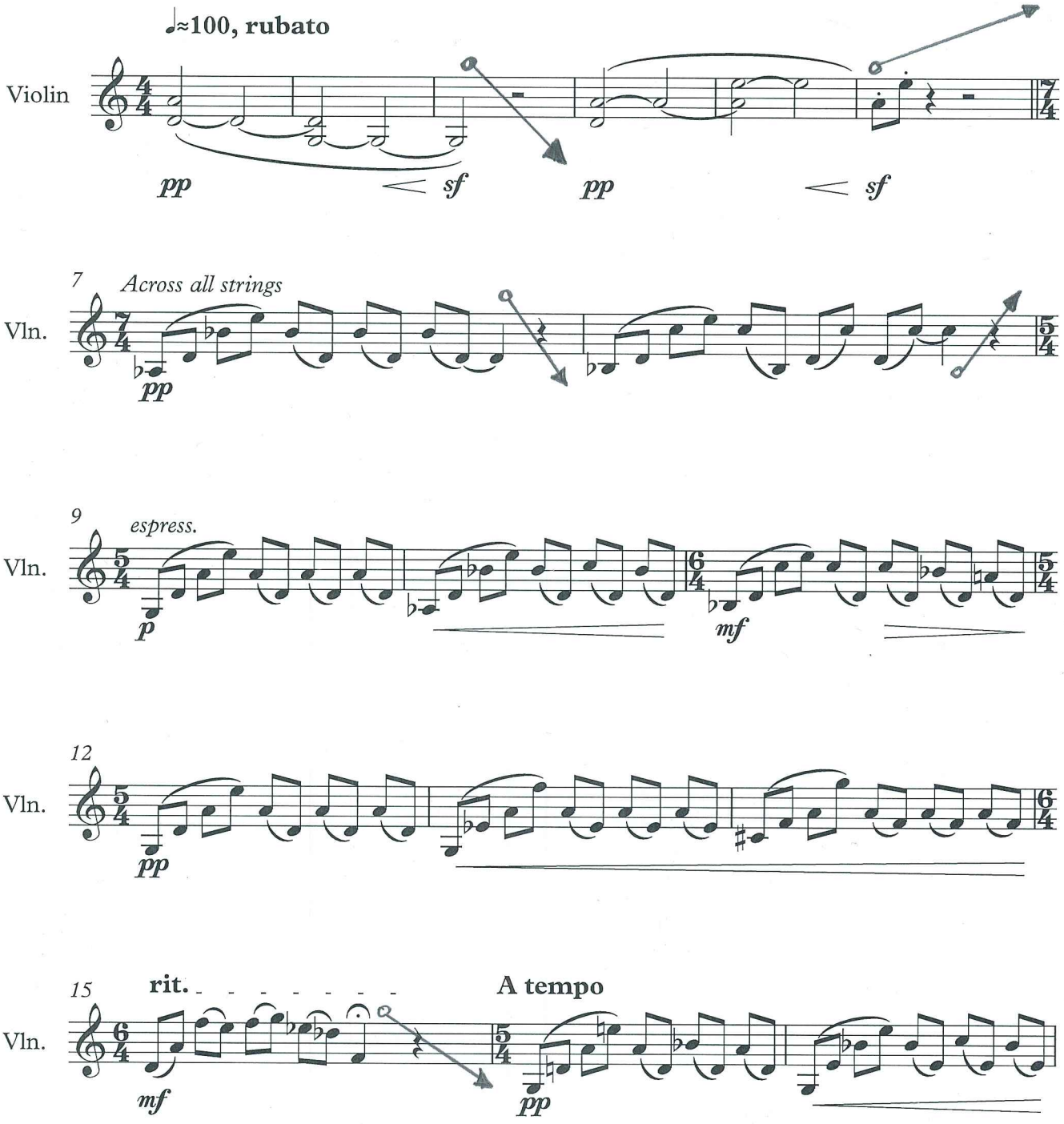
Reverb Size and Delay Feedback

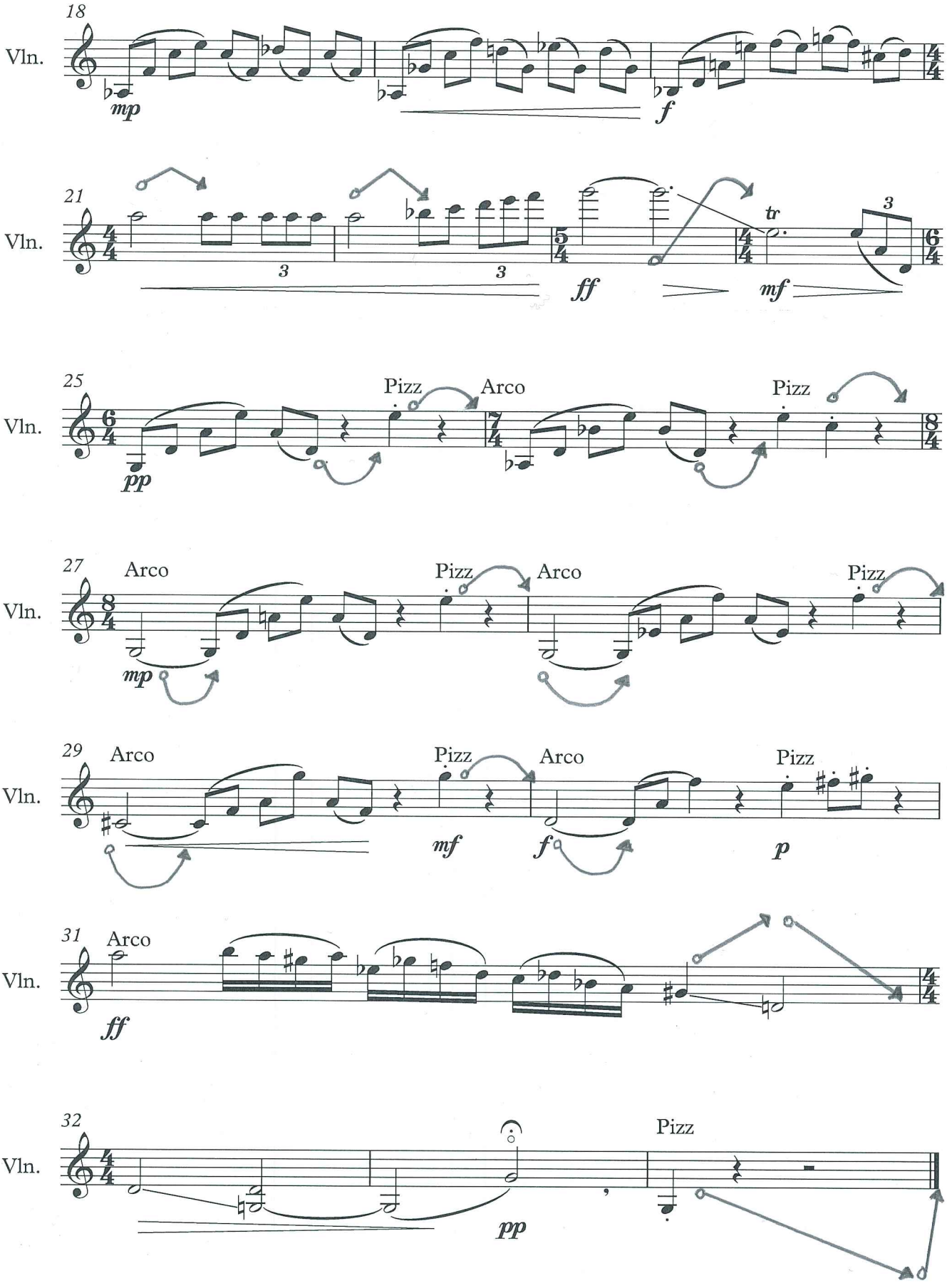
GyrOSC CCs
Pitch: CC2
Roll: CC1
Yaw: CC3

FX1 Tilt Control: On
Parameter: Size
Inverted (No/Yes): No
Reverb
Enabled: On
Mix: 80%
Size: Controlled by Tilt
Air: 60%
PreFilter: 53%

FX2 Tilt Control: On
Parameter: Feeback
Inverted (No/Yes): Yes
Delay
Dry/Wet Mix: 100
Delay Time: 0.45s
Feedback: Controlled by tilt
Lowpass Cutoff Frequency: 5375

Blend Control: On
Volume Range: -2 to 4db
Blend Tilt Control: On
Inverted (No/Yes): No
Clean Signal Through: -18dB



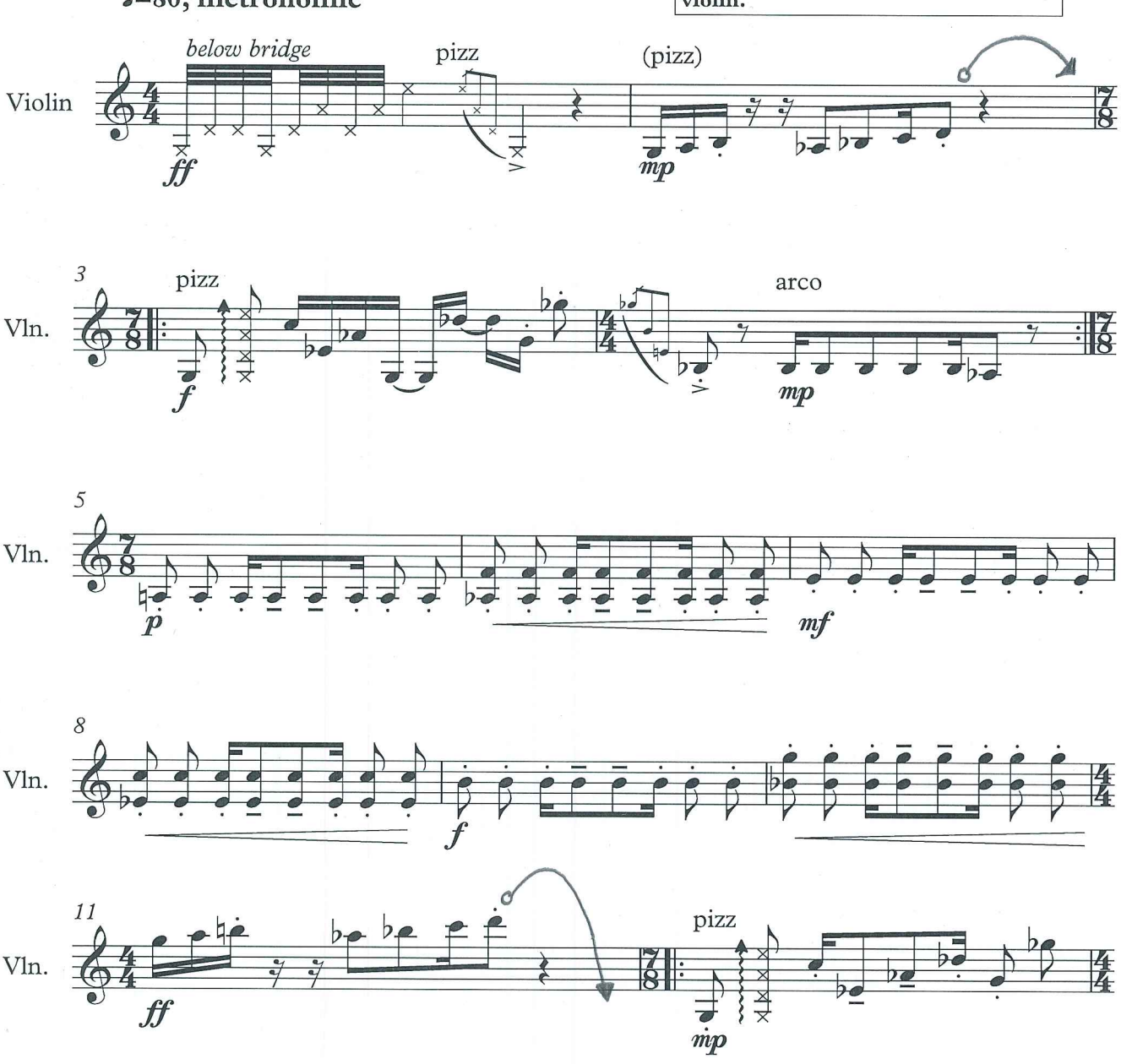

18
Vln.
mp
f
21
Vln.
3
3
ff
tr
3
mf
25
Vln.
pp
Pizz
Arco
Pizz
27
Vln.
Arco
mp
Pizz
Arco
Pizz
29
Vln.
Arco
mf
Pizz
Arco
f
Pizz
p
31
Vln.
Arco
ff
32
Vln.
pp
Pizz

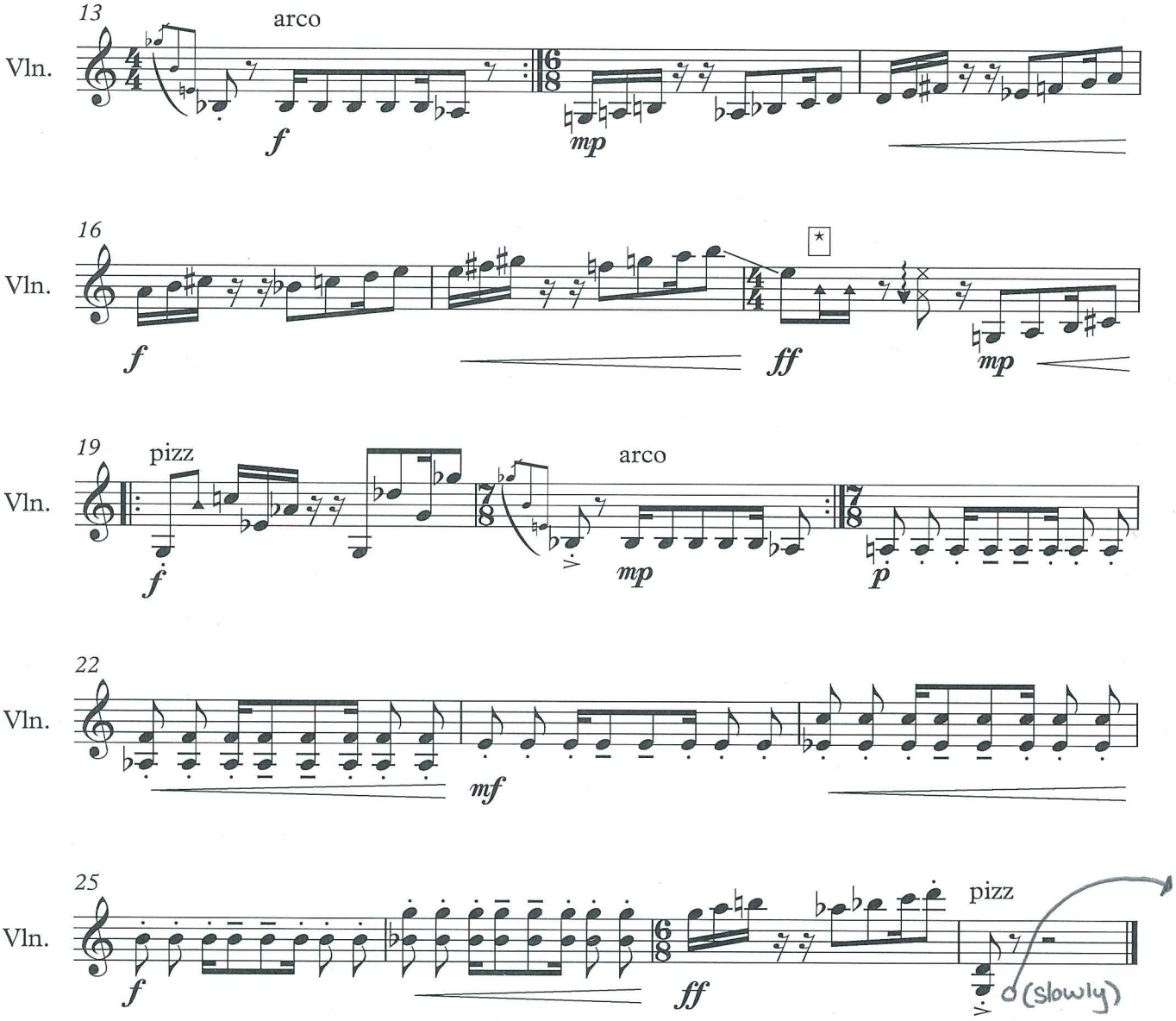
2. Singularity

Delay Time

GyrOSC CCs	FX1 Tilt Control: Off	FX2 Tilt Control: On	Blend Control: Off
Pitch: CC2	Reverb Enabled: On Mix: 100% Size: 78% Air: 60% PreFilter: 0%	Parameter: Delay Time Inverted (No/Yes): No Delay Dry/Wet Mix: 60 Delay Time: Controlled by tilt Feedback: 39 Lowpass Cutoff Frequency: 5375	Blend Tilt Control: Off FX2 Output: 0 dB. FX1 Output: -36dB Clean Through: 0dB

***Triangle-headed notes (b.18/19) indicate tapping the body of the violin.**




13
Vln.
arco
f
mp
16
Vln.
f
ff
mp
19
Vln.
pizz
f
arco
mp
p
22
Vln.
mf
25
Vln.
f
ff
pizz
(slowly)

3. Depletion

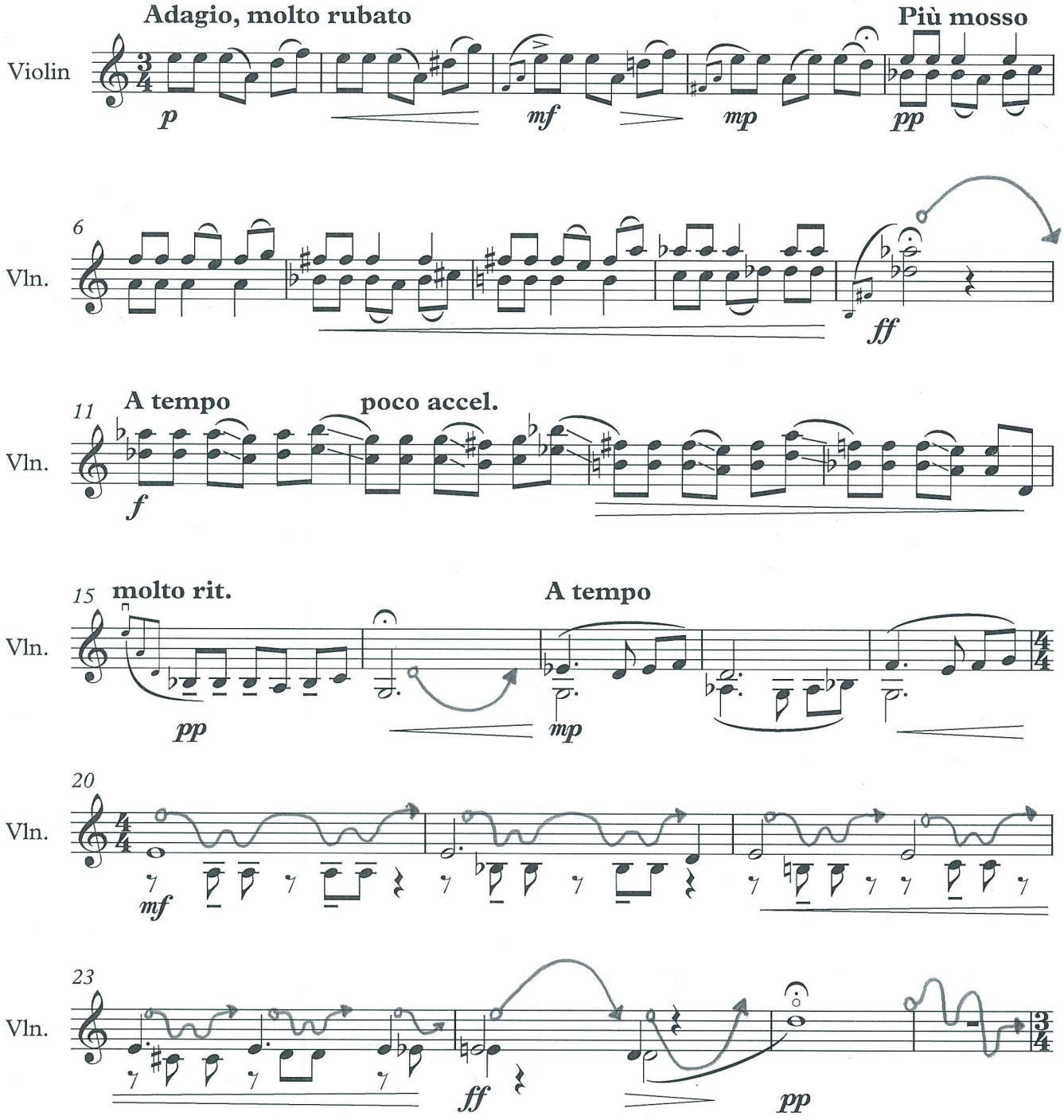
Reverb and Delay Mixes

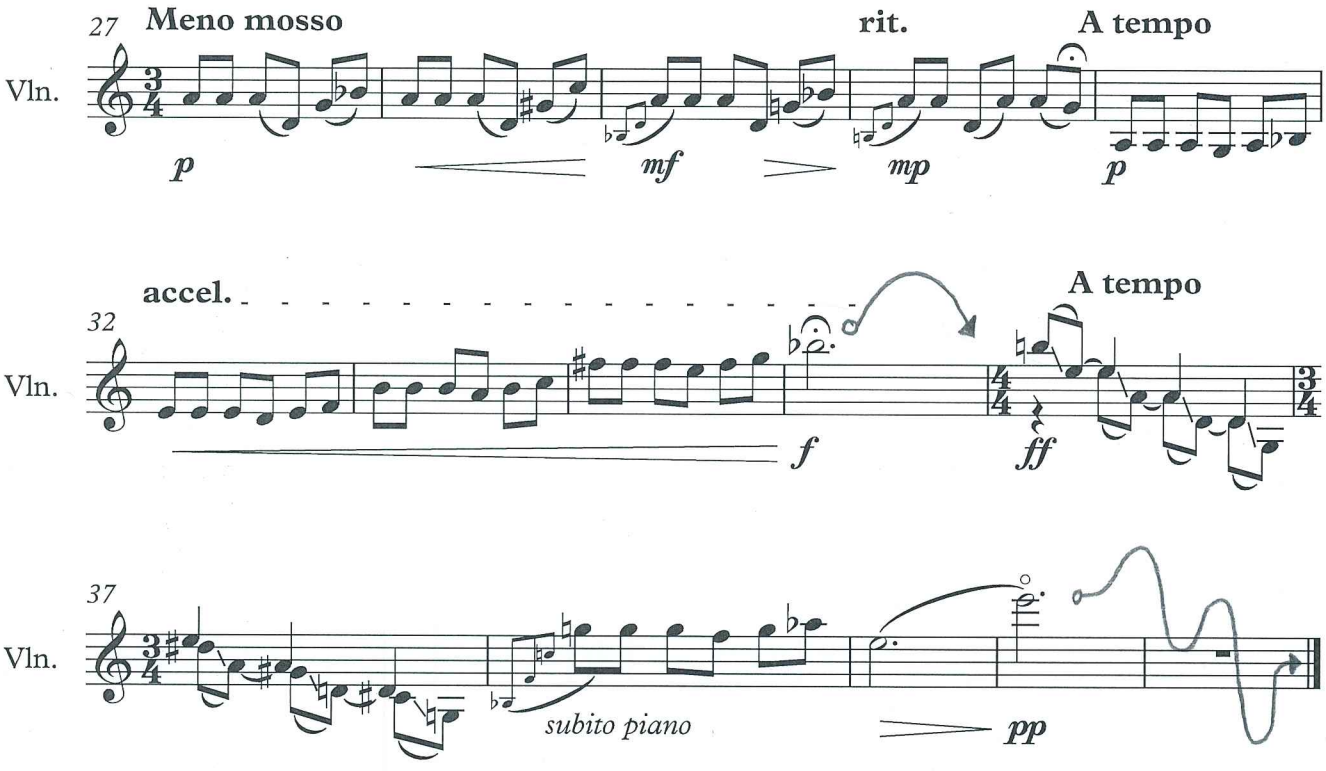
GyrOSC CCs:
Pitch: CC2
Roll: CC1
Yaw: CC3

FX1 Tilt Control: On
Parameter: Mix
Inverted (No/Yes): Yes
Reverb:
Enabled: On
Mix: Controlled by tilt
Size: 78%
Air: 60%
PreFilter: 0%

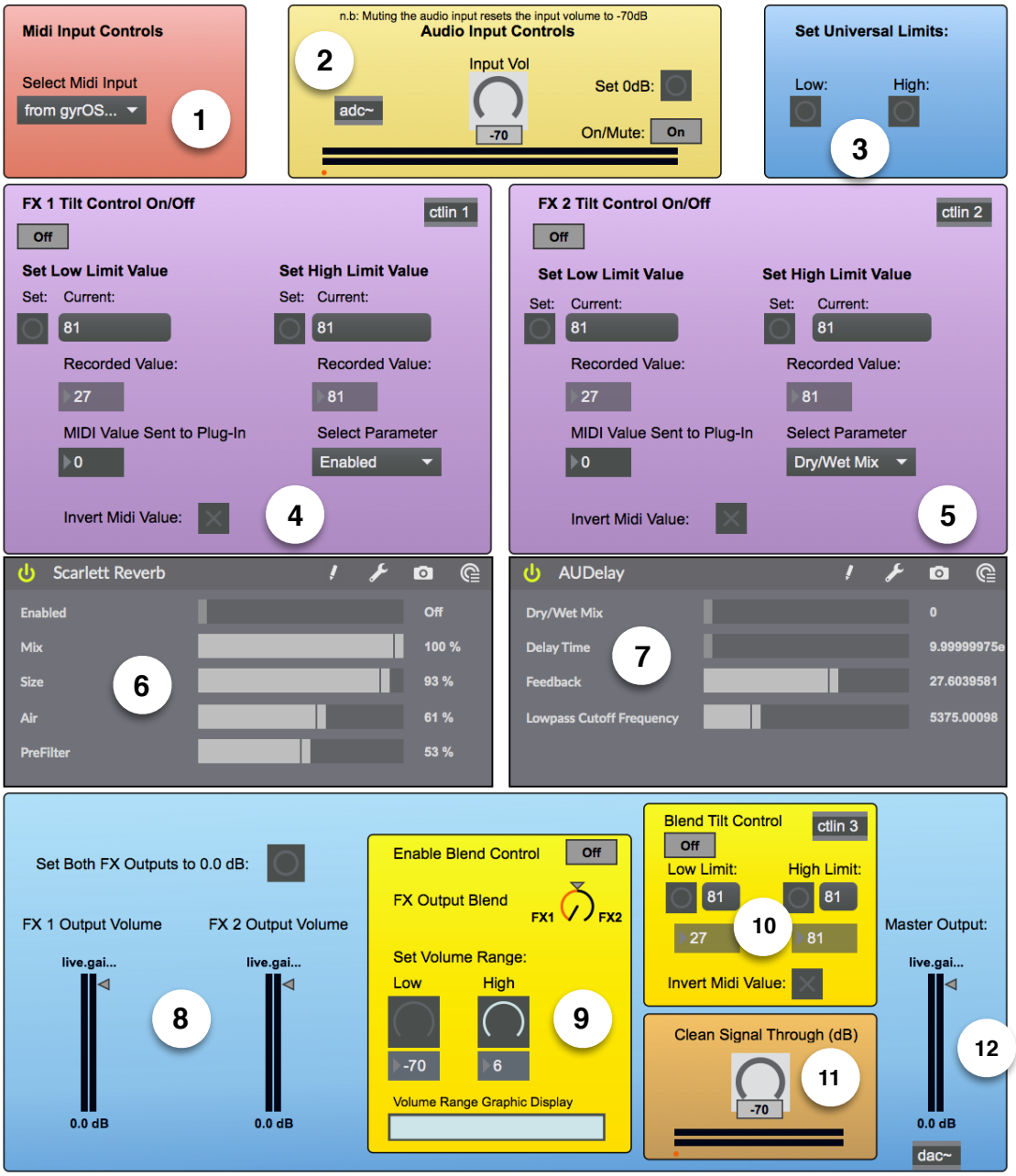
FX2 Tilt Control: On
Parameter: Dry/Wet Mix
Inverted (No/Yes): No
Delay:
Dry/Wet Mix: Controlled by tilt
Delay Time: 0.6s
Feedback: 65%
Lowpass Cutoff Frequency: 5375

Blend Control: On
Volume Range: -2db to 4db
Blend Tilt Control: On
Inverted (No/Yes): Yes
Clean Though: -20dB




27
Meno mosso
rit.
A tempo
Vln.
p
mf
mp
p
accel.
A tempo
32
Vln.
f
ff
37
Vln.
subito piano
pp

SOFTWARE LAYOUT



1. MIDI Input Selection
2. Audio Input Controls
3. Set Universal Limits - allows range of movement to be set simultaneously across all midi ctrl values
4. FX 1 Tilt Control - controls the movement range and MIDI values sent to the reverb plugin. Selects parameter of reverb plugin to be controlled by tilt
5. FX 2 Tilt Control - same as FX 1 Tilt Control but for the delay plugin
6. Reverb Plugin
7. Delay Plugin
8. FX output levels
9. Blend Control - blends the two FX output levels over a specified range
10. Blend Tilt Control - enables Blend Control to be controlled by the tilt sensor
11. Clean Signal Though
12. Master Output

SETUP

1. Download the GyrOSC app onto the iPhone. This enables the gyroscope date from the phone to be sent to the computer as an OSC signal.
   http://www.bitshapesoftware.com/instruments/gyrosc/

2. Download and install David Collins' GyrOSC-to-MIDI software patch. This acts as an interface between the phone and the audio processing, converting the OSC signals into routable MIDI signals.
   https://davidbcollins.com/software-patches/

3. Set up a network connection between the phone and laptop. This works best if it is a device network, rather than anything connected to the internet (which can be temperamental and has interference). To do this in a mac, click the WiFi icon and select 'Create Network' in the dropdown menu.

4. Open all three applications. Match the IP address of GyrOSC to the IP address of the device network.

5. Match the 'Port Number' of GyrOSC and GyrOSC-to-MIDI.

6. Make sure that the MIDI input selection in TiltFX is set to receive MIDI from GyrOSC-to-MIDI, and make sure that GryOSC-to-MIDI is outputting MIDI to TiltFX (click 'MIDI Output Device' and select the relevant output destination).

7. Set up the audio input and outputs of TiltFX. Double click either the adc~ icon in the Audio Input Controls, or the dac~ icon by the Master Output - this will open a popup window in which the audio input and output destinations can be selected.

8. For a live/concert performance, the affected signal should be outputted through speakers in the space to blend with the natural 'clean' sound of the violinist in the acoustic environment. The 'Clean Signal Through' function exists to synthesise this if using the software to create a recording, in which case the effected audio should be blended with the clean signal and outputted to either external recording hardware, or a DAW on the laptop.

9. Attach the phone to the violinist's bowing arm using a sports wrist strap. The following model works particularly well as the phone can be placed at different angles, enabling optimal placement for capturing the movement of the bowing arm:
   https://www.amazon.co.uk/gp/product/B073QP2NMP/ref=oh_aui_detailpage_o02_s00?ie=UTF8&psc=1

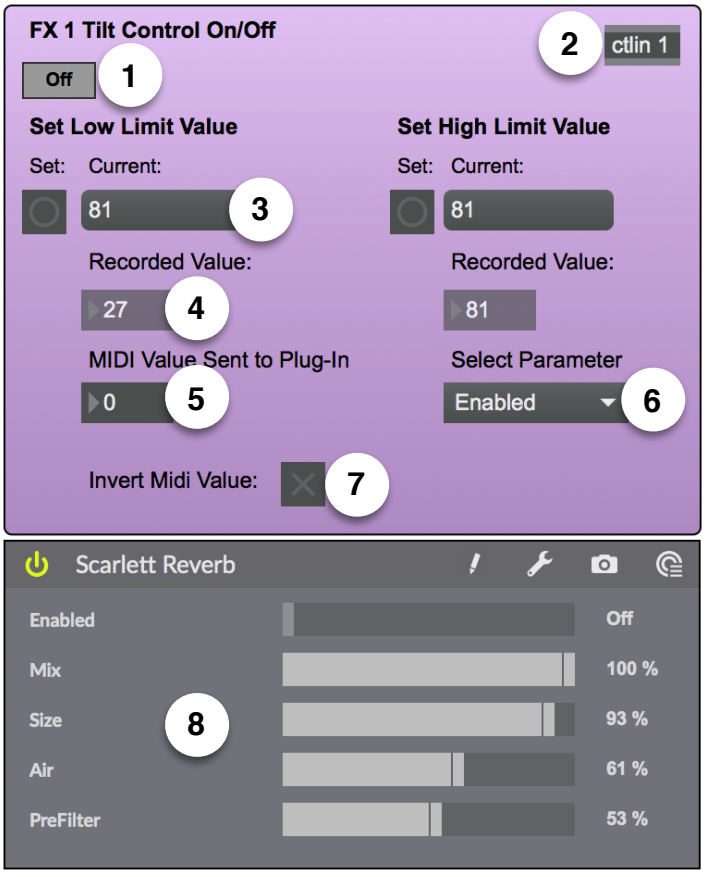
10. Set the CCs in GyrOSC-to-MIDI to correspond to the parameters of control in TiltFX. In GyrOSC-to-MIDI, each gyroscopic parameter (pitch, roll yaw) can be assigned a total of three CCs. One gyroscopic parameter can send out MIDI information on multiple CCs simultaneously, but do not select the same CC on multiple parameters. CC1 corresponds to FX1 Tilt Control, CC2 to FX2 Tilt Control, and CC3 to Blend Tilt Control.

11. Record the highest and lowest angles that the violinist is likely to play at. Get the violinist to hold a high and low position, and click the high and low button respectively in the Set Universal Limits section. Alternatively, the high and low limit for each CC can be set individually in FX1, FX2, and Blend Control sections. This ensures that the full range of MIDI (0-127) is mapped to the full range of movement used in the piece.

12. Select the parameter of FX that each CC controls through clicking the drop down menus in the FX sections. Adjust the various parameters of TiltFX to fit the specific performance circumstances. The software is now fully ready for use.

FX TILT CONTROL

The FX Tilt Control panels control the ways in which the information from the tilt sensor interacts with the electroacoustic effects. This panel allows the user to map the MIDI range to performer's range of movement, and assign specific parameters of the effects to be controlled by this movement.



1. On/Off Button: Clicking enables/disables the tilt control.
   If tilt control is disabled, audio will still run through the effect. To disable the sound of this effect entirely, drag the relevant FX Output Volume slider to the lowest point.

2. MIDI Ctrl In: Double click to specify CC input device. By default will be set to 'All Devices By Channel'.
   This shouldn't have to be changed unless altering the patch to receive midi input from devices other than GyrOSC-to-MIDI.

3. Limit Values: Displays the current midi value received, and records this value as a limit when clicked.
   This enables the tilt control to be mapped onto the full range of motion. For example, if the movements of the violinist only produce midi values between 27 and 81, then setting these as the lower and upper scales 27-81 to 0-127.

4. Recorded Limit Value: shows MIDI value recorded as the limit.

5. MIDI Value Sent to Plug-In: displays the MIDI value currently being sent to the VST effect.

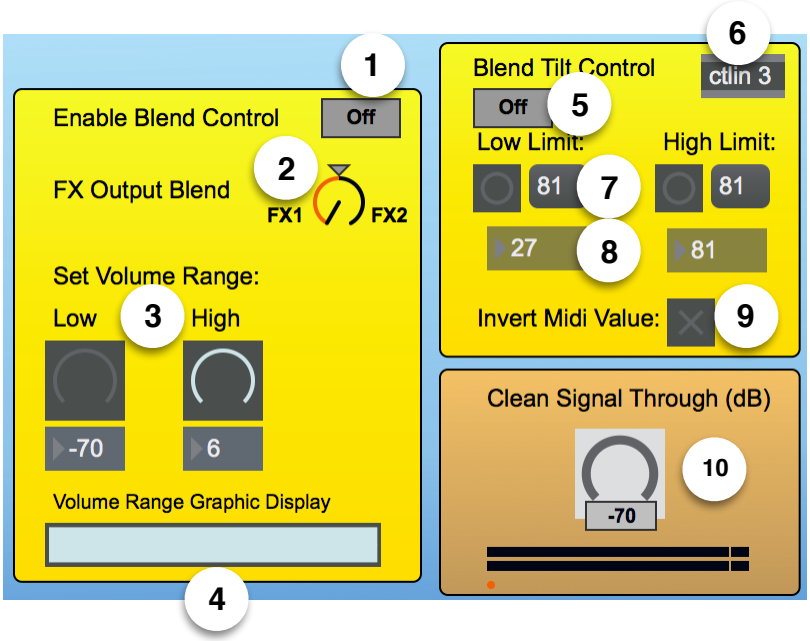
6. Parameter Selection: Click drop-down menu to select the parameter of the VST effect that is controlled by the tilt.

7. Invert MIDI Value: If enabled, this inverts the MIDI value so that low angles output high MIDI values, and high angles output low MIDI values.

8. VST Effect: The VST Plugin that processes the audio. The parameters of this can be adjusted manually as well as being controlled by tilt data. The two effects built into TiltFX are Focusrite's 'Scarlett Reverb' and the Apple AU Delay.
   Should other effects be needed in their place, the Max patch can be easily edited by replacing the plugin with another.

BLEND TILT CONTROL

Situated after the FX in the signal chain, the Blend Control enables control over the balance between the two FX outputs. This can either be manually assigned, or controlled via tilt.
Enabling tilt control is particularly useful when situating effects at opposite ends of the movement range: for example, the software can be set up so that the reverb sounds on the lower strings and delay on the upper strings, with the range of movement in between cross-fading between the two.



1. Enable Blend Control: Click to turn blend control on/off. When off, the blend control is bypassed so that none of the parameters of the blend control panels will have any effect on the audio levels.

2. FX Output Blend: Manual knob that controls the balance between FX1 and FX2 outputs.

3. Set Volume Range: Controls the decibel range that the two effects are blended over. By default these are set to -70dB and 6dB, where -70 is equivalent to -∞dB; this means that the blend will work to both extremes, with either end of the knob completely silencing one FX whilst playing the other at full volume. For a more subtle mix, these limits can be shortened. Since the numbers refer to dB, the scale is logarithmic; thus a low of -4 and high of 2 can still create a substantial and noticeable difference.

4. Volume Range Graphic Display: Gives a graphic indicator of the volume range, where the leftmost point represents the low value and the rightmost point represents the high value.

5. Blend Tilt On/Off Button: Turns the tilt control for the Blend on and off.

6. MIDI Ctrl in: Double click to specify CC input device.

7. Limit Values: Displays the current midi value received, and records this value as a limit when clicked.

8. Recorded Limit Value: shows MIDI value recorded as the limit.

9. Invert MIDI Value: If enabled, this inverts the MIDI value so that low angles output high MIDI values, and high angles output low MIDI values.

10. Clean Signal Through: Allows signal to pass through to the output unaffected by TiltFX.