

Adventures in Casual Instruments and 3D Input

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Outline

- Casual Instruments
- 3D Sensors
- Space Palette
- Space Palette Pro

Casual versus Performance Instruments

- Casual Instruments

- Simple, discoverable with few or no instructions
- Immediate gratification, fun, and pleasing results
- Direct control is obvious to the player
- Each person sounds different and can be uniquely creative

- Performance Instruments

- Prioritize proficiency and control
- Proficiency requires instructions, practice, learning curve

Physical Interface Design Goals

- A single physical interface serving both casual and performance use
- Different physical interface semantics for each
- Different GUI interface
- Can be changed on the fly
- Can have more than 2 levels

Physical Interfaces - Dance Pads

- With Wireless QWERTY keyboard



- Woodstockhausen performance – Happy Feet
 - Done entirely on 4 dance pads
 - No hands, No light, and EL-wire-outlined pants

Dancing under the Stars of Lyra



Burning Man 2003

Fingerworks-based Controller

- Capacitive multitouch with finger area detection
- Extremely responsive, excellent driver support
- First exposure to 3D input



Monolith 2.0 at Burning Man 2009



Monolith 2.0 – details



- Implements two independent 5-track MIDI loopers

- Korg Nanokeys used as buttons
- M-Audio Trigger Fingers used for drum pads



UniLooper



- LinnStrument for input
- 4-track MIDI looper
- Loops trigger visual shapes
- Implemented with KeyKit
- Looping Festival in 2015
- Burning Man in 2016

3D Input in Physical Interfaces

- Fingerworks pads showed the expressive potential
- Physical interface providing a third dimension can be:
 - Slider or scroll wheel
 - Pressure (Wacom, Continuum, Eigenharp, Linnstrument, etc)
 - Area (Fingerworks, Magic Trackpad, iPad)
 - Vibration, Orientation, Acceleration (smartphones, joysticks)
 - Spatial (Kinect, Leap Motion, Senz3D)
- 3D input provides natural and expressive input
 - Music: third dimension is useful for vibrato and filters
 - Graphics: very natural for position and size control

3D Input Sensors I've explored

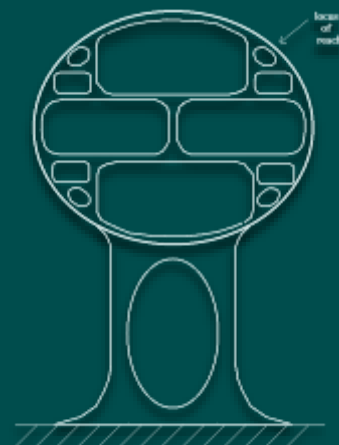
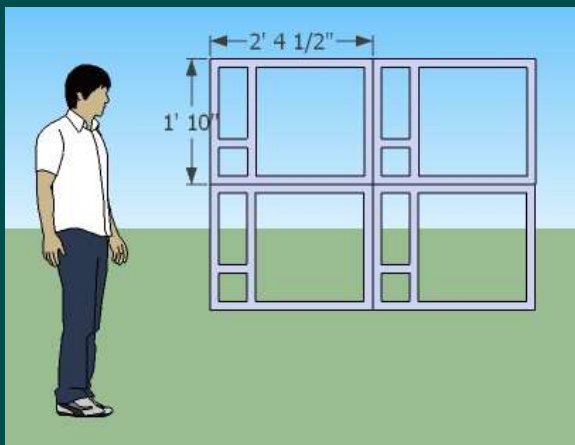
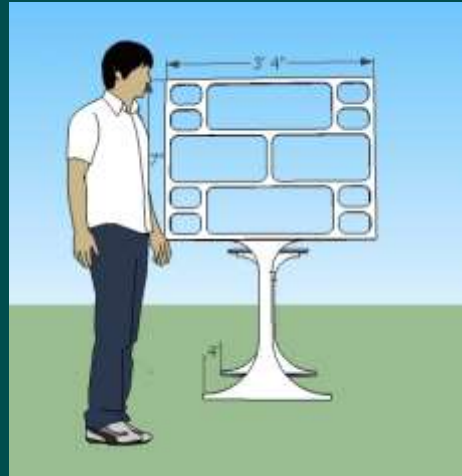
- Fingerworks iGesture pad
 - Finger area is the third dimension
- Microsoft Kinect
 - Breakthrough consumer product, structured light
- Leap Motion
 - Mind-blowing resolution [Movie](#)
- Creative / Intel / Senz3D / RealSense
 - Shorter range than Kinect, Time-Of-Flight
- Microsoft Kinect 2
 - Higher-resolution, Time-Of-Flight
- Sensel Morph
 - Multitouch and Pressure-sensitive

Space Palette - a 3D Instrument Interface

- Holes in a frame become 3D multitouch surfaces
- Any number of hands or objects, simultaneously
- Flexible layout allows many control possibilities
- Immediate access to different sounds/graphics
- Provides frame of reference for player and audience
- Larger visual footprint is more interesting to audience
- Immediately playable, no initial dexterity required
- Larger and less-restricted motion by player is relaxing and expressive

[Movie](#)

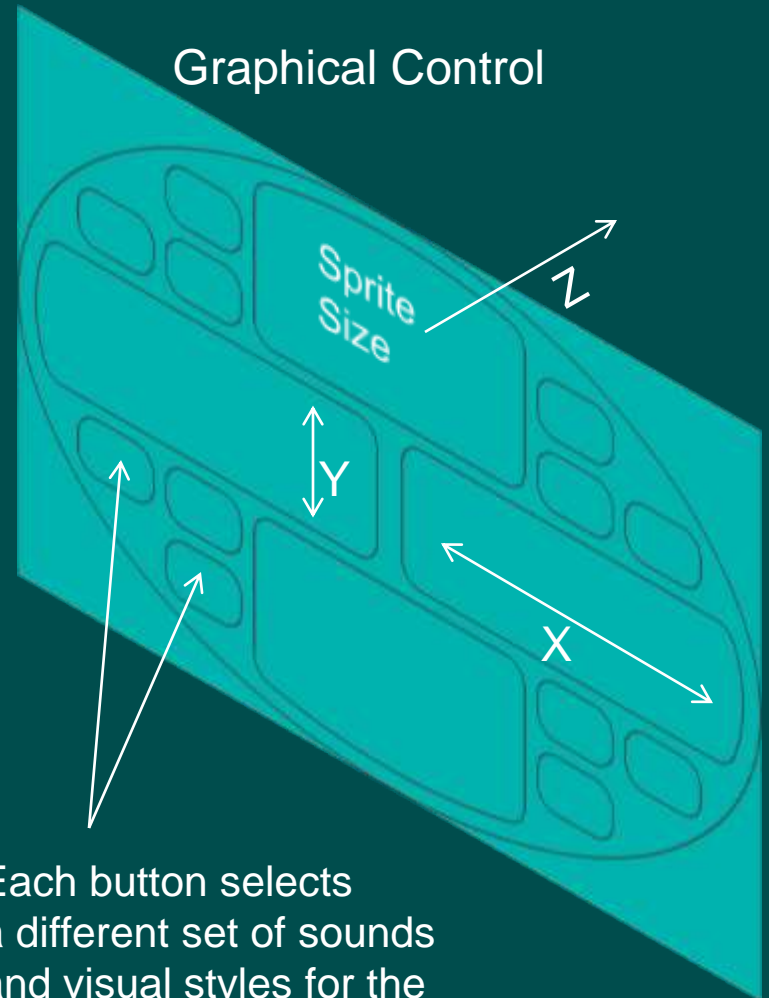
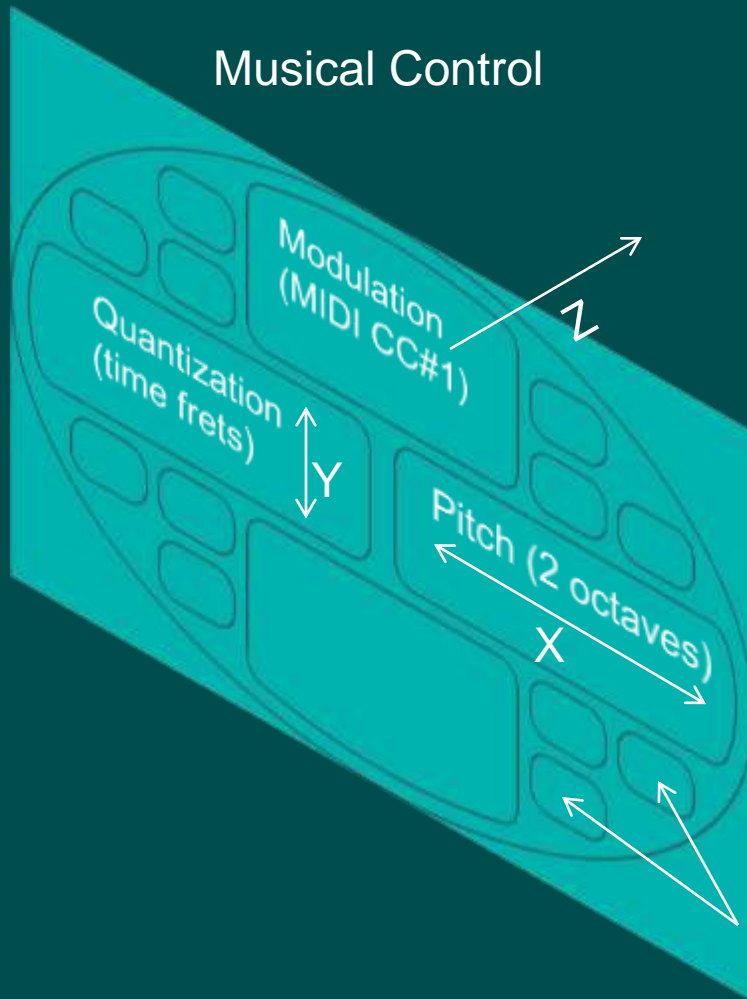
Space Palette - Prototypes and Evolution



Space Palette - Festival Appearances



Space Palette Interface



Each button selects a different set of sounds and visual styles for the four big holes

Where does the Space Palette fit?

- As a Casual Instrument
 - No learning curve: walk up, play, sound good
 - Natural interaction, effortless, engaging
 - Players recognize that they're the ones controlling it
- As a Performance Instrument
 - Physical presence, larger movement, and correlation of actions to output engages the audience
 - Frame of reference allows more and better control

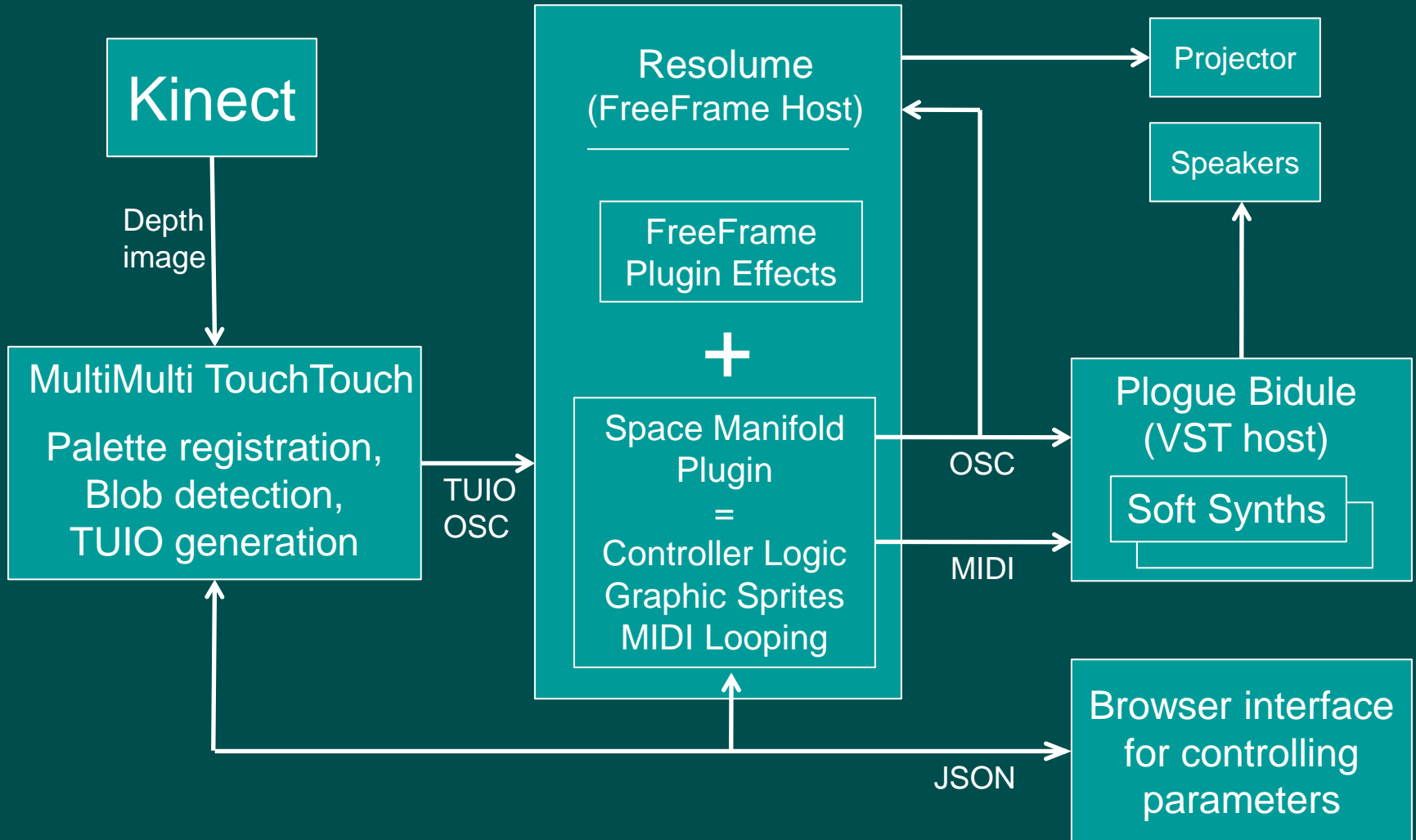
Spatial 3D Input – The Pros

- Large movement is enjoyable, engaging, expressive
- Finger dexterity not necessary
- Unified and simultaneous control of all 3 dimensions
- Simultaneous control of multiple continuous values
- Hands-free (e.g. operating room, vehicles)
- Not just hands
 - Full body
 - Object scanning
 - Objects as fiducials

Spatial 3D Input – The Challenges

- Discrete Control
 - Where is the trigger point?
 - Latency, feedback, confirmation
- Gestural Control
 - When to pay attention?
- Tactile feedback
- Controlling one dimension (or finger) independently
 - Latching values
- Reproducibility
- Historical bias and unfamiliarity

Space Palette Design - 2012

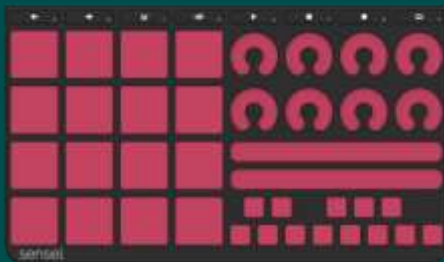


MultiMultiTouchTouch (MMTT)

- C++ program interfacing with the Kinect
- Uses depth image only
- Blob detection using OpenCV
- Trainable interactively on new frames, holes of any shape
- Trainable without a frame, using a specially-colored image
- Browser interface to control it, using JSON over HTTP
- Output is TUIO (a standard multitouch format) over OSC (a standard UDP protocol)
- Windows-only, source code is available

Sensel Morph - a dream come true for 3D input

- 20,000 force-sensing resistors, detects 5g to 5kg
- Raw data is easily obtained
- Overlays for different control layouts



- Magnets in overlays allow detection and swapping
- No overlay == blank canvas

Space Palette Pro

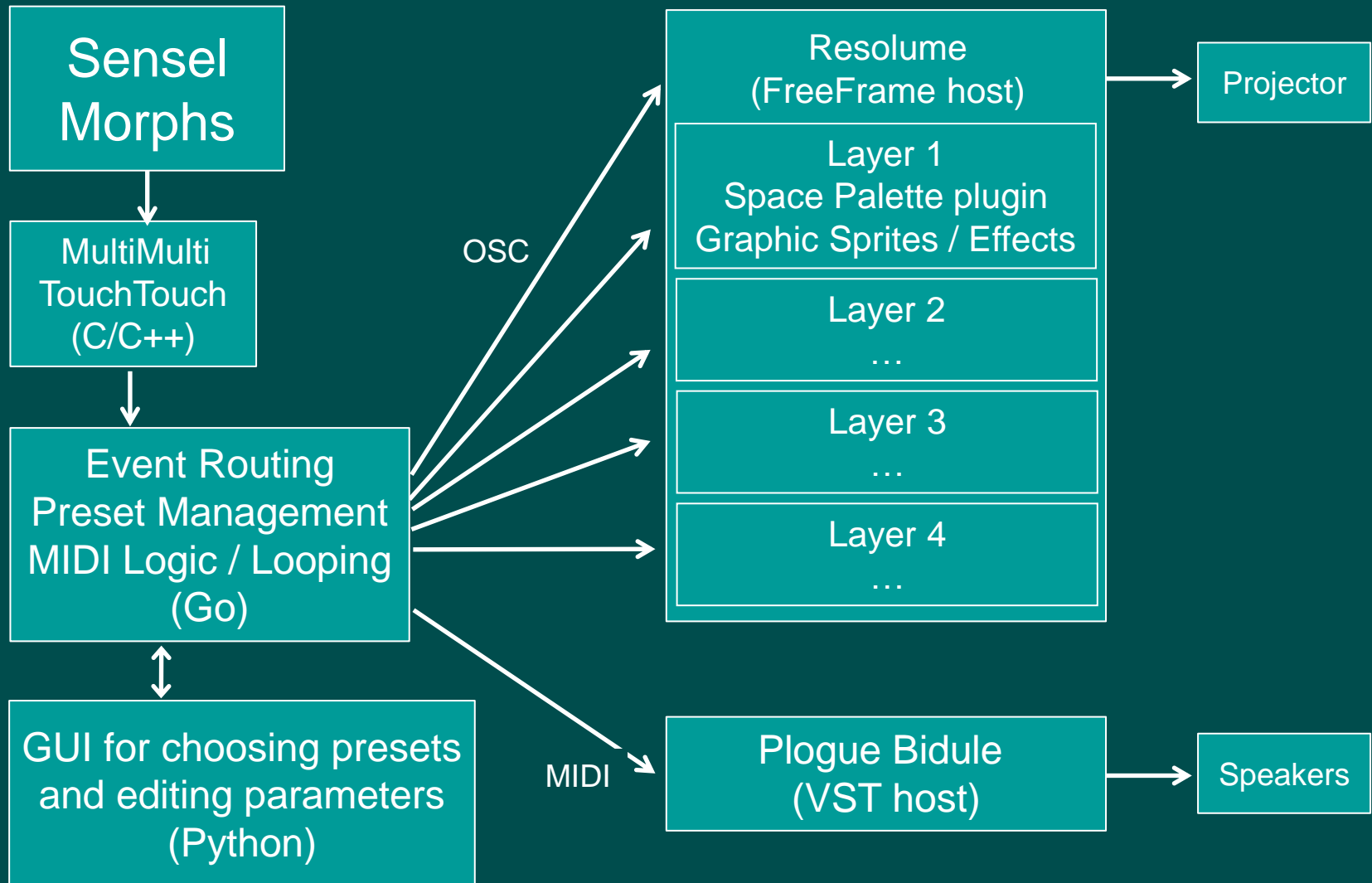
- Differences from Space Palette:
 - Sensel Morphs and a touchscreen
 - Pressure rather than depth
 - Five 3D cursors per hand
 - Separate visual layers, greater variety



Space Palette Pro - Overview

- Each of the 4 Morphs has independent control of:
 - Gesture looping; gestures generate both MIDI and graphics
 - Visual effects applied to graphics within Resolume
 - Sounds (Omnisphere 2)
- Python-based GUI for preset selection and editing
- Go-based router
 - Handles all input - TUIO, MIDI, APIs
 - Generates MIDI output
 - Realtime looping of gestures
 - APIs for parameter and preset control (used by GUI)

Space Palette Pro - Design



Space Palette Pro - GUI

Casual

Presets

All Drums	Basic Chaos	Bellsy Bells	Bold Strokes
Complex Kaleid	Deep Triangles	Dream Puddles	Drifting Borders
Dusty Pools	Edgy Kaleid	Endless Colors	Explosive Shapes
Full Bodied	Ghost Puddles	Line Dance	Organic Growth
Perky Trails	Plucky Stuff	Shape Shards	Simple Organism
Smooth Breathing	Smooth Dust	Spiro Graphical	Too Square

Actions

Looping OFF	Length 8 Beats	Fast Fade	Clear Loops
Default Scale			Reset All

Performing

Space Palette Pro

Monitor MidiScale Midipassthru Midisplit

Preset: < 000_Guitars > Save Send

Effects: < Smooth_Dust >

Chan: 1 Port: < >

ANO Slower Faster Reset

Transpose: Next Prev Reset

Clear All Fade All Loop All Loop Non


AreaA

S: Smooth_Dust_1 Edit

V: Smooth_Dust_1 Edit

L: Record Play Fade Clr

Leng: 4b Fade: Fast Rpts: Inf




AreaD

S: Smooth_Dust_4 Edit

V: Smooth_Dust_4 Edit

L: Record Play Fade Clr

Leng: 4b Fade: Fast Rpts: Inf




AreaB

S: Smooth_Dust_2 Edit

V: Smooth_Dust_2 Edit

L: Record Play Fade Clr

Leng: 4b Fade: Fast Rpts: Inf




AreaC

S: Smooth_Dust_3 Edit

V: Smooth_Dust_3 Edit

L: Record Play Fade Clr

Leng: 4b Fade: Fast Rpts: Inf



Space Palette Pro – Performing GUI (take 3)

Preset

African Borders	African Modern	Amoebic Drips	Amoebic Growth
Another Kaleidoscope	AquaBell Elevations	Basic Shapes	Bending SpaceTime
Blobby Borders	Blobby Pop	Blurry Kaleidoscope	BubblesOf Bliss
Burn Barrels	Candied Blobs	Circular SpiderWebs	Cloud Flowers
Cloudy Circles	Dirty Virus	Drum Fragments	Fireful Foursome
Floating GuitarSquares	FourSided Flowers	Fractured Squares	Glowing Lava
Guitar Flowers	Horizontal Percussion	Kaleidic Space	Lava Blobs
Mirrored Mania	Pastel Lozenges	Percussive Purple	Ruptured Terrain
Scatalogical Chaos	SeaOf SodaStraws	Simply Circles	Smooth Fractures
Softest Circles	Synth Blobs	Synth Symphony	Traffic Jam
Trembling	Universe	Voracious	WhiteBorders

Perform

Looping is OFF
 Loop Length 8 beats
 Loop Fade Fast
 Loop Clear
 Transpose 0

Fret Quantize
 Pressure Vol
 Newage Scale
 Tempo Normal

Preset Snapshot Sound **Visual** Effect Sliders

Save

alphafinal	0.000	<<	<	.	.	>	>>
alphainitial	1.000	<<	<	.	.	>	>>
alphatime	2.289	<<	<	.	.	>	>>
aspect	1.000	<<	<	.	.	>	>>
bounce	false	<<	<	.	.	>	>>
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filled	true	<<	<	.	.	>	>>
huefillfinal	0.000	<<	<	.	.	>	>>
huefillinitial	288.000	<<	<	.	.	>	>>
huefilltime	5.000	<<	<	.	.	>	>>
huefinal	252.000	<<	<	.	.	>	>>
hueinitial	252.000	<<	<	.	.	>	>>
huetime	2.003	<<	<	.	.	>	>>
lifetime	6.000	<<	<	.	.	>	>>
luminance	0.500	<<	<	.	.	>	>>

Perform Main Sliders1 Sliders2 Sliders3

Looping is OFF
 Loop Length 8 beats
 Loop Fade Fast
 Loop Clear
 Transpose 0

Fret Quantize
 Pressure Vol
 Newage Scale
 Tempo Normal

Space Palette Pro - Burning Man 2019

- Photon Salon



- PlayAlchemist Grand Pyramid



[Movie](#)

Future

- Open sourcing of CNC data, parts list, software
- Two-handed control
- Phrases rather than notes
- Scanning sequences
- Samchillian style
- Etc etc



Links

Slides:

<https://timthompson.com/talks>

Source code:

<https://github.com/nosuchtim>

<https://github.com/vizicist>



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