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Abacus (or "handchimes") is a rigid body simulation and digital instrument created with Max/MSP. Collisions of rigid bodies are guided by a LeapMotion tracking device to create sound. Audio is then routed through Ableton and Alex Harker's convolution reverb.

In Jitter, up to 72 cubes are created, each with its own unique physics constraint. Each cube is placed on a barslide with a variable limit of motion. As a result, each cube can be moved along a single axis in space. The collision strength of each cube (either with another cube or the LeapMotion device) can be measured as impulse. The impulse of each collision is used to generate a corresponding envelope for each pitch. Harder collisions last longer.

FM synthesis was used to play back the pitches of each collision. Different scenes are created by varying FM index, the pitch space, as well as controlling the methods, grouping and density of collisions. The LeapMotion device gives expressive control over which collisions occur in a given scene. The result is an organic and varied music instrument. Below are the Mira parameters used to create the scenes. S0 and s1 are cues that control reverb, octave, global pitch, gravity and a few things such as limits which have their own dedicated slider in addition to being controlled by cues.

https://streamable.com/w64sd Video demonstration of parameters and scenes being changed (no sound, although a send demo is attached in email).
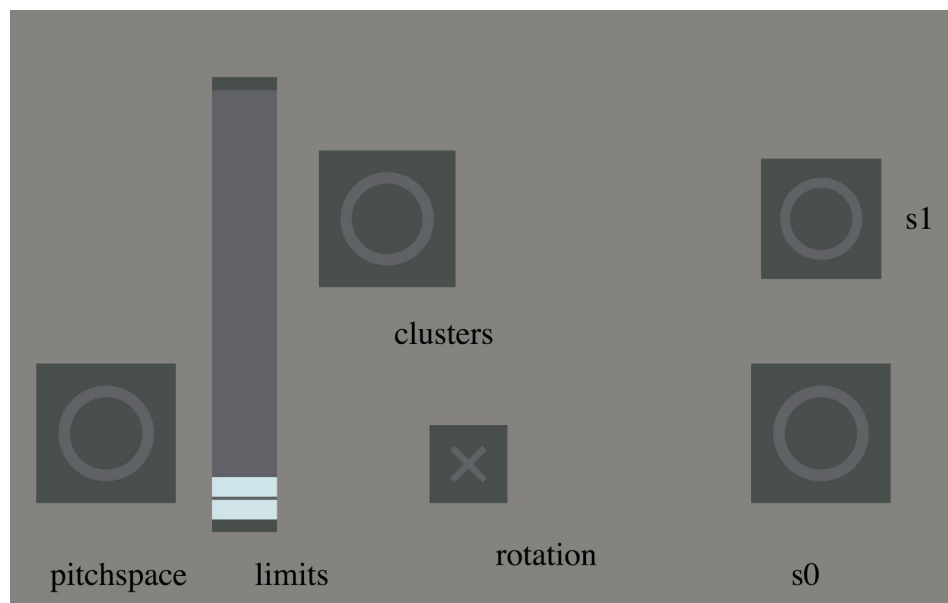
Tonal clusters

Physics debugging is turned on to highlight each cluster of blocks, representing discrete pitches and potential chords if they are struck. Two different clusters are shown below, however throughout the performance many clusters were created. This mode is only effective when the limits of the barslide are low, as each clusters will only interact with themselves. The LeapMotion device is used to expressively choose which clusters are struck. Different scenes are created by changing the set of clusters.
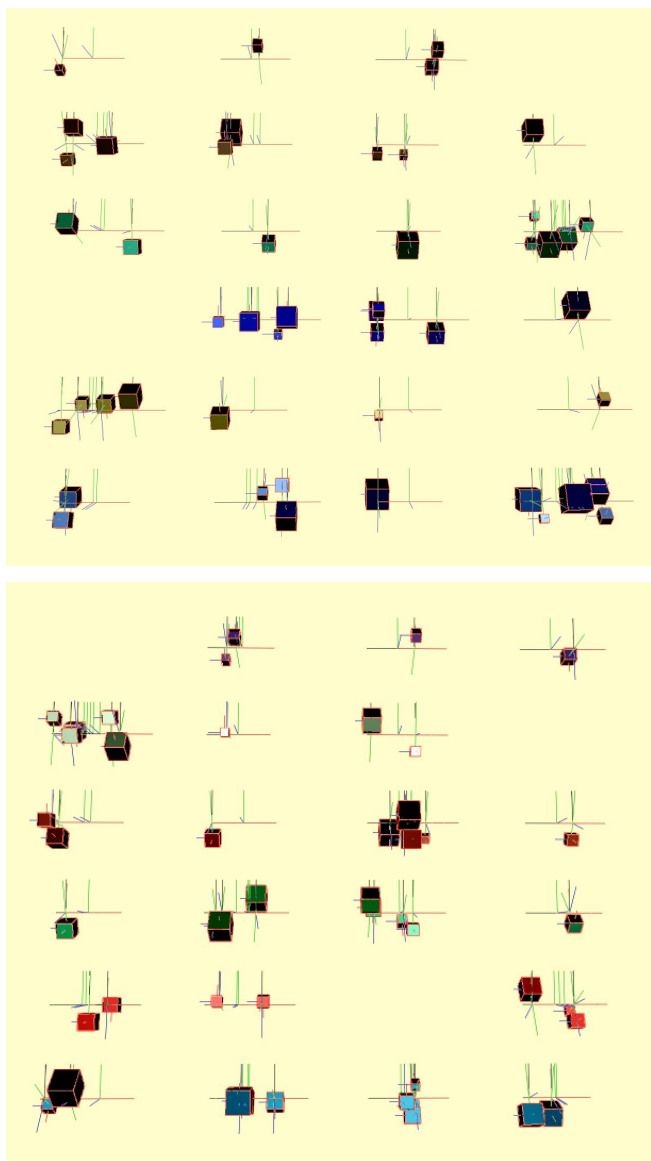
<u>Rotation</u>

In the following figures, the limits of the barslides are large enough so that the cubes are not limited along their respective axis.

Cubes only move horizontally and therefore only collide in their row. Thus, the chords created consist of tones close to each other.

After all the hinges are rotated by 90º, cubes move vertically and interact with other rows, producing a new set of chords.

Pitch space

Pitches are created according to the harmonic series. Each cube of each row of the barslide lattice gets a unique pitch. Each row has 12 pitches. The lowest row has pitches 0-11, the next 12-23 and so on. The harmonic series is stretched at several points throughout the performance to create variations in the tuning system. The pitch set is also varied by offsetting the set by an octave or offsetting the global pitch by a given number of semitones. A few example pitch sets are given below. Any change in pitch space is accompanied with a change in color for all cubes. Each row has its own EQ band.

(stretch factor 1.234, octave 0) =
[3.640109 15.640109 22.659658 27.640108 31.503246 34.65966 37.328369 39.64011
41.679211 43.503246 45.15329 46.65966 48.045387 49.328369 50.522797 51.64011
52.689663 53.679211 54.615238 55.503246 56.347919 57.15329 57.922852 58.65966
59.366383 60.045387 60.698761 61.328369 61.935883 62.522797 63.090466 63.64011
64.172836 64.689659 65.191505 65.679207 66.153549 66.615242 67.064934 67.50325
67.930733 68.347916 68.755287 69.15329 69.542343 69.922852 70.295174 70.65966
71.016624 71.366386 71.709213 72.045387 72.375153 72.698761 73.016426 73.328369
73.634789 73.935883 74.231827 74.522797 74.808952 75.090462 75.36747 75.640106
75.908524 76.172836 76.433182 76.689659 76.942406 77.191505 77.437073 77.679207
77.918007 78.153549 78.385933 78.615242 78.841545 79.064934 79.285477 79.50325]

(stretch factor 1.018, octave 0) = [0.308852 12.308851 19.328402 24.308851 28.171989
31.328402 33.997112 36.308853 38.34795 40.171989 41.822033 43.328403 44.71413
45.997112 47.19154 48.308853 49.358406 50.34795 51.283981 52.171989 53.016663
53.822033 54.591595 55.328403 56.035126 56.71413 57.3675 57.997112 58.604622 59.19154
59.759209 60.308853 60.841579 61.358406 61.860249 62.34795 62.822292 63.283981
63.733677 64.171989 64.6 65.016663 65.424026 65.822029 66.21109 66.591599 66.963921
67.3284 67.685371 68.035126 68.377953 68.714127 69.0439 69.3675 69.685165 69.997108
70.303535 70.604622 70.9 71.191536 71.477699 71.759209 72.036209 72.308853 72.577263
72.841583 73.101921 73.358406 73.611145 73.860245 74.10582 74.347954 74.586746
74.822296 75.05468 75.283981 75.510292 75.733681 75.954216 76.171989]

(stretch factor 0.748, octave 1) = [6.973323 18.973324 25.992872 30.973324 34.83646
37.99287 40.661583 42.973324 45.012424 46.83646 48.486504 49.99287 51.378601
52.661583 53.85601 54.973324 56.022877 57.012424 57.948456 58.83646 59.681133
60.486504 61.256069 61.99287 62.7 63.378601 64.031975 64.661583 65.269096 65.85601
66.423683 66.97332 67.50605 68.022881 68.524719 69.012428 69.486763 69.948456
70.398148 70.836464 71.263947 71.681129 72.088501 72.486504 72.875565 73.256065
73.628387 73.992874 74.35 74.6996 75.042427 75.378601 75.708366 76.031975 76.34964
76.661583 76.968002 77.269096 77.565041 77.85601 78.142174 78.423683 78.7 78.97332
79.241737 79.50605 79.766396 80.022881 80.27562 80.524719 80.770287 81.012428
81.251221 81.486763 81.719147 81.948456 82.174759 82.398148 82.61869 82.836464]