κῦμα – Technical rider

OHME

1. Introduction

$\kappa\tilde{\upsilon}\mu\alpha$
Ohme and Frederik Vanhoutte
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25 electromechanical modules, airflow disturbance system, signal and process visualisations

Acrylic tubes, wood, electrical engines, spheres, infrared sensors, customised PCBs, UV lights, electronic development platform, fans, LED displays

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The Ancient Greek term $\kappa\tilde{\upsilon}\mu\alpha$ (pronounced Kima) means *wave*, the physical movement on the surface of a liquid layer. In physics, a *wave* describes dynamic disturbances of a physical quantity around a position of equilibrium.

By controlling the vertical position of each of the twenty-five spheres, $\kappa\tilde{\upsilon}\mu\alpha$ produces a discrete 3D levitating choreography.

Randomly activated fans interact with the spheres, disturbing their movements by blowing from above: the choreography patterns are broken, becoming unstable or even chaotic.

A control loop feedback mechanism counteracts this tendency towards chaos; its efficiency varies over time, highlighting the impact of its action.

Thanks to the mathematical equations defining the physical laws of the system, $\kappa\tilde{\upsilon}\mu\alpha$ controls itself through the real-time processing of multiple signals from sensors and motors.

The analogue signals of the physical system are used as raw data to generate digital visuals reinterpreting the movements, disturbances and deviations of the spheres and airflows.

Midway between kinetic art, digital technology, and creative coding, $\kappa\tilde{\upsilon}\mu\alpha$ sheds light on two hidden sciences that permeate our daily lives: *automation* and *control theory*. Dealing with the modelling, analysis, and control of dynamical systems, they allow to reduce human intervention in engineered processes and machines, assuring levels of precision and stability beyond our reach.

Are these complex technologies, with their far-reaching potential, revealing the desire to control our surroundings? How much power hold in their hands, they who can emerge patterns and structures out of chaos?

More information on Ohme web page and Order of Operations exhibition web site.

Production: Ohme
With the support of: Innoviris | Pilar | CREA.Brussels, an initiative from the Brussels-Capital Region, operated by ST'ART in collaboration with Hub.Brussels
Design and production: Ohme and its lab team
Original concept, direction and engineering: François Bronchart and Raoul Sommeillier
Visuals and creative coding: Frederik Vanhoutte
With the help of: Bartlomiej Drewnowski, Florian Jehin, Teo Serra (Ohme Lab interns), Laurent Catoire and Christophe Mertens (Université libre de Bruxelles (ULB), Brussels School of Engineering, Department of Control Engineering and System Analysis (SAAS), MobiDaLab)
Distribution: Ohme

2. Technical requirements

2.1. Scenography and spatial configuration

The installation forms a square on the ground of approximately 3x3m. The minimum height required for the installation, including the disturbance system, is 3.5m (see details in section Dimensions, schemas and plans).

Ideally, a setback distance of at least 3m is required for the public to appreciate the installation.

The installation is best appreciated in a black box or darkened room.
The visual impact of $\kappa\tilde{\upsilon}\mu\alpha$ is much better if the installation is placed in a room with dark floors and especially dark walls (black paint, curtains or fabric), without any light coming from outside the room.

2 configurations are possible:
- Option 1: $\kappa\tilde{\upsilon}\mu\alpha$ with two video walls in the corner of a room and the public walking on the accessible sides.
- Option 2: $\kappa\tilde{\upsilon}\mu\alpha$ with four video walls in the centre of a room or in an arrangement allowing the public to walk around the installation.

- ☐ A blackbox of at least 6x6x3.5m is required for Option 1
- ☐ A blackbox of at least 9x9x3.5m is required for Option 2

Note: κῦμα is a particularly modular installation. Other configurations and setups are therefore possible depending on the constraints of the exhibition space. For any suggestions, questions, or doubts, please contact us (see section Contacts).

The 4 fans (each: diam. 47cm, h 21cm, w 2kg) of the disturbance system should be hung or suspended from the ceiling at a height of about 3.5m. This is the most complex and time-consuming part of the assembly and disassembly.

Depending on the type of ceiling and the technology on site , several fan hanging systems are possible. The organiser must suggest a system to Ohme that he considers the most suitable for the context (with photos if possible). E.g. hanging rails, perforated ceiling tiles compatible with dowels, etc.

The organiser must provide 2 ladders or adequate scaffolding and tape in the colour of the ceiling.

Note: It is possible to show κῦμα without its disturbance system, which would affect the meaning and intention of the artwork, but not that much its aesthetics.

2.2. Power

The maximum electrical values are given in the following table.

#	Item	Volt	Amp	Watt	Watt tot
4	Fans (disturbance system)	240V	0.3	70	280
4/8	Displays Samsung UE55D	240V	0.64	154W	616/1232
2	DC power supplies units	30	10	300	600
1	Mini PC Intel NUC BXNUC9I7QNX	240	3	720	720
1	Wireless router	240	1	240	240
1	Raspberry Pi	5	2	10	10
					2466/3082

Total max power/current consumption at 240V is ~3000W/12,5A.

To isolate the power circuit for the video walls from the rest, 2 x 16A power circuits are required.

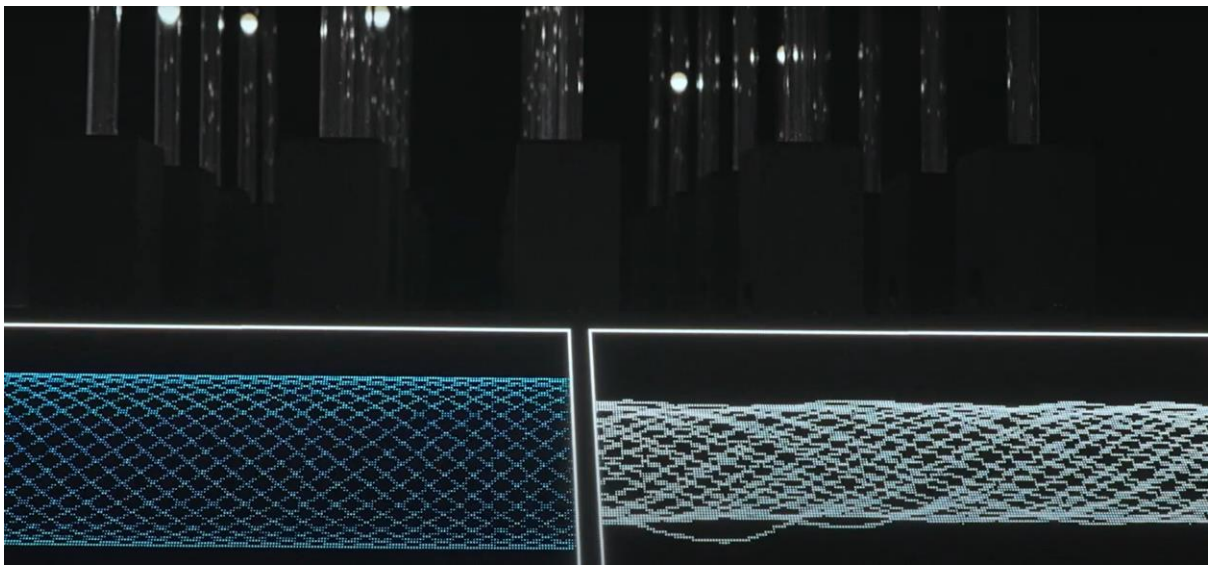
2.3. Video

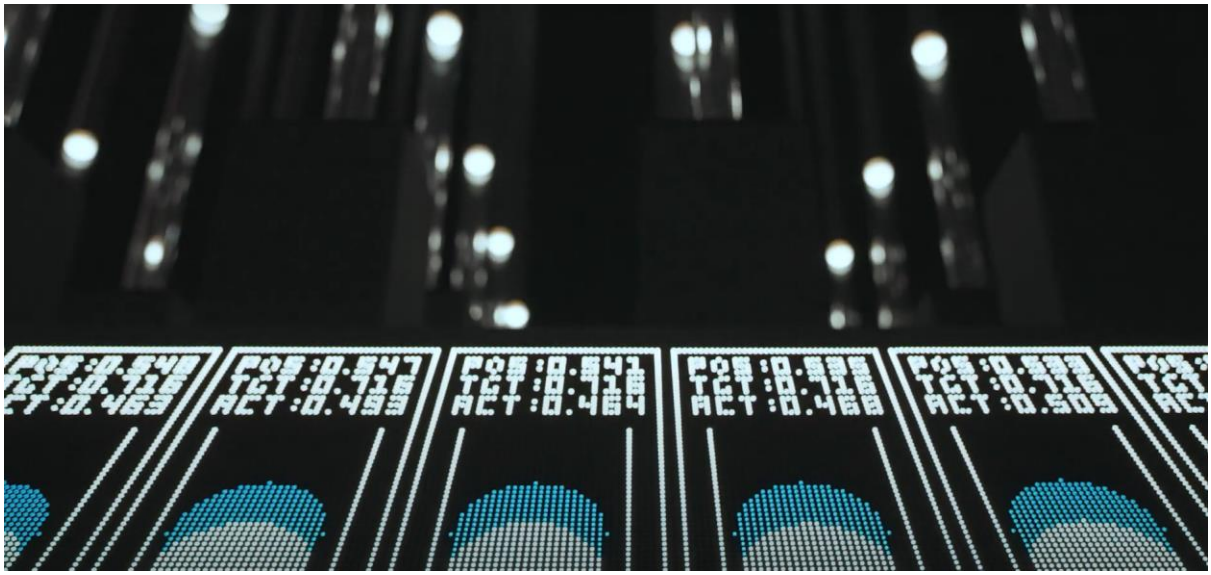
The video walls show real-time visualisations of signals processed by the mini PC.

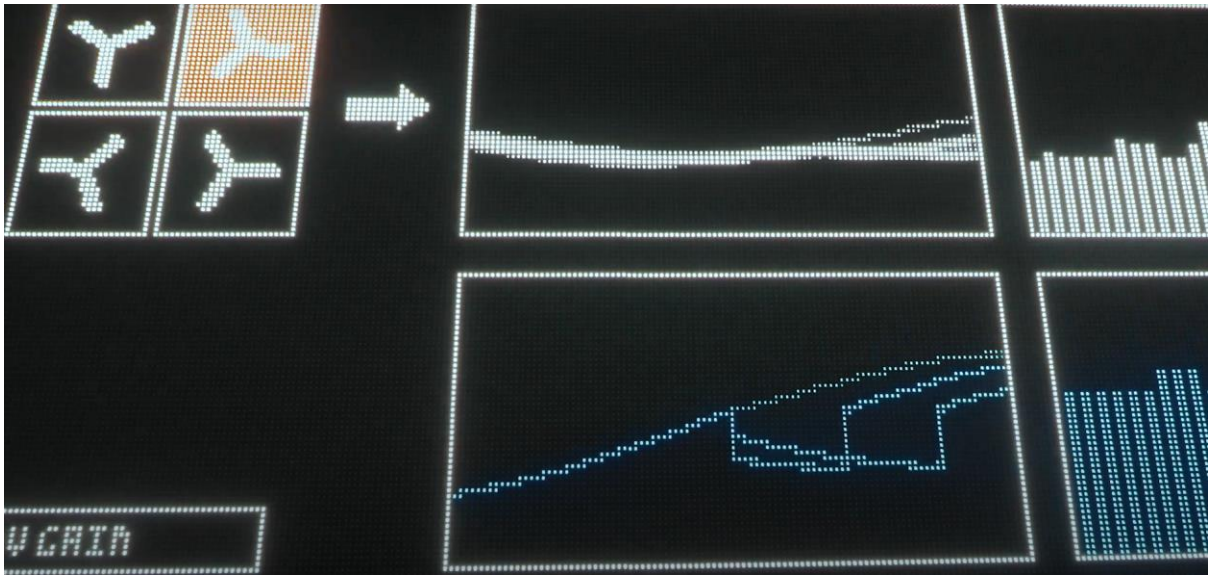
Two video technologies are possible:

- 55'' LCD displays (Samsung UE55D) provided by Ohme: 4 displays for Option 1 and 8 for Option 2.
- 50 x 50 cm 3.9 pitch LED panels + controller (ex: VisionX LB3.9 Indoor, 1000 NIT, 50 x 50cm + Novastar MCTRL 300), rented by the organiser: 8 displays for Option 1 and 16 for Option 2.

The second possibility allows a pixelation of the visuals aesthetically aligned with the discretization of the choreography of levitating balls (see pictures below coming from this video). But for your information, and in our experience (it depends on your rental partners), the cost per day of renting is at least 3€ per LED tile and 15€ for the controller.
So, for example, for a one month exhibition (30 days), in Option 2 (video wall made of 16 panels all around the installation), this gives a total rental price excluding tax of 30*16*3+30*15=1440€+450€=1890€.







2.4. Sound

There is no active sound system in $\kappa\tilde{\upsilon}\mu\alpha$ (i.e. no amplification or speakers). The sound emitted by the installation comes from the movements of the 25 drone propellers hidden in the boxes and the 4 fans of the disturbance system.

These sound sources of kinetic origin together form a kind of evolving hum (one can just by listening understand if the regulation is working well or not). This reinforces the immersive and hypnotising aspect of the installation, so that the sound is an integral part of the experience and the perception of the audience.

This means that that $\kappa\tilde{\upsilon}\mu\alpha$ should preferably not be presented next to another sound-emitting work, so that the two artworks do not interfere with each other in terms of sound.

2.5. Checklist

To be provided by the organiser:

☐ A blackbox of at least 6x6x3.5m (Option 1) or 9x9x3.5m (Option 2), ideally with dark/black walls and floor, and with no sound or light noises
☐ 2 x 16A direct circuits
☐ 1 roll of Gaffa/tape (in the colour of the ceiling, 50 mm)
☐ 1 roll of Gaffa/tape (in the colour of the floor, 50 mm)
☐ 2 ladders or adequate scaffolding to access the ceiling and hang the disturbance system
☐ 1 technical proposal for hanging the disturbance system from the ceiling of the room
☐ If the selected hanging system of the ceiling disturbance system requires (wood) construction, a technician on site to help us making it.

To be provided by the organiser or brought by Ohme (to be discussed):
☐ 2 stage platforms 2 x 2 x 0.1m + 8 legs + wheels
☐ If chosen video technology is LED: 8 or 16 LED panels 50x50cm 3.9 pitch (Option 1 or 2) + controller, provided by the organiser
☐ If chosen video technology is LCD: 4 or 8 Samsung UE55D displays (Option 1 or 2), provided by Ohme

Brought by Ohme:
☐ 25 modules (box + tube + ball + electronics)
☐ All RJ45 and power connectors
☐ 2 DC power supply units
☐ 1 Mini PC NUC Intel + 1 control display
☐ 1 Raspberry Pi
☐ 1 WLAN router
☐ 4 fans that blow the air downwards (disturbance system) and must therefore be hung from the ceiling
☐ Toolbox for installation and setup

3. Installation, setup and dismantling

The installation will be assembled and calibrated by Ohme on site.
It requires a dedicated team of 2 persons (from Ohme Lab) during min 2 days for setup, calibration and testing (about one day for the disturbance system and one day for the rest).

The installation will be disassembled by Ohme on site.
It requires a dedicated team of 2 persons (from Ohme Lab) during min 1 day.

4. Transport

The transport of the *κῦμα* requires a van or a pickup truck with a boot of minimum 20m³ with a depth of minimum 2,5m.

The transported material comprises (dim. w x l x h):

- 1 box with 25 acrylic tubes (0.4 x 0.4 x 2m)
- 1 flight case with 25 electromechanical modules: (1.2 x 0.6 x 0.6 m)
- 4 boxes with fans (0.5 x 0.5 x 0.2 m)
- 2 stage platforms (2 x 1 x 0.1 m) + legs and wheels
- 1 or 2 flight cases with each 4 x 55'' display (1.4 x 0.5 x 1.2 m) (not on picture below)
- 1 fight case with other equipment and cables (1 x 0.5 x 0.6 m) (not on picture below)

5. Operation

Once fully installed, *κῦμα* can be activated simply by pressing two power switches.

We recommend a maximum operating period of 14 hours per 24 hours.

The mini PC receives all the sensor data from the physical installation and processes these signals to produce the video wall visuals in real time. It can run continuously for several days.

We recommend turning this mini PC off and on once every 2-3 days to ensure its memory reset. Once turned on, simply open and run a file in Processing software. The simple procedure above (reset the installation and the mini PC) can also solve most potential bugs.
Details will be provided with the operation and maintenance guide for the installation.

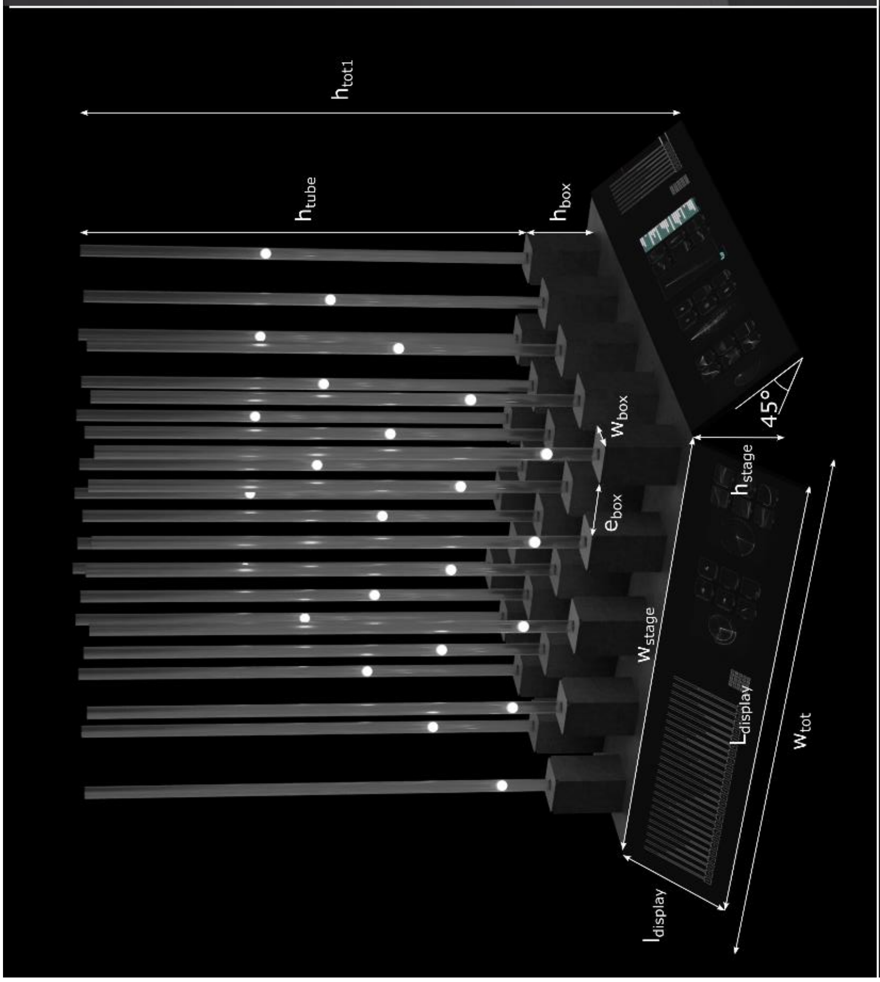
Note: In case of a bug, please contact a member of Ohme Lab (see section Contacts).

6. Insurance value

The total insurance value of *κῦμα* (material, equipment and production costs) is 25,580.00€.

#	Items	Insurance value	
		Unit	**Total**
8	Samsung UE55D displays	1,200.00 €	9,600.00 €
25	Electromechanical modules (custom PCBs, plexi tubes, motors, IR sensors, CNC wood, etc)	500.00 €	12,500.00 €
2	Stage platform + stands + wheels	350.00 €	700.00 €
1	Mini PC Intel NUC BXNUC9I7QNX 1T SSD 16Go RAM	1,000.00 €	1,000.00 €
1	Monitoring display ASUS Zenscreen MB16ACE	203.00 €	203.00 €
5	Big fans	100.00 €	500.00 €
1	DMX multi-channel controller	400.00 €	400.00 €
1	Custom Rasberry Pi	150.00 €	150.00 €
1	Teensy + Airlift Wifi	80.00 €	80.00 €
1	Wifi Router	200.00 €	200.00 €
1	Cables, connectors & accessories	450.00 €	450.00 €
TOTAL			**25,783.00 €**

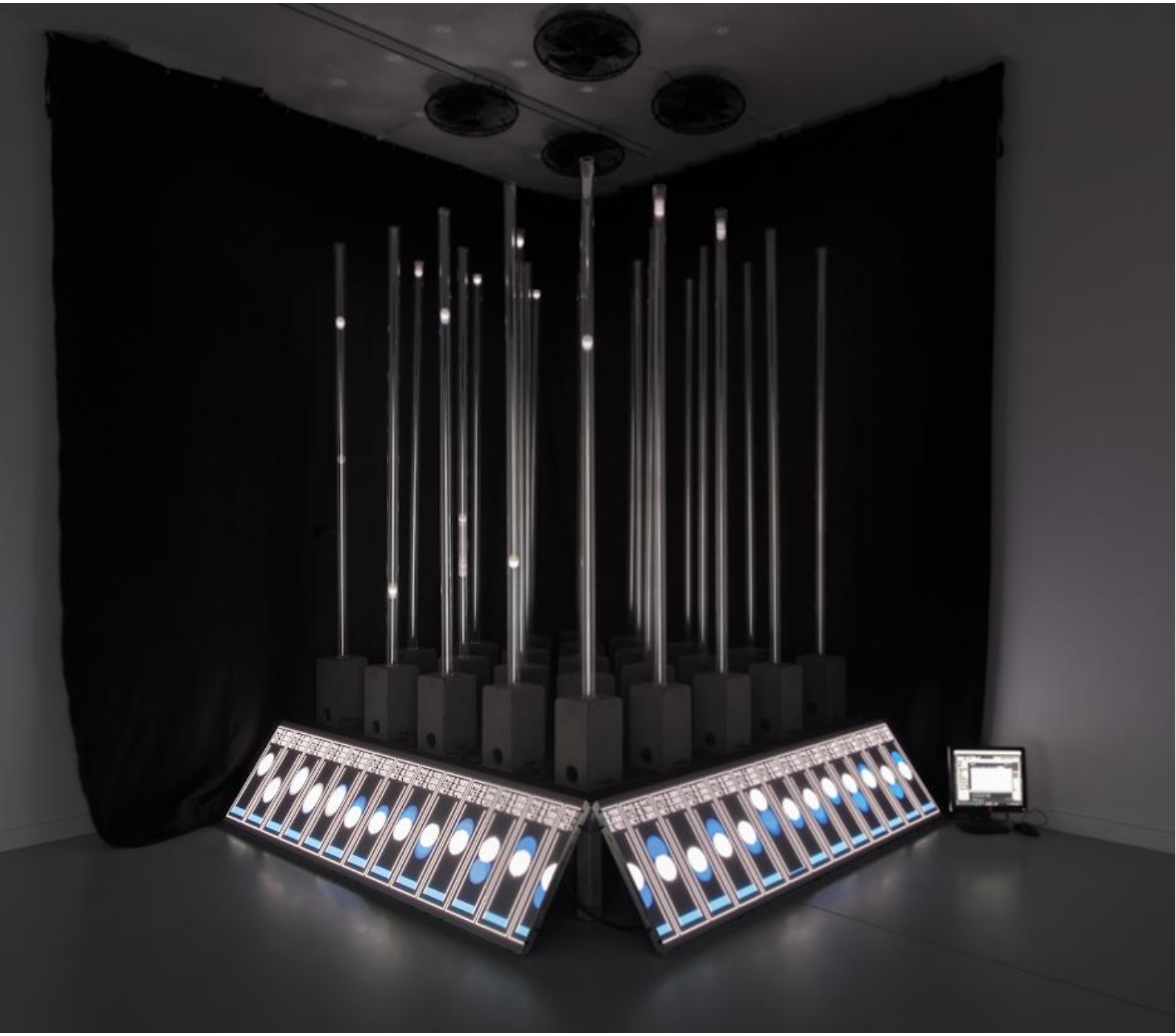
7. Dimensions, schemas and plans



		16 LED tiles 50 x 50cm	8 LCD Display 55''
Stage:	$w_{stage} \times w_{stage} \times h_{stage}$	= 200 x 200 x 36cm	= 244.4 x 244.4 x 49cm
Boxes:	$w_{box} \times w_{box} \times h_{box}$	= 17 x 17 x 31cm	idem
Spacing:	e_{box}	= 19cm	= 26.6cm
Tubes:	$D_{tube} \times h_{tube}$	= 5 x 190cm	idem
Display:	$L_{display} \times l_{display}$	= 200 x 50cm	= 244.4 x 69.3cm
Fans:	$D_{fan} \times h_{fan}$	= 47 x 21cm	idem
	$e_{fan} = 2 \times w_{box} + 2 \times e_{box}$	= 72cm	= 87 cm
	Δh	= 40-80cm	idem
Total:	$w_{tot} = w_{stage} + 2 \times h_{stage}$	= 272cm	= 342cm
	$h_{tot1} = h_{stage} + h_{box} + h_{tube}$	= 257cm	= 270cm
	$V_{tot1} = w_{tot} \times w_{tot} \times h_{tot1}$	= 272 x 272 x 257cm	= 342 x 342 x 270cm
	$h_{tot2} = h_{tot1} + \Delta h + h_{fan}$	= 318-358cm	= 331-371cm
	$V_{tot2} = w_{tot} \times w_{tot} \times h_{tot2}$	= 272 x 272 x 318-358cm	= 342 x 342cm x 331-371cm

8. Photos and videos

Video teasing: https://youtu.be/Xjnq3Jz1Q_8



9. Contacts

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