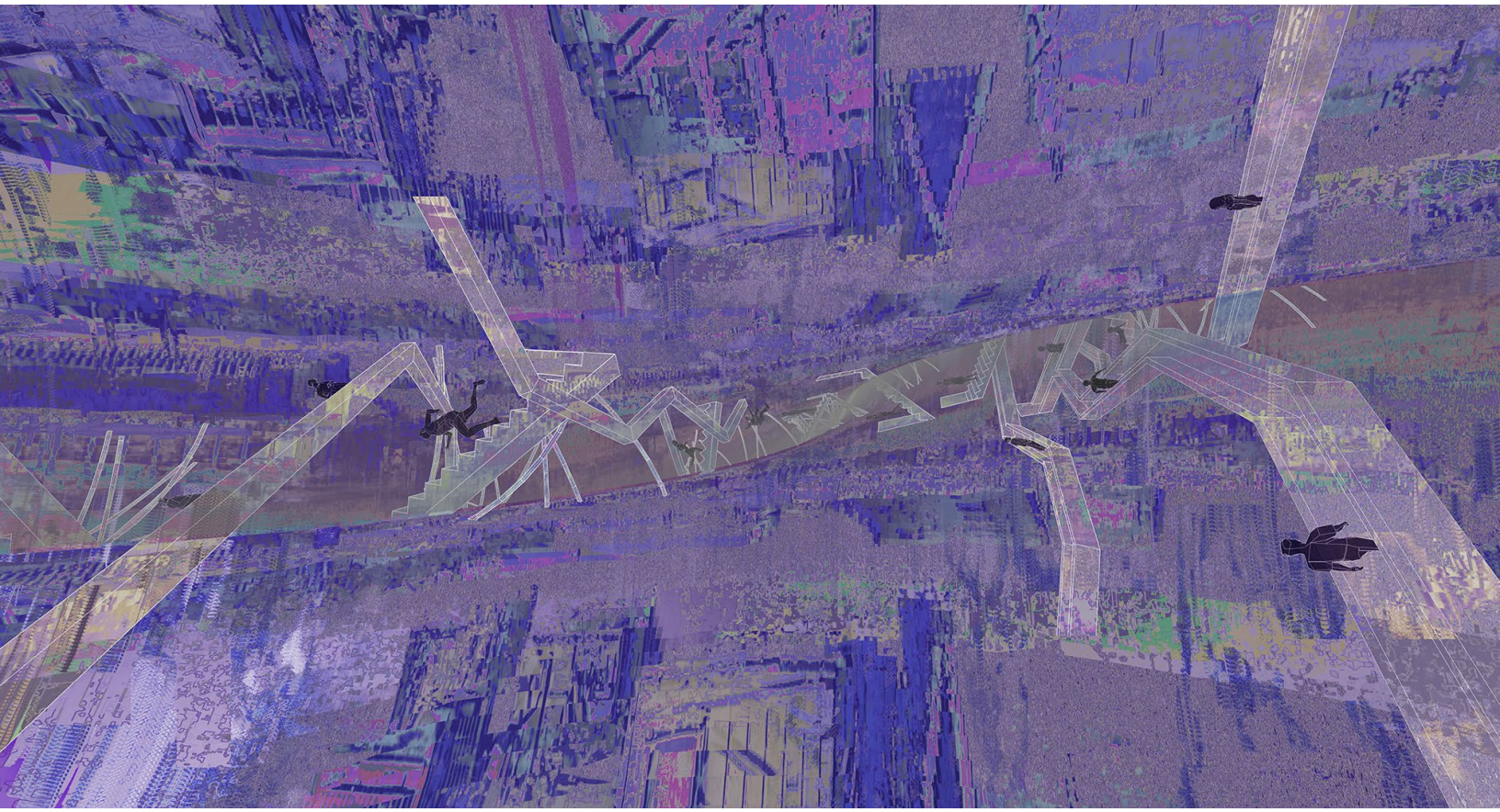
ARCHITECTURE OF SOUND



Advanced Sonic Space in Dynamic Architecture

Yufan Xie

BRIEFIN

Related Link: http://uvnlab.com/gap-en/

Project Description:

Unreal Engine provides means to create a remote modular music collab system in 3d gaming space where the spatial mixer and multi-player environment can integrate music and sound with architectural definition of volume, grid, field and sequence, in which user can customize procedural dynamic sonic spaces in an architectural way.

As a current graduate student at the University of Southern California with Gensler Diversity Scholarship, I work with people from various backgrounds for innovation in design industry. "Multi-dimensional Thinking" is my guiding discipline, I take inspiration from different fields to generate new ideas.

With years of research experience on computational design and interactive interfaces, I discuss experiential space and digital architecture with various medias. Experiences on music and installation largely inspired me on architecture design, which turned out to be my graduate project "GAP+". It is an award-winning design which experimented on dynamic sonic space, and critically reconsidered our senses fractured by dominant ocularcentric culture.

As an extension, this new project will develop a remote modular sound collaboration system in 3d gaming space. It will provide a platform for musicians and designers to build and play music in architectural/urban logic. On the one hand, project will largely enhance the collaboration of music performances. On the other hand, the project will provide sound simulation and ambience rendering for architecture.

First in music aspect, despite most existing DAW (Digital Audio Workstation) are based on linear and abstract interface. Meanwhile modular programs (vvvv, MAX/MSP etc.) and remote collaborations(zoom, rtp MIDI) have already provided us great example on modular sound design and distributed performance. A space-driven sound design system will be a bold attempt in music industry. Second, in the COVID-19 pandemic, a huge number of remote music show and online house parties have also shown us the prospect of remote collaboration - the market is calling for a new form of music which hasn't emerged yet. As a response to above, this project will be a combination of visual/3D interface and spatial sound mixing as a shared platform.

In architecture aspect, similar to BIM (Building Information Model) system, this project will integrate sound elements and sound mixing attribute layers with architectural elements and coordinate system (e.g. multi-layer information of elements in Revit). Architectural methods – volume, zone, grid, field, surface - will be directly linked with music performances, the 3D space will become a medium in rendering soundscape. Technically, unreal engine has already provided a full set of basic elements for sound processing but there's no specific design utilizing these strong features. Under support of sound design environment in unreal engine, the gaming space will inherently provide a spatial mixer and multi-player environment. Thus, architectural space will be a key variable of sound mixing and user variables (location, behavior) will be the core of modulation. With designed sound parameters, the project can simulate acoustic environment in architecture design process(e.g. noise/reverb analysis/landscape simulation/ sound navigation). With amplified sound parameters, the space can provide aural experience beyond simulation of reality(e.g. pitching environment/behavior-based filter/).

In such an environment, every user can naturally be the player through shared sense of "architecture of sound" in real-time. By designing interactive architectural space, sonic space can be designed and presented in the same method. The project content will include:

1. Music Hierarchy(remote MIDI sync, timelock, Scene Group)
2. Music Elements (Sequencer, Sampler, Integrated Synthesizers, FFT parameter portal)
3. Architectural Hierarchy: (Grid/Voxel, Zone, Field)
4. Architectural Elements: (Model Loader, Reflective Surface, Material, Visualizer)
5. Environment(Interface/sensor source,Integrated fx volume, Integrated Shader Volume, Characters)

In conclusion, by decoding architecture with sonic space, and decoding music with architectural space, the project will bridge architecture and music in practical aspect based on predecessor's studies. It will be explored as a real-time and user-driven platform in unreal engine.

Project Plan

The project will be considered as a long-term development.

1. Development in 2020 USC Master Thesis (ARCH 793 Directed Research including academic research)
2. Usability study in USC Interactive Media department(CTIN 591 Advanced Development)
3. Promotion for production/live set performance (Several labels will be contacted. Artist/genre/show TBD)
4. Presentation on 2021 USC Architecture "ART + TECH + ENVIRONMENT" Research Symposium
5. Submission for 2021 Ars Electronica
6. Business involvement in future career in architecture firm.

Application Prospect

1. Sonic space simulation in architecture
2. Visual-based sound programming
3. Distributed collaboration of music production/performance
4. Space navigation system for blind community

Yufan Xie 2020.07.10

PLAY THE SPACE

HEAR THE SPACE

HIERARCHY

	ARCHITECTURE	TYPE	FEATURE	MUSIC
Environment Factors	Field/Map	Field	Pixel/Parameter	Modulation
	Grid/Zone	Zone	Vector/Domain	Tempo/Scene
	Object	Element	Element/Attributes	Sound Element
User Experience	User	User	Game Character	Performer/Audience
	Designer	Designer	AXO/Controll	Designer/Mastering

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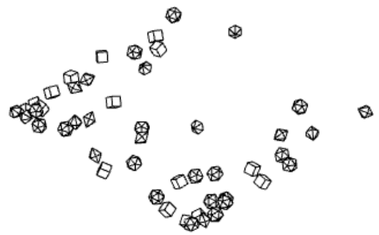
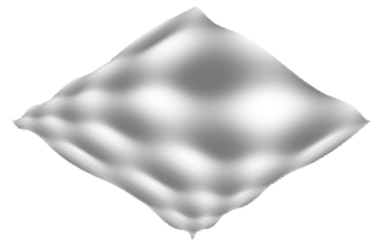
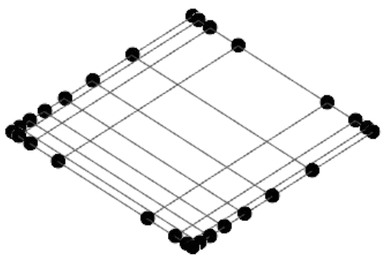
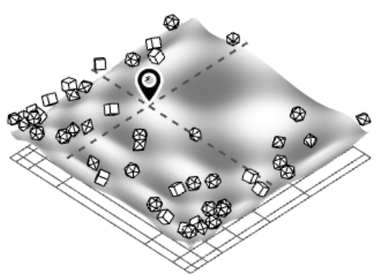
MECHANISM





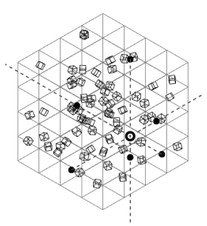




	1D Music Definition	2D Space Definition	3D Space Definition
ELEMENT	Clip/Midi	Shape	Object
FIELD	Modulation	Wavetable	ISO Surface
ZONE	Bar	Grid	Volume
SPACE			

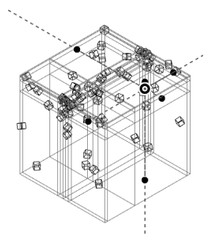
DESIGNER

CONTROL

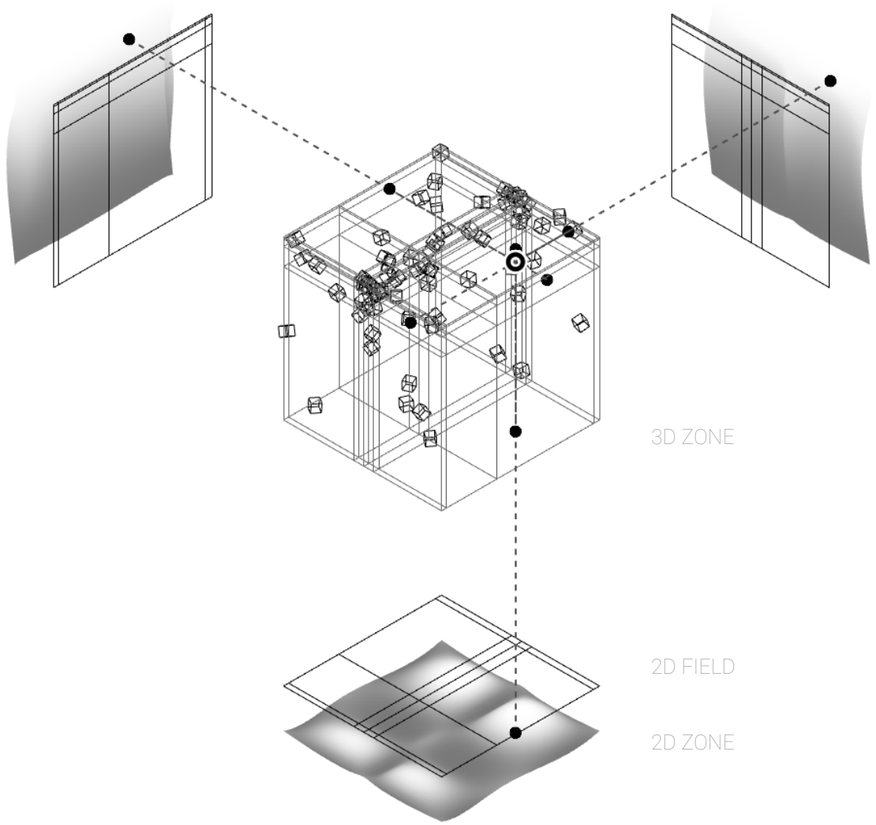


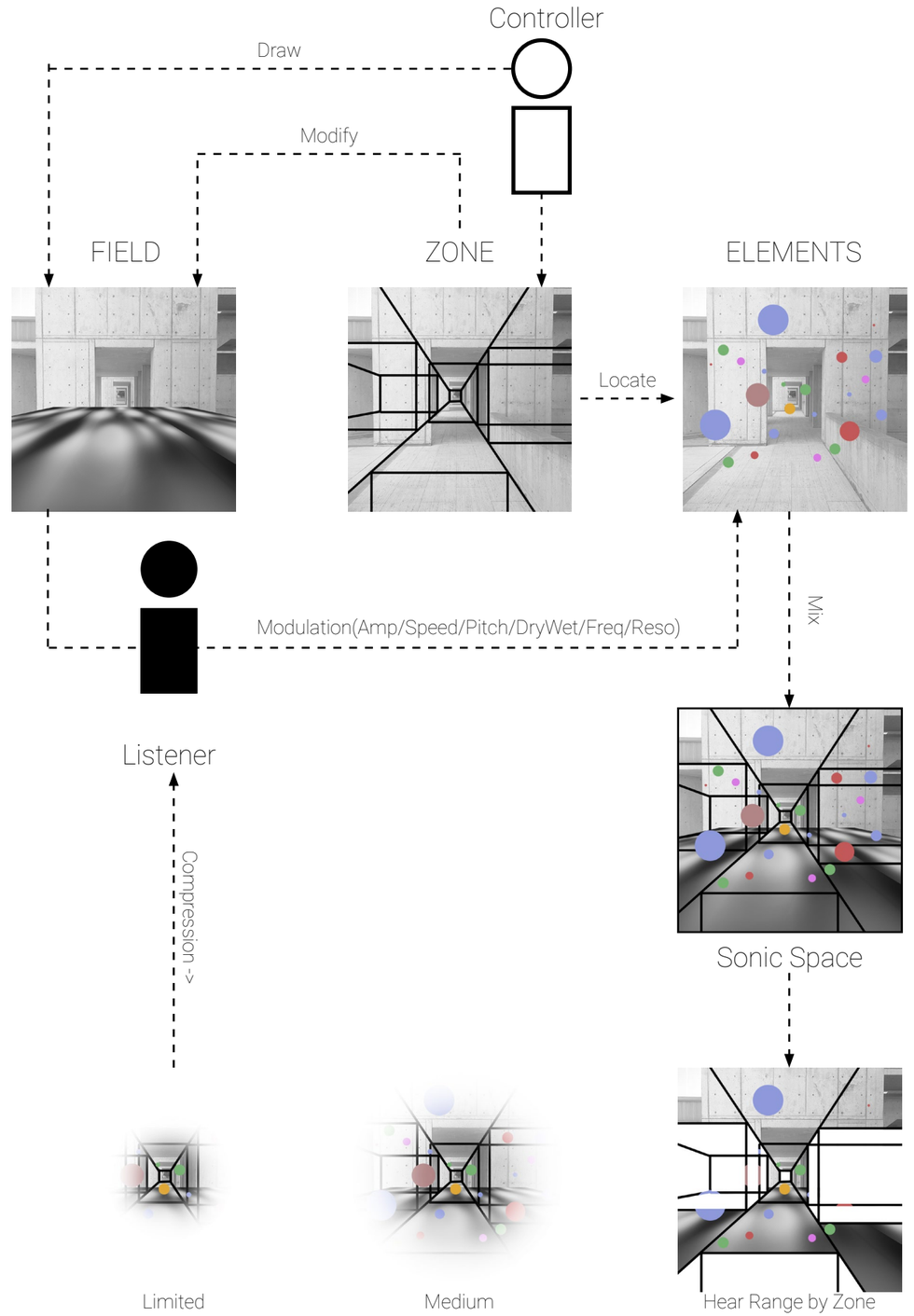
USER

PERFORM

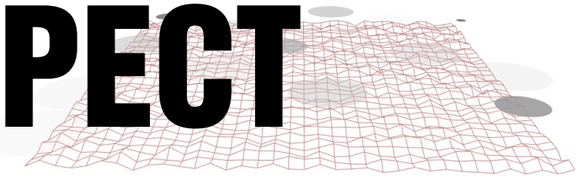


3D SONIC SYSTEM DIAGRAM





PROSPECT



Sonic space simulation in architecture

With proper settin and placement, the sonic space of a designed architecture can be rendered in real-time.

Visual-based sound programming

With upgraded music structure, a music can be expressed in a 3d/architetcural way with modular system.

Distributed collaboration of music production/performance

Parallel Music Set

The music scene experienced by audiences will depend on where they are, as Field/Zone will provide different ambience and tempo. Audiences will experience different scene at the same time in the same live set.

Remote Music Production/Set

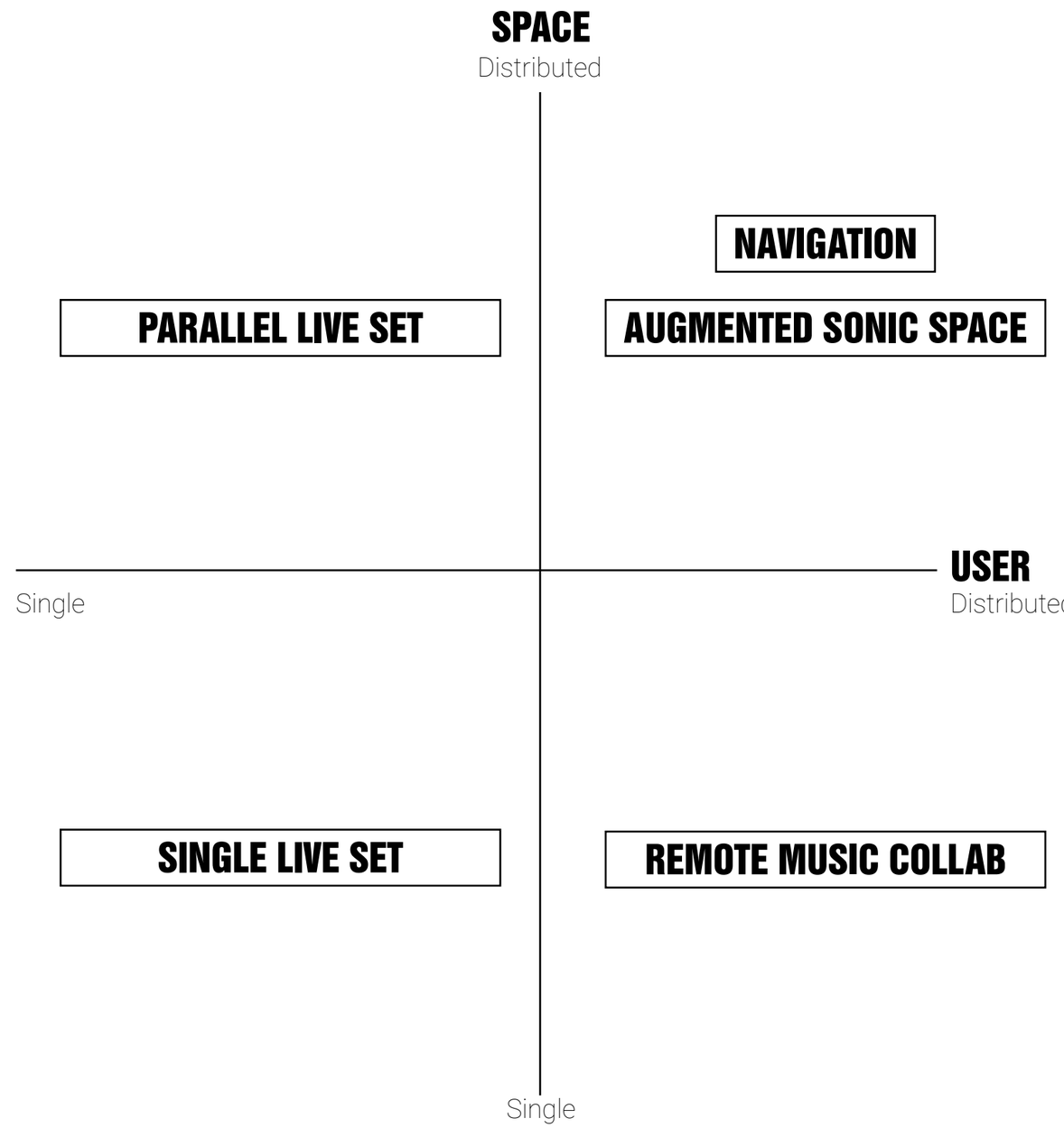
Producers will have access to edit a music/sound structure at the same time.

Sonic space navigation system

Overlapping sonic space with physical world, the modulation will remind user the actual location and direction.

Augmented Sonic Space

The sonic space is not merely for simulation/ imitation, the proposed framework will produce new space form.



Space-driven Live Set

By single controlling characters, as performer walk through music scene preset, a live set can be presented in gameplay. While traditional interactive set cannot provide highly controlled and precise location mapping of bahavior/volume/speed/ modulation, with the tool a space driven liveset can be developed with locating devices(vr/ar/phone)

Parallel Live Set

By adding listeners to multiple personal terminals(AR/). The physical space is assigned with different music scenes.

The music scene is no longer controlled by performer. It will be triggered by audiences. Gathered people will share the same scene, which may become a new

Augmented Sonic Space/Navigation

For blind communities, aural space is a essential part of daily life. As their walking behavior can trigger various sonic space, their life experience can be largely enhanced.
While behavior is related to sound modulation, space navigation can be developed.

Remote Music Collab

As the constructions of music scenes happen in the same gaming space, the collaboration will be fun and easy as playing blocks. The remote collaboration will no longer be abstract or indirect.

METHOD

ELEMENT FAMILY

INTERFACE	Constructor	Add MIDI device Add coordinate device(AR/VR/Phone) Add output device
VISUAL	Constructor	Import model Basic Texture Display point/curve Display Text
	Shading (user based)	Brightness/contrast Curve Gradient Mapping Depth Blur/focal lens
SOUND	Sound	Sampler Synthesizer
	MIDI	Sequencer
	FX (user based)	Reverb/Delay Overdrive/Saturator Compressor

FIELD FAMILY

1D/2D/3D Wavetable for modulation, applicable for speed/volume/pitch/midi parameters

AUTO	Constructor	Sine/Saw/Square/Noise Generator 2D field from 1D 3D field from 2D Fill with value()
	Method	Layer overlap Smooth Set tone Smooth Mosaic Downsample Threshold
MANUAL	Constructor	Field from image
	Method	Draw with brush Erase

ZONE FAMILY

1D/2D/3D domain, output control over fields or nodes controlled by field

AUTO	Constructor	Cube Zone (x*y*z)
	Method	Subdivide Sequence Auto Binary Subdivision Auto Quad Tree Auto Oc Tree Modify node coordinate (with parameter field)
MANUAL	Constructor	2D zone from free curves Rectangle/Cube zone
	Method	Split on edge(Binary) Split on volume center(Oc Tree)

USER FAMILY

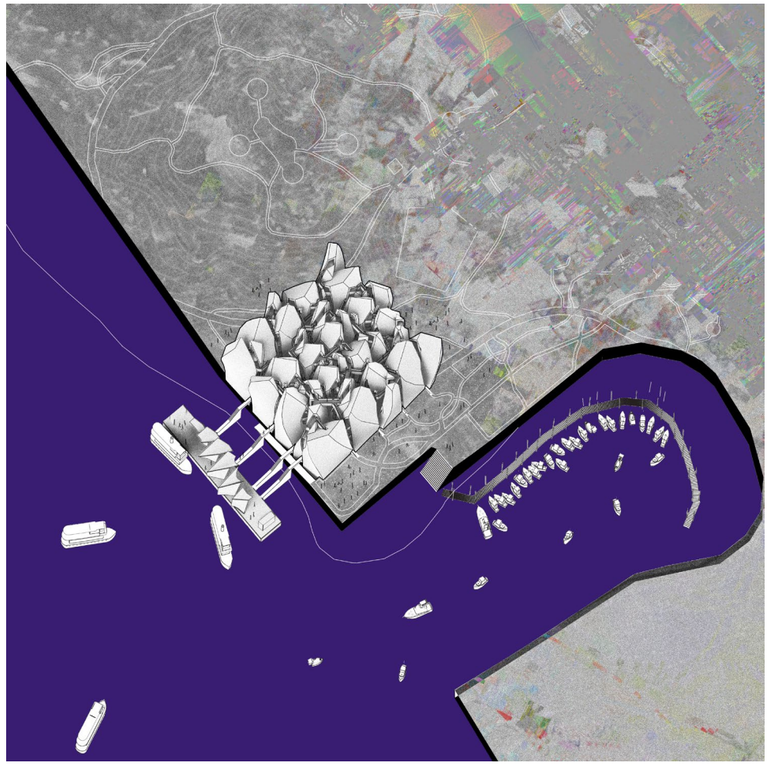
Volume/modulation listener, sample parameter from field.

MASTER	Controller	AXO Controller (Default)
	Listener	World center listener(Default)
USER	Controller	First Person Controller(walk/fly)
	Listener	Output sound/modulation sampled at current location(with far clipping/ fading sphere) Parameter output: distance/boolean
	Method	Anchor listener to controller(Default) Hold/Switch current location Record Trail Lerp from A to B

CONTEXT

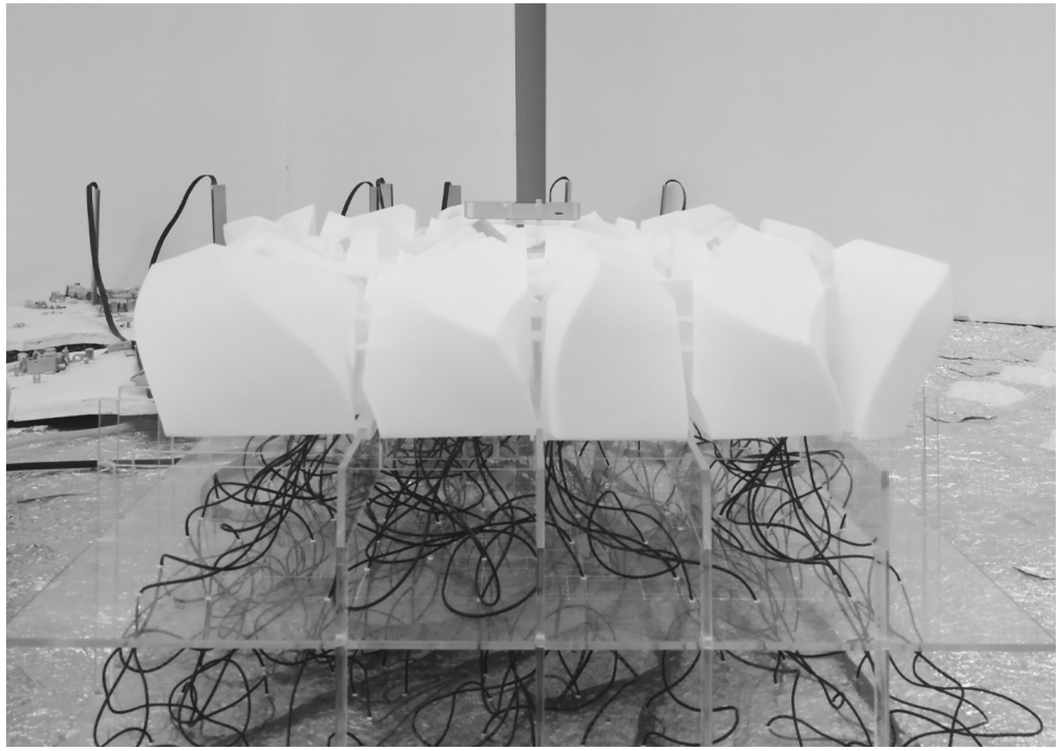
GAP+: Architecture of Sound

http://uvnlab.com/gap-en/



2019 CAFA SoA A9 Studio Graduate Design, 1st Award
2020 Gensler Diversity Scholarship

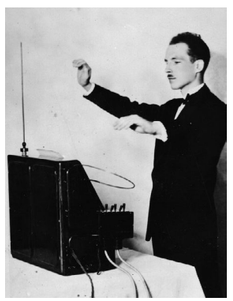
"GAP+" explores the mixing mechanism of sonic space. By translating "on-going" aural space, it re-defined how digital architecture and media intervenes our daily life in various ways. A new perspective of aural space and digital museum is proposed in a real-time and remote manner, in response to urban renovation in digital era. The project well developed architecture into a non-linear form.



GAP-, the second part of design, turned out to be an installation of sound. In traditional live set, visual space has always been an additional part(e.g. vj/dj mode). Instead, the installation of GAP- used visual space as an initial trigger of soundscape.

GAP- developed live set performing method into a "visual" way – according to space location of a 3d sound system, music scenes are modulated, mixed and switched to present a music set, in which spatial behavior becomes a key factor(The form is similar to Theremin) The soundscape becomes a shared personal experience for audiences at exhibition - the initiative is returning back to every player.

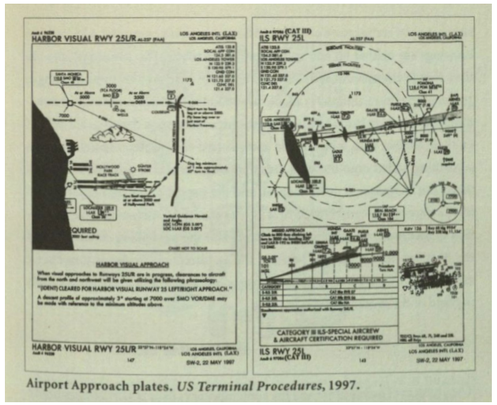
Right: Theremin
Bottom: GAP-



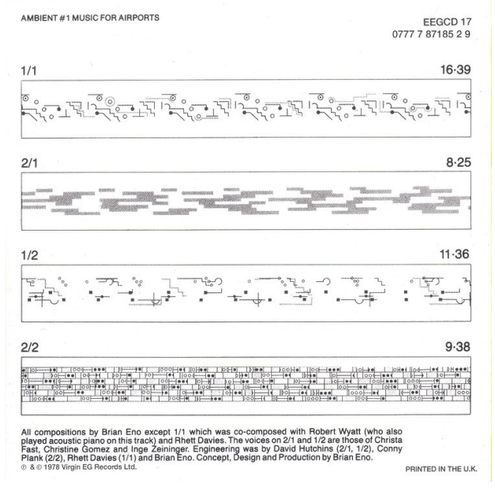
Architecture and Music

Researches on architectural form and music have always been a topic. Architect Stan Allen stated his idea on notation of music and architectural space that they are inherently driven by the same logic: rhythm, frequency, grid, element and etc... On the other side, classic composer like Bach has experimented architectural hierarchy in music, electronic musicians also discussed sequence in space and music.(e.g. EP "Music for Airports" by Brian Eno from Warp Records).

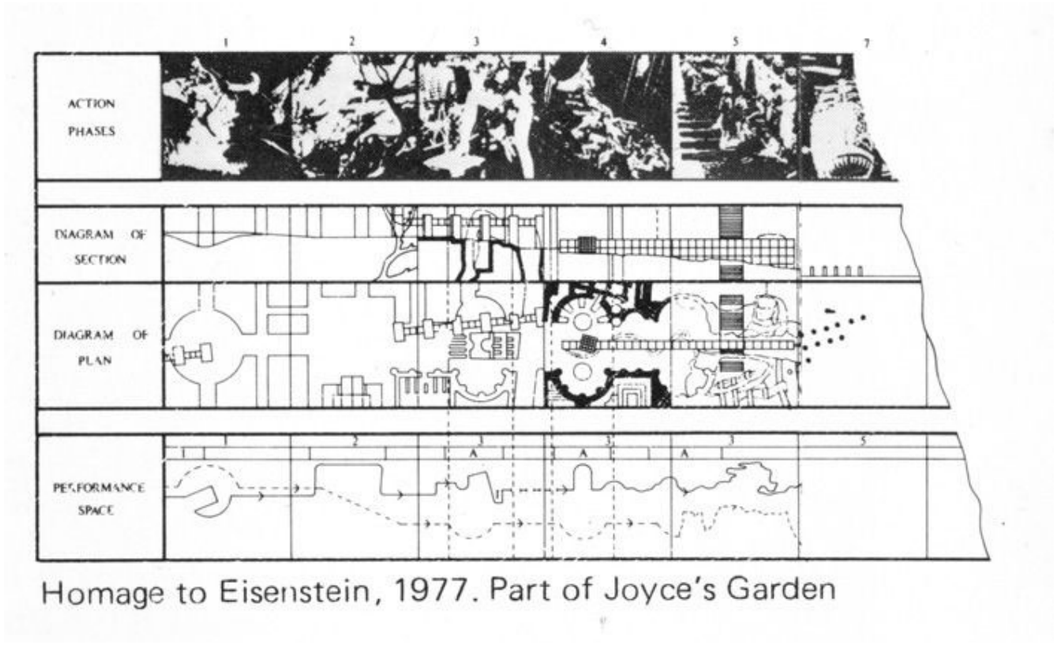
These researches have been examined twice in modern music scenes, especially in electronic music performance and interactive installations. Emerging hardwares – synthesizers, mastering interfaces and various midi controllers has largely developed music performance and production from linear into non-linear in the past few decades. There were both shifts from linear to non-linear in architecture and music field.



Airport Approach plates. *US Terminal Procedures*, 1997.



Top: "Mapping the Unmappable" by Stan Allen
Bottom:"Music for Airports" by Brian Eno



Bernard Tschumi 1977 Research on Joyce Garden

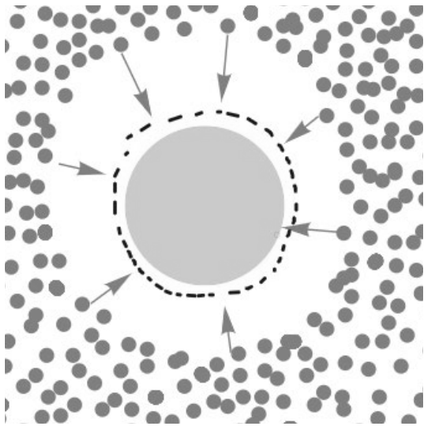
As an instance, Bernard Tschumi argued in his research "The Manhattan Transcript Series" -how we experience through architectural/urban space is exactly the sequence we travel through movie/music, by which scenes and space are shaped and rendered. Though in physical world, though architecture form and method has never been dynamic as music, meanwhile music is neither solid as material world - with developed media and interface, they are both stepping into a non-linear stage. Our experiences can be largely extended and linked in virtual world.

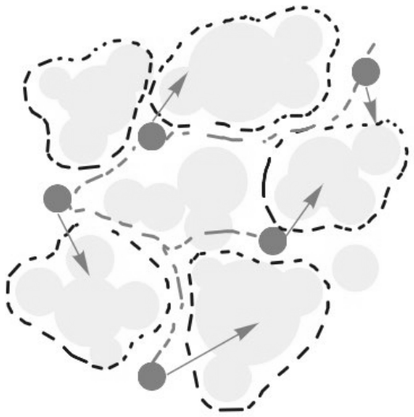
A Shift to Non-linearity and Instant Message

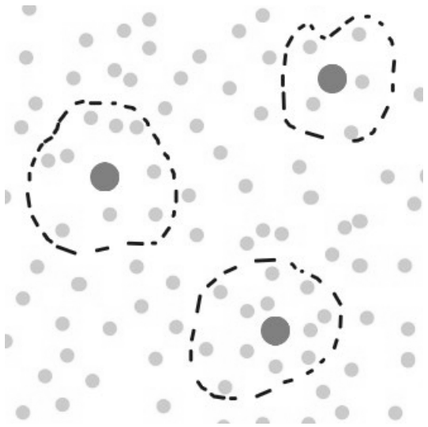
The typographic age developed a linear culture, corresponding to which, the media-dominated age produced non-linearity. Trend of non-linearity has emerged in many fields - jazz/electronic music, high DOF games, media installation, and, parametric architecture.

Meanwhile, personal experience becomes a common part of parallel world created by mass media. New interfaces largely intervened in daily life of individuals, but causing isolation of our communities(e.g. isolated socialplatforms/limited daily feed). A transition is needed - a transition from ocularcentric culture to all-sense culture, from parallel internet to shared internet, from isolation to inclusion.

What is the next step for music scenes?
The Live Set is half-way to dynamic structure, in which scenes are breakdown, but still not open to listeners.
In the next stage,
User defines the scene, the scene defines users.
Listener is the player, you will be the storyline.







	Object	Scene Sets	Real-time Interaction
Visual	Theater	Immersive Set	Livestreaming
Game		PC Gaming	VR/AR Gaming
Design	Render	VR/AR presentation	AR fabrication/design
Sound	Concert	Live Set	?

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EDUCATION

2014 - 2019 Bachelor of Architecture
China Central Academy of Fine Arts(CAFA), SoA

2018.2 - 2018.4 Exchange Program
University of Westminster, SoA

2019.9 - 2021.5 Master of Architecture
University of Southern California, School of Architecture

CAREER

2017.9 - 2019.7 Research Member of Parametric Group Team CAFA
Algorithm researches and digital fabrication

2017.8 - 2017.11 Internship at Tuning-Synesthesia Studio, Beijing
3D printing research and pre-design survey

2020 MADA s.p.a.m LA Internship

EXHIBITION/AWARD

2019 1st Award of Graduate Design
China Central Academy of Fine Arts(CAFA), SoA

2019.12 Shenzhen Bi-City Binnale of Architecture and Urbanism (UABB)
"The Unknown City" in "Ascending City" section

2020 Gensler Diversity Scholarship

Thanks for reading!
Cheers!!