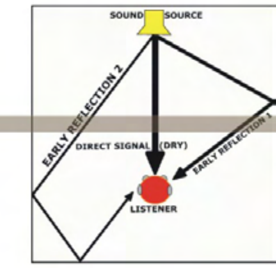
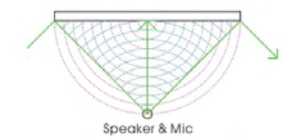
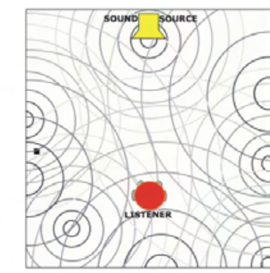
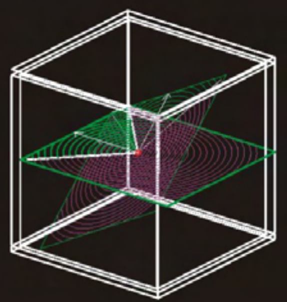
V = 331 + 0.6 x T
340 x 0.125 = 42.5 m
42.5 / 2 = 21.25 m

Reflection





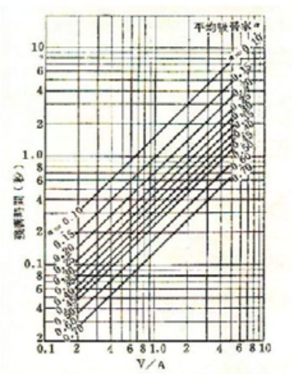




de-Fusion**

a score metamorphosis of original, and initial reflected sounds.

Here I want to discuss is the relationship between TIME LAGS of ECHOES and CORRESPONDING CHANGES in the ORIGINAL SCORE, and develop a magnify view on relative time and absolute time.
The SCALE, DEPTH and CHARACTERISTIC of the interface do have a great influence on ENHANCEMENT and DIMINUTION of reflected sounds.
According to physic theory, audio wave form (SPHERE WAVE) could be viewed as light wave form (LINEAR WAVE) in particular circumstances.



Physical situation [source : mp3]

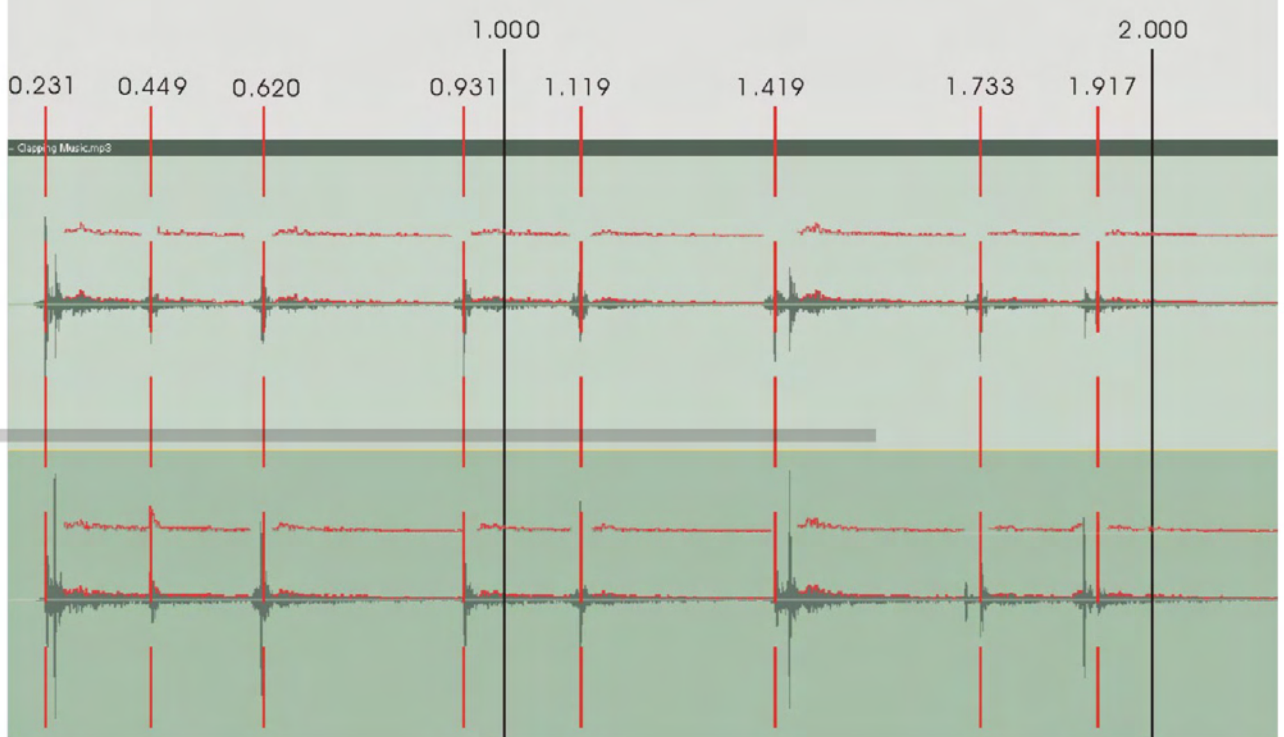
The gaps between quavers are not certainly the same.
The tempo is just a **relative tempo**, not **absolute tempo** exactly.

On the other hand, the echoes' position **could not be measured precisely**.
The diagram only shows a magnitude interference.
Because of the close time gaps,
the echo will be ended **till another clapping sound appears**.

The echo in hearing presents **an effect of room scale**.
The larger the **room** is, the longer the **reverberant time [RT60]** would be.

The Rt60 range of a typical 1000 cubic feet [28.31 cubic meters] room is **0.75 to 0.3 secs**. [0 or full capacity]

Equation of Rt60 is $T = (0.049 * V) / (a*S)$
V = volume, S = wall area, a = wall absorbing factor



Time gaps

It's **a trio of two original clapping and one reflected harmonic sound**.
The **chance for harmonics to appear is the gaps among quavers**.
Original sounds have more energy than reflected sounds to be heard.
And reflected clappings also will insert into gaps.
All gaps are 1/8 quavers. They are gaps remaining **0.125 secs**..

Relatively, the **time space between each quaver** offers opportunities to echoes and reverberate sounds.
While once clapping, the **remnant energy of sounds** keep performing in the whole space.
A **declining form of wave** shows possibilities of **potential sound activities beneath** original superficial structure.
The complexity of spatial echoes doesn't clarify the innocense of simple interaction between sound and space.
Therefore, I put hypothesis on **an environment with only one sound reflective wall**.

Echo Position [density]

The **initial two or three** reflected sounds are so-called **echoes**.
Mostly, they have enough intensity to be reflected and heard.
When emerging from time line, echoes act like foreigners to the native two clapping sounds.
They are **arising beats [sounds] under original structure**.
They also **represent a spatial parallel changing roles in the whole march**.
The timing that echoes are put into is determined by **the distance of walls in the stage** .

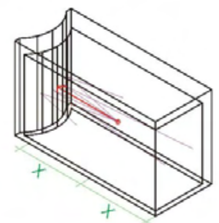
I choose to **hypothesize** an environment which
CONTAINS ONLY ONE SPHERE INTERFACE THAT CAN TOTALIY REFLECT SOUNDS from two sound sources.
OTHER WALLS ARE ALL ENTIRELY ABSORBING MATERIALS.

Here I try to discuss **the relationship between time lags and position of sounds in score.**

Equation of sound speed is $V = 331 + 0.6T$ [1 atm]

I make an exaggeration on the scale and materials of a stage
X is the distance between sound source [mic] and walls.
$V_{25c} = 331 + 0.6 \times 25 = 346$ m/s

If X = 10 m, 10 /346 = 0.028902 secs.
X = 100 m, 100/346 = 0.28902 secs.
X = 346 m, 346/346 = 1.00 secs
X = 500 m, 500/346 = 1.4451 secs.
X = 1000 m, 1000/ 346 = 2.8902 secs.



then, the 1st echo would be 0.057804 secs.
0.57804 secs.
2.00 secs
2.8902 secs.
5.7804 secs.

the 2nd 0.115608secs.
1.15068secs.
4.00 secs.
5.7804 secs.
11.5608 secs.

the 3rd 0.17341secs.
1.7341secs.
6.00 secs.
8.6705 secs.
17.3410 secs.

Reverb Saturation [concentration]

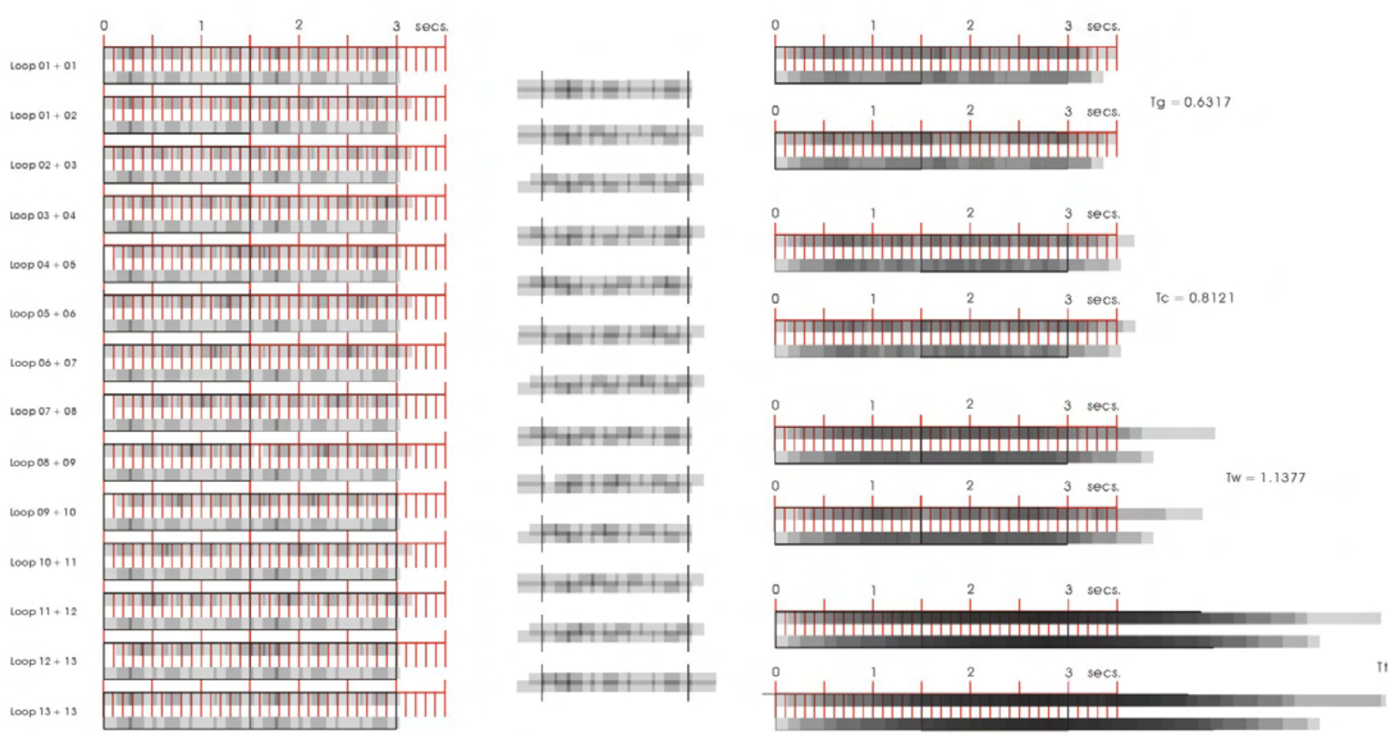
Echo holds a time duration that lasts for a few seconds.
This phenomenon " reverb " is related to the spatial scale in sound domain.

The accurate time gaps between quavers should be
0.125 to 0.250 secs.
If we fit the Rt60 scale into the frame,
the corresponding volume size should be ?

In a room of cement,
the factor of cement = 0.015
T = (0.049 X V) / (0.015 X S) = 3.2667 X V / S
if 3.2667 X V / S = 0.125, V / S = 0.0383
3.2667 X V / S = 0.250, V / S = 0.0765
and if **the width and height of room are both 9.8424 ft [3.0 meters].**
V / S = (L X W X H) / (LW + WH + LH) = L X 9.8424 / (2L + 9.8424)
, so L1 = 0.0388, L2 = 0.0778 (ft),
and if the room walls are **covered with double carpets [a = 0.39],**
the result would be : L1 = 1.2474, L2 = 2.4948 (ft).
concluded, the hypothesis is out of reality !

In another case, if we have a room of **17.3L X 17.3W X 10H**
= 3000 cubic feet [84.93 cubic meters] and
all wall materials are **cement**, T = 7.5852 secs.
The same room size with all double-carpeted walls,
T = 0.2917 secs.
If we substitute with different materials,
like wood, thick glass, glass window and carpet,
we could get a series of data :
Tw = 1.1377, Ttg = 2.8444, Tg = 0.6317, Tc = 0.8121 .

Here I take RT of double carpets for example :

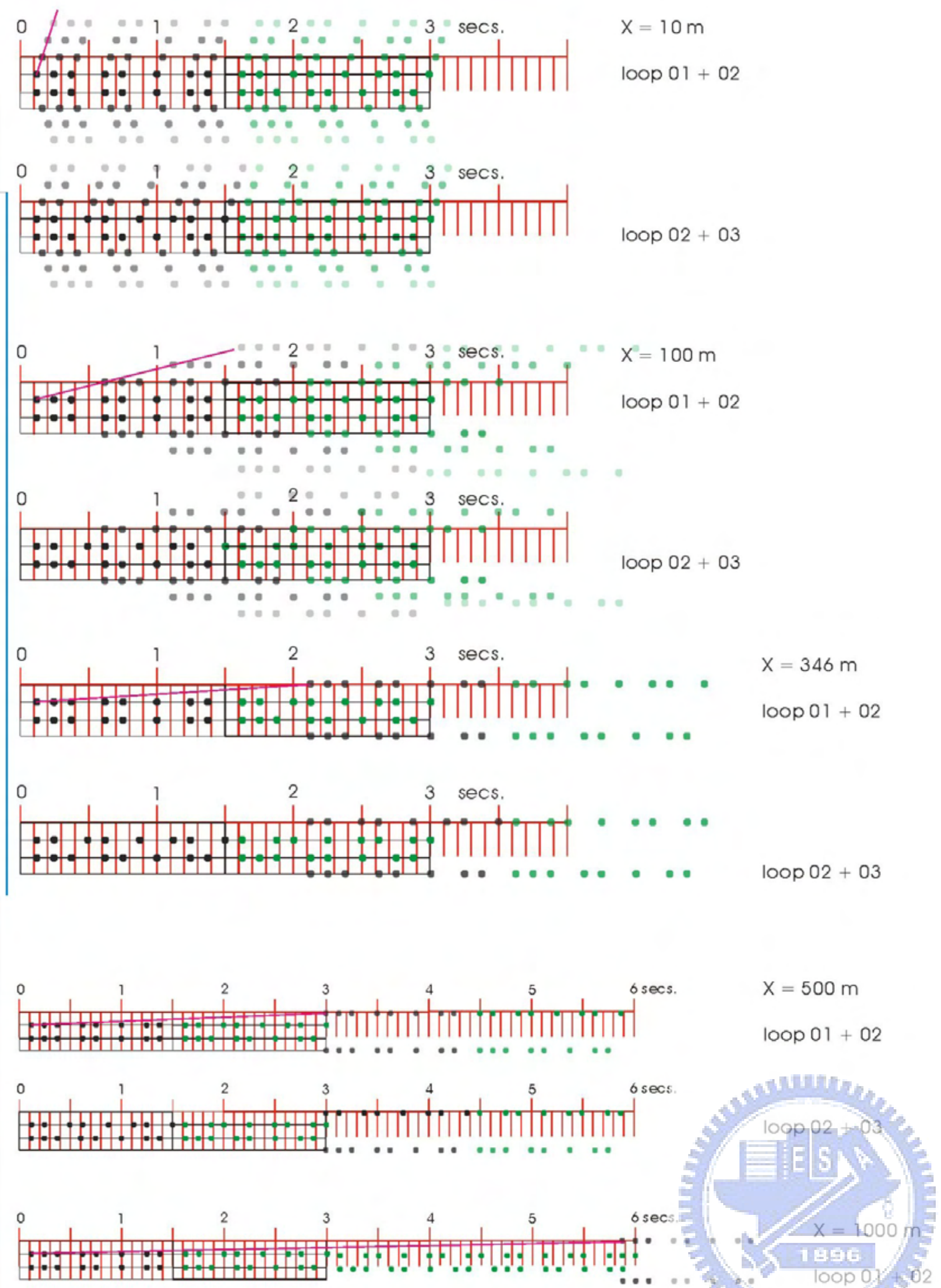


Demonstration

Because of the time lags, the echoes of clapping return to interact with itself.
As we knew,
walls will **absorb some section of sound frequency.**
Echoes are changed when reflected.
As long as we know how to confirm which frequency are deleted,
a sound symphony has been built.

And
the position where echoes are located
displays a multi-dimensionof sound space.
The vertical density informs
a crucial **proportion guided by stage situation.**
It's possible to find **some time spots which contain of 8 sounds.**

From these,
we get **a clear echo score** that tells us
the method **sounds control and are controlled by echoes.**



Differentiation

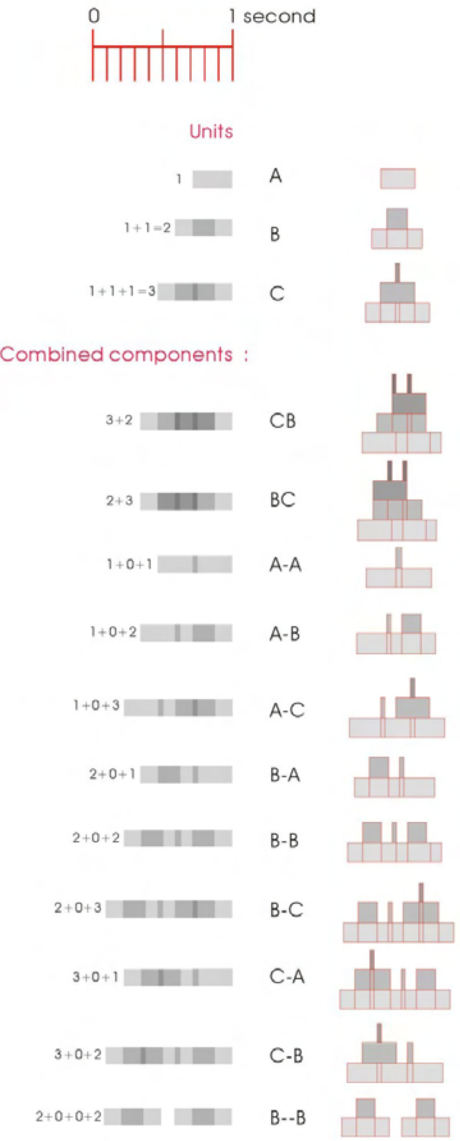
Translation

Clapping A

30201020 , 202010201 , 102010202 , 020102023 , 20102030 , 101020301 , 010203022 , 102030200 , 020302010 , 20302010 , 103020101 , 03020102 , 30201020
C-B-A-B-B-B-A-B-AA-B-A-B-B-B-A-B-CB-A-B-C-A-A-B-C-A-A-B-C-BA-B-C-B--B-C-B-A-B-C-B-A-A-C-B-A-BC-B-A-B-

Clapping B

30201020 30201020 30201020 30201020 30201020 30201020 30201020 30201020 30201020 30201020 30201020 30201020 30201020
C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-C-B-A-B-

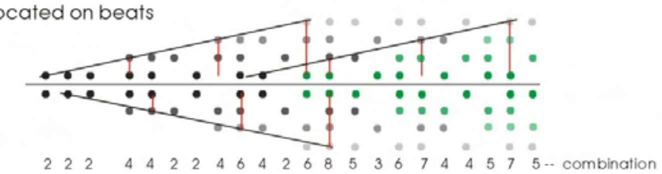


Echo Position Analysis

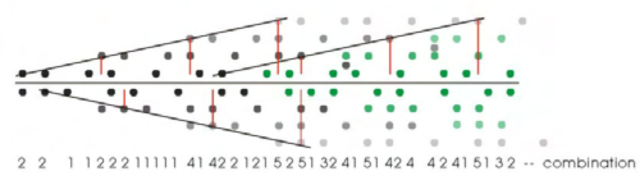
The first 3 reflected sounds have a crucial factor on how the tempo proceeds.
Echo itself has its own orders.
The scale of room regulates the order --how long the sound will be repeated.

The vertical view can inspect the system of accumulation.
As we know, more sound energy at the same time spot could create a mix effect.
And if the components have different frequency, there are chances to form a harmonic chord.
Even if the echoes are all unique , the uniposition and malposition tell 2 simple structure.

Uniposition : echo located on beats



Malposition : echo located on gaps



How many ways of assembling along one section ?
2 X 2X 2 X 2 = 16 ways

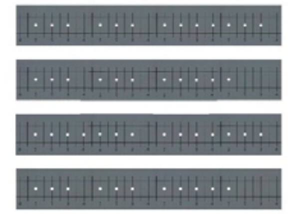
Reverb Saturation Analysis

This is what makes sounds be provided with a sense of extensity .
The longer Rt60 prolongs, the deeper sounds dive into space.
The whole music is made of these components.
Components inform a substructure of reverberant rhythm.
Beyond original clappings, reverberation forms another tempo
that differs from single beats.
Reverberant tempo is a composition which consists of overlapped duration.
Overlapped areas have a higher concentration of sound color [timbre].
According to this relationship, composers could compose the same score
in counter ways.

<-- we have 3 kinds of components to arrange the relationship within groups.

With these components, we could decide the length, proportion, frequency of duration block
we could apply it in composition.
In this way, we not only could arrange single beat patterns, but also could take the saturation of timbre
into consideration when the materials of stage react with reverberant sounds properly.
When two arrays of tempo interact with each other, there is a more complicated relationship.
But it could be purified with simple composition rules listed on the left.

Honeybees



Application

Take the children's ballad " Honeybees " for subject regardless of its pitch.
And then translate it into Echo and Reverb score to inspect its result pattern.
We can find it easily that there are different layers emerge when take spatial factors into consideration.

At first, I try to define that ⋮ is the big beat and locate it after the 2nd echo appeared.

Continuity and discontinuity of big beats are controlled by the original patterns.
The arrangement of the score and one after influences the combination of echoes.

The reverb time defines how long a note should be.
Overlapped zone here is a big beat.
Horizontally, the notes affect each other.
A different tempo is created under time control.

X = 100 m, RT = 0.2917 secs