Tutors: Prof. Huang Wei Xin, huangwx@tsinghua.edu.cn
Team: Chia Hui Yen, Bai Jing, Hu Jing Yuan, Zheng Li Yu
Contributions: Artificial Fog System Design 100%, On-site Construction 20%

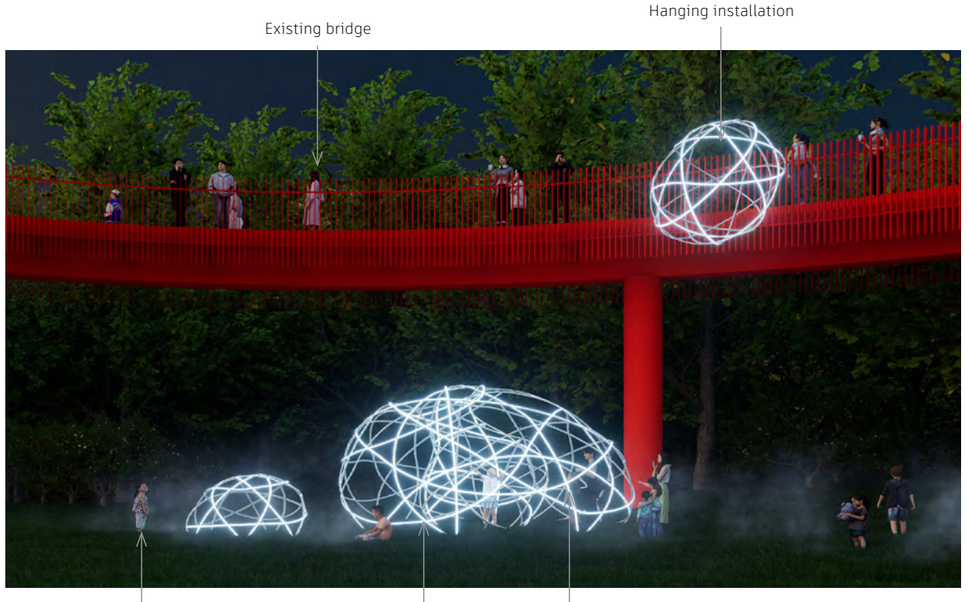
Digital Fabrication: Droplet

_Digital Fabrication, Structure design, Artificial fog system design

October 2023 - December 2023

Introduction

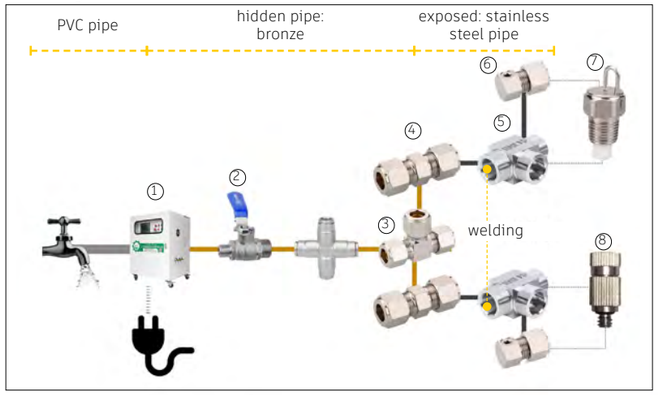
Inspired by water droplets, the concept features diverse droplet shapes distributed throughout the venue, forming illuminated woven curves for interactive engagement. Utilizing anodized aluminum profiles, LED strips, and misting devices create a dynamic interplay of shadows and offer a cool resting spot during the day,The intelligently generated structure mimics natural relationships, serving as both a stable form and an interactive installation for children, parents, and architecture enthusiasts. Technologies include generative and participatory structures, along with self-sustaining lighting.

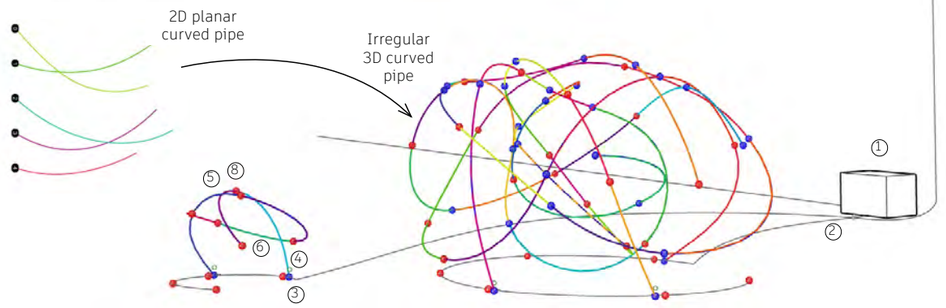


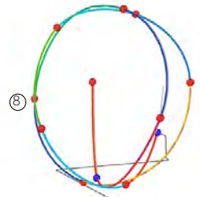
As a actual built project, the design module included LED strip system design. electricity system design, structure detail, structure fabrication and artificial fog system design. I participated in **structure manufacturing optimization design** and lead the **artificial fog system design individually**

Artificial Mist System Design:

In line with the exhibition's nature focus, a landscape mist system is integrated, enhancing the woven structure with natural mist effects. A preliminary routing system design optimizes mist coil requirements, minimizing nodes and levels:

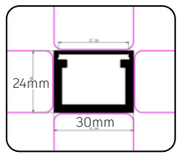


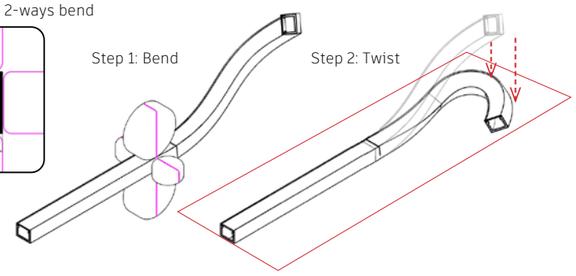




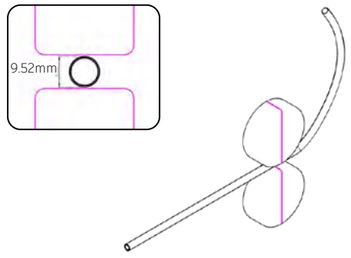
Structure Fabrication Optimization:

0. Manufacture process:
Aluminium frame: 2-ways bend

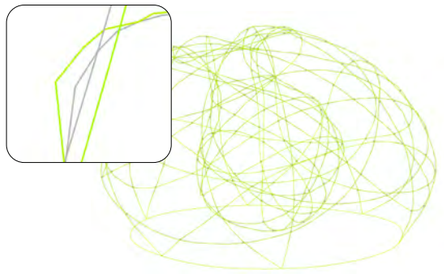




Stainless steel pipe: 1-way bend



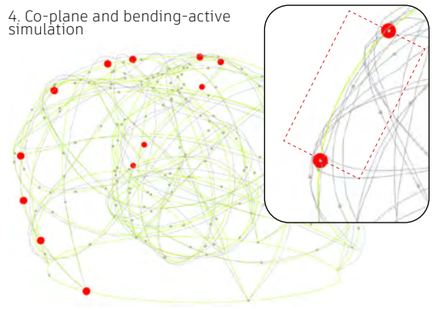
1. Polyline Generation
2. Polyline dynamic relaxation
Final polyline generation:



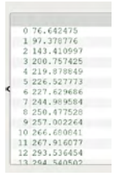
3. Segment polyline according to coplane threshold

4. Co-plane and bending-active simulation

Coplane/planarize:



5. Data conversion and generation



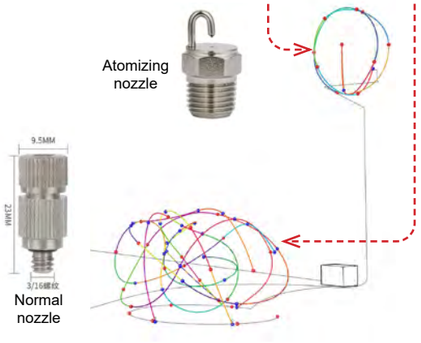
Structure fabrication optimization done by teammate, Hu Jingyuan

DROPLET

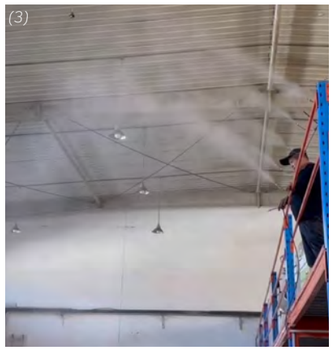
Artificial Fog System Design Process:

(1) Factory vist and experiment:

	Type	Pressure	Direction	Visually effect
(1)	Normal	4	Parallel	1
(2)	Normal	4	Verticle	1.5
(3)	Normal	6	Verticle	1.5
(4)	Atomizing	6	Parallel	2.5
(5)	Atomizing	6	Verticle	3



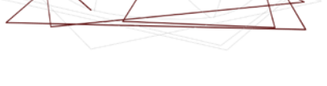
Testing out diffrent type of nozzle under different pressure, and differentiate types depends on visual needs



(2) Rod & nozzle design optimization

0 Needs:

NEED 1:
Nozzle coverage length (a) based on nozzle type, calculation on irregular curve is different on straight-line.



NEED 2: Segments should be a planar curve

1 Basic curve generation

Choose the curve that able to cover the largest area

2 Simulation Method:

0 Basic curve generation

Generate offset curves from original curves

Iterate bounding rectangle, find out the biggest rectangle for each curves

List the curve that has biggest cover area

Opt1. Kangaroo Simulation Method

Equally generate point on curves

Kangaroo collide to equally distibute points on curves

Opt2. Simulated annealing Method

Project points from relative original curve to offset curve

Using simulated annealing method to pick points

Opt1. Kangaroo Collide Simulation Method

Distance between nozzles (m):
Uneven: 0.14m~2.03m

Even

Distance between nozzles (m):
Uneven: 0.725m~1.53m

Opt2. Simulated annealing Pick & choose Method

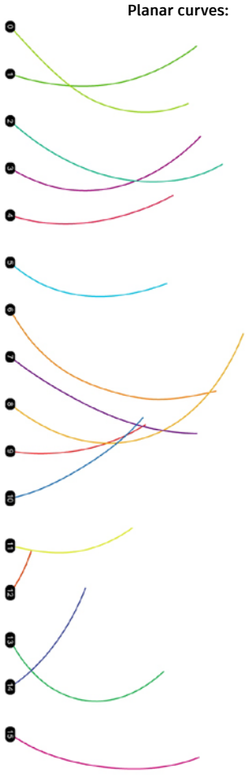
Even, coplane

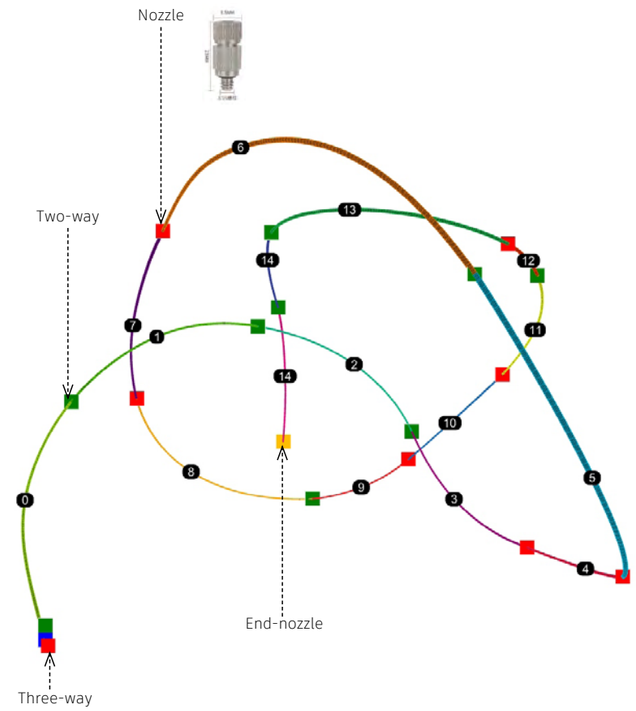
Distance between nozzles (m):
Uneven: 0.795m~2.325m

(3) Preparation, data management and fabrication process

1. Extract split curve segments, and unfolding rod, purchase raw material depends on needs

Planar curves: → **3D Irregular curves**





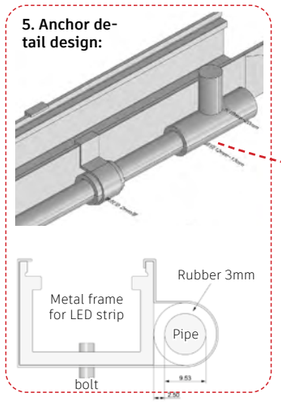
Avergge length=3.0m, purchase straight rod 4.0m

3. Generate roll bending data

By Ws Finder, a plugin for weaving curve genration, generate curvature of curves' segments as roll bending data, ready for manufacture process

	{0}
0	532.026016
1	565.409733
2	810.36768
3	841.51085
4	992.576094
5	1093.048068
6	2938.364796

5. Anchor detail design:



4. Go through Manufacture process

6. On-site manufacture

Joining detail

Process:

Site Photos:

Tailor the anchor holder design to specifically accommodate the metal frame, ensuring it effectively secures the water pipe in place.

Positioning the nozzle parallel to the LED strip light enables the illumination of mist during the night, creating a captivating D'Arsonval effect.

The joint, designed collaboratively with teammate Baijin, incorporates a metal frame ending that interfaces seamlessly with the floor, ensuring a perfect alignment of the installation with the ground surface.

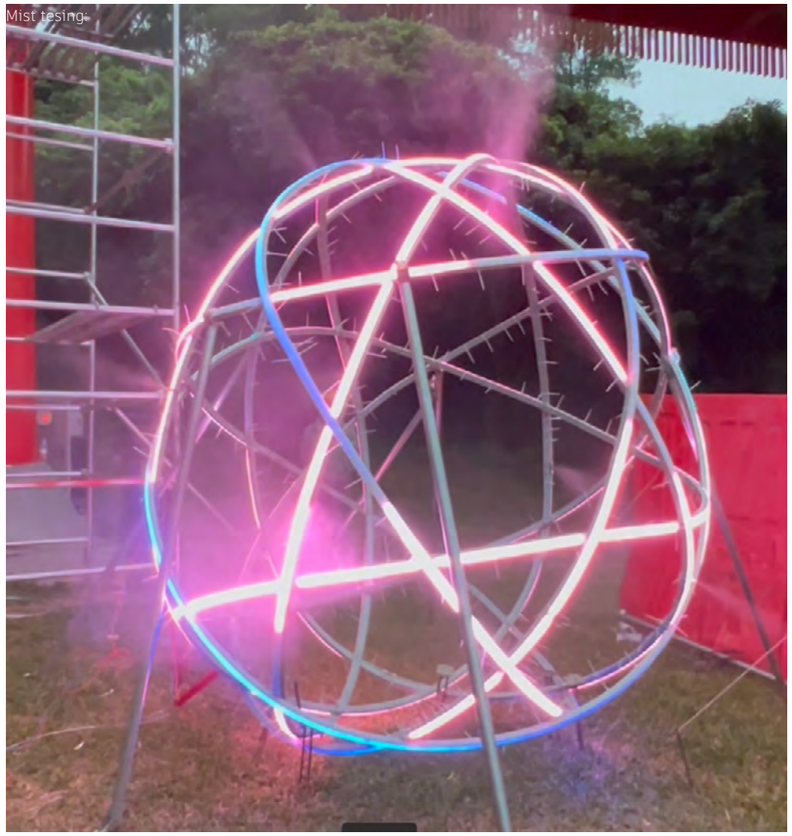
The appearance of the material for the planar curve before it is assembled into an irregular curve in 3D space.

The installation of the structure was primarily overseen by another teammate, Hu Jingyuan.

Site Photos:

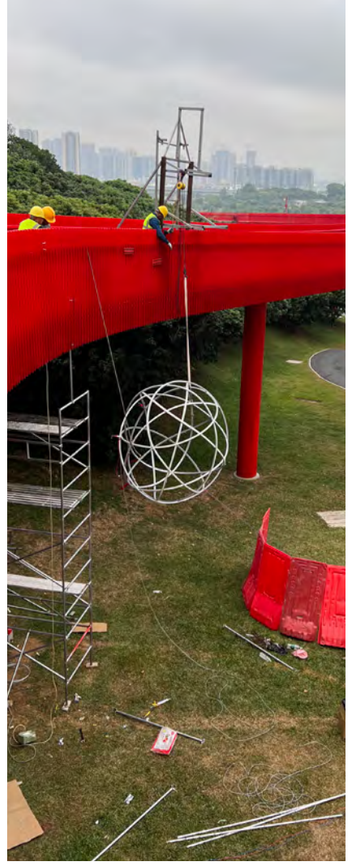
Light strip testing, work done by collaborator team:

Mist tesing:



Can be lifted up easily

Installation process:



Contriburion:
I am primarily tasked with ensuring a unique combination of lightweight structure and a mist system in structure.

Testing process:
Verify the visual effect and adjust the pressure of the mist system, as well as test the timer control settings, such as a cycle of 1 minute on and 1 minute off.

Construction process:
Many elements need coordination during the component installation process, and I engage in communication with construction workers to ensure the seamless completion of the installation.

Candidate interacting with installation

Final photos by local media: