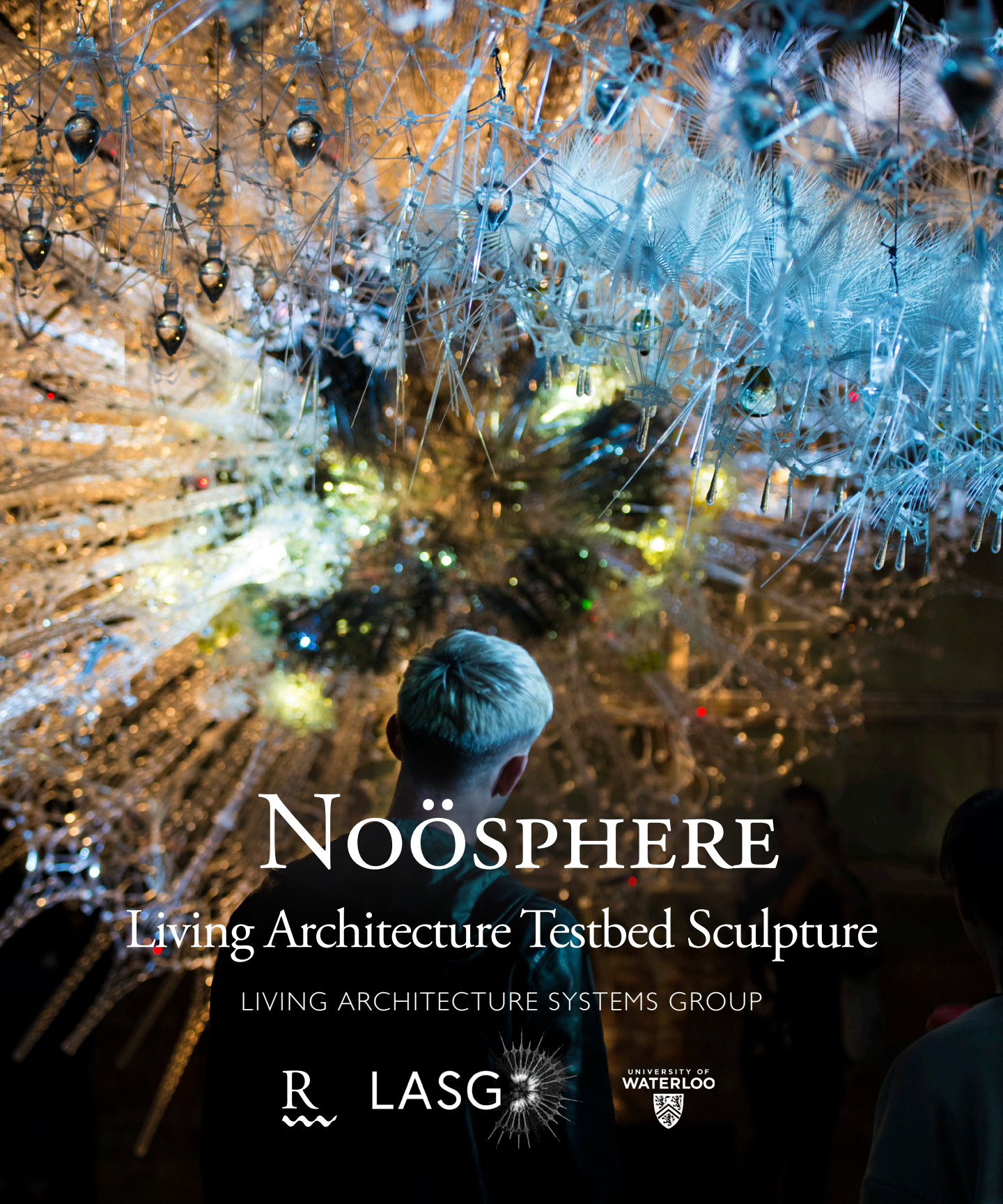


NOÖSPHERE

Living Architecture Testbed Sculpture

LIVING ARCHITECTURE SYSTEMS GROUP

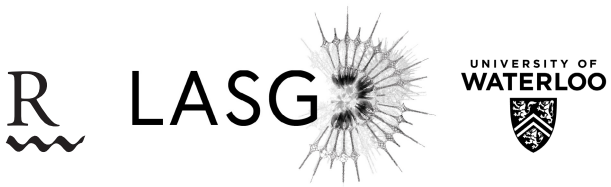
LASG

UNIVERSITY OF WATERLOO

Noösphere

Living Architecture Testbed Sculpture

Living Architecture Systems Group



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Facing Page

Stellated Noösphere sculpture with canopy, Astrocyte at DX EDIT: Expo for Design, Innovation & Technology, Toronto, 2017

Introduction

This publication documents the inner workings of the Noosphere sculpture. Noosphere is an evolving interactive spherical sculpture that acts as a powerful public beacon, a positive symbol of shared sustainable futures. The exhibitions of Noosphere have been seen by hundreds of thousands of in-person visitors in Toronto and Berlin and by millions of online viewers.

The giant suspended sphere of Noosphere contains a nest-like structure of intricate webs powered by artificial intelligence. High-powered lights pulse and shimmer while densely gathered fronds shiver. Arrays of high-fidelity, omnidirectional speakers produce a collection of individual sounds that together rise to intense crescendos and soften to gentle whispers. The expressive, open forms of the Noosphere sculpture provide valuable examples of next-generation paradigms for interdisciplinary research and design, helping to equip emerging generations of designers and creators with the skills they need for working with far-from-equilibrium environments.

The evolving sculpture is created by the Living Architecture Systems, an international group led by artist-architect Philip Beesley and hosted by the School of Architecture, University of Waterloo. This international partnership research partnership combines artists, engineers, designers and scientists from many organizations around the world studying how the next generations of experimental buildings and environments might grow, think, and care.

Facing Page

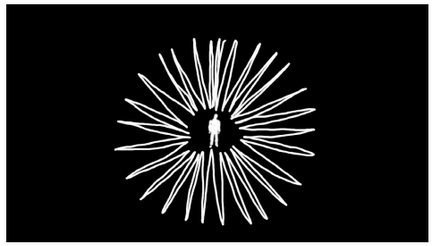
Noösphere sculpture, Futurium, Berlin, 2019-2024

Following Page

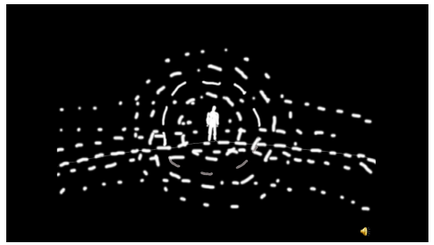
Distant and near views, conceptual renderings of Noösphere sculpture installed within Innovation Gallery, Huis van Delft.

The expressive, open forms of the Noosphere sculpture provides valuable next-generation paradigms for interdisciplinary research and design, helping to equip emerging generations of designers and creators with the skills they need for working with far-from-equilibrium environments. The symbolism of the Noosphere sculpture carries messages of caring collective relationships, sustainable environments, and next-generation renewable technologies. Noosphere derives from the Greek word 'Noos' meaning 'knowing.' The title refers to life on Earth as a vast organism with a thinking skin. The term noosphere was coined by the 20th-century theologian and geologist Teilhard de Chardin, offering an optimistic vision where the Earth could evolve as a whole organism. In de Chardin's compelling interpretation, the noosphere could help to transform the earth in next stages of evolution with a collective consciousness, and even mutual sympathy and empathy.

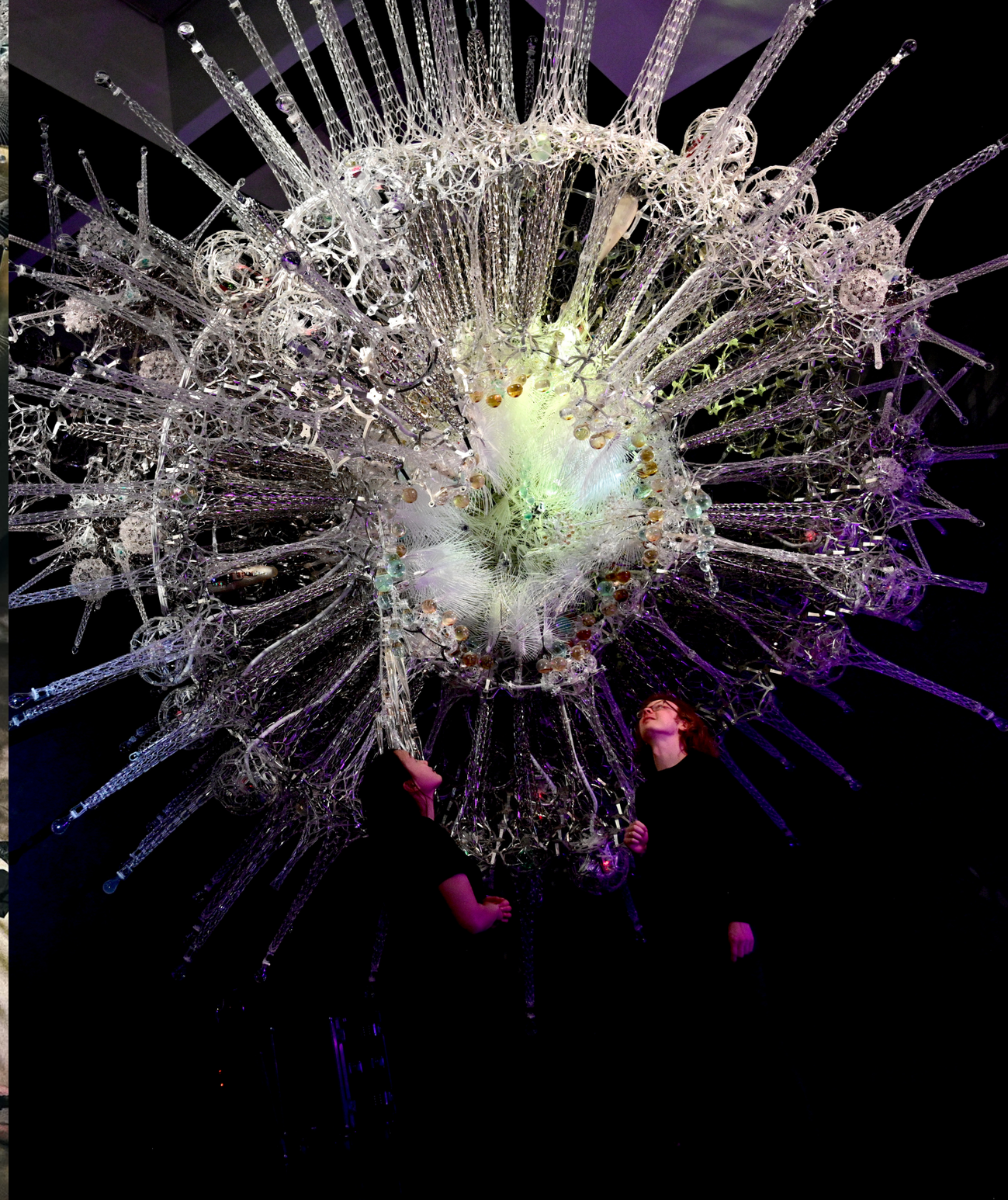
The expressive, open forms of the Noösphere sculpture provide valuable examples of next-generation paradigms for interdisciplinary research and creation expressing strategic futures.



Open, inclusive qualities expressed by Noösphere evoke relationships that extend far beyond human boundaries.



Noösphere can act as a public beacon, a symbol of shared sustainable futures,



Evolving Noösphere Project

Preceding Page (Left)

Experiencing sound and light performance within Noösphere sculpture Meander at Tapestry Hall , Cambridge ON, Canada.

Preceding Page (Right)

Noösphere sculpture, Futurium, Berlin, 2019-2024

Facing Page

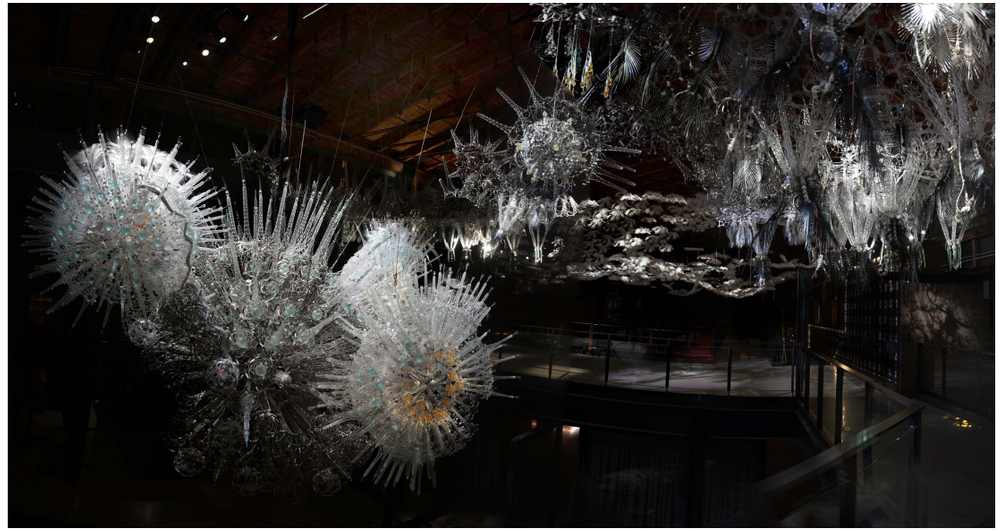
Noösphere sculpture, Threshold at Norman Y. Mineta International Airport, San Jose, US

Each installation of this evolving project has been adapted to the needs and context of its host. Professors in Indiana University's Luddy Hall building have integrated the sculpture into their network science curriculum. In Berlin's Futurium, Noösphere formed a core of public programming and a 'must-see' tourist destination. Meander, meanwhile, provides an expressive background to the many social events of Tapestry Hall in Cambridge, Ontario. As interactions accumulate, the relationship between the sculpture and its context changes. Like a garden, each testbed requires ongoing care, integrating Living Architecture with the human systems of institutions and community.

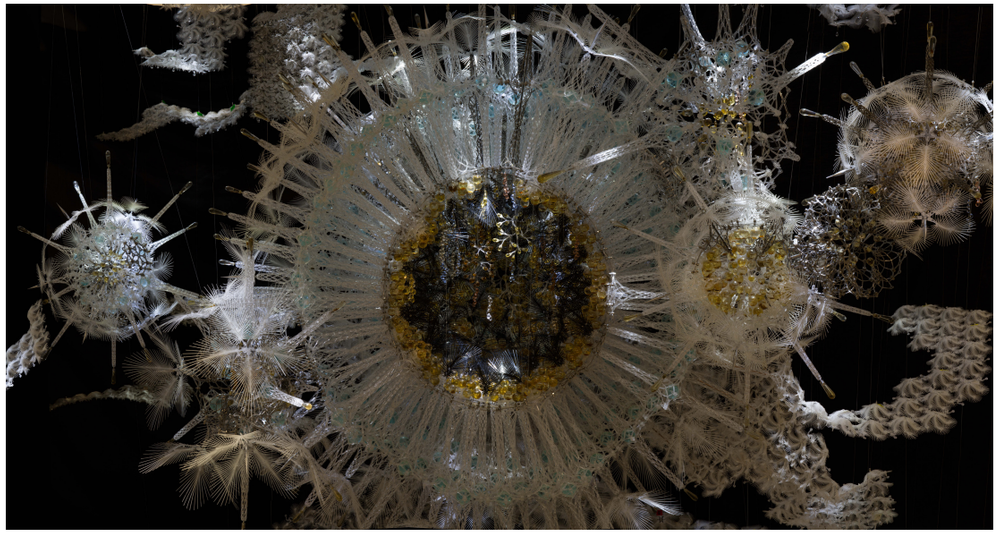
A first prototype of the interactive systems of Noösphere was installed at DX Edit, an event that occupied massive industrial facilities in abandoned portlands, Toronto, 2017.

Amatria, installed in Luddy Hall, an informatics research building at Indiana University in Bloomington, since 2018.

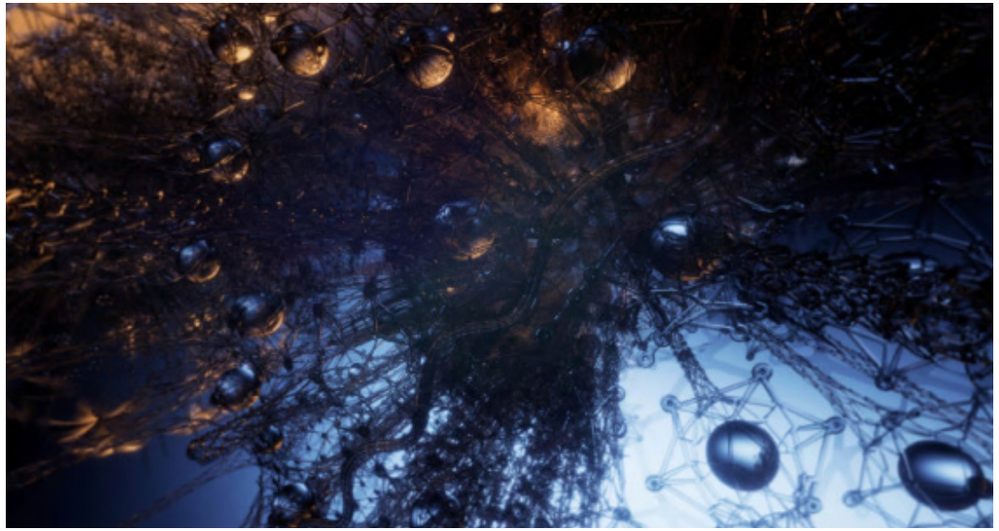
Futurium Noösphere, installed in Futurium gGmbH, a hands-on museum in Berlin, Germany, from 2019 through 2023.



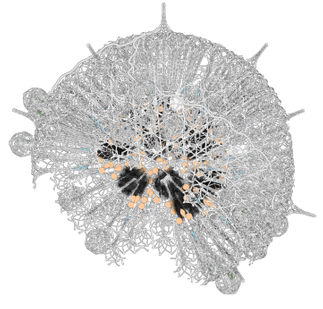
Meander, installed in Tapestry Hall, an historic warehouse building that has been converted into an event space at the heart of a residential high-rise development in Cambridge, Ontario, since 2020.



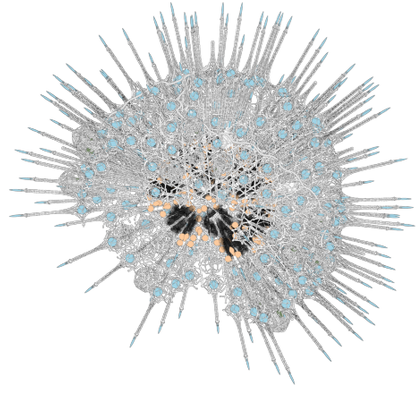
Threshold is a pair of sculpture cases containing visions of worlds in formation including miniature Noösphere forms enwreathed with clouds and veils. The sculpture creates a permanent gateway to the public airport of Norman Y Mineta airport, San Jose, California.



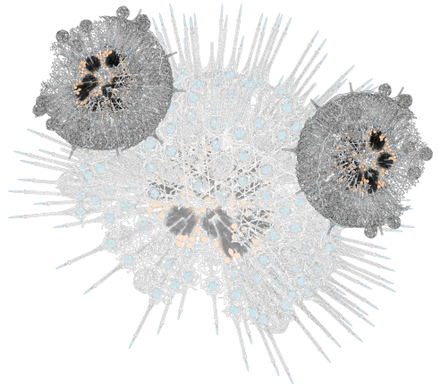
Grove Cradle was originally intended as an immersive physical installation at the Venice Biennale for Architecture. In response to the Covid pandemic, the project shifted to become a virtual world, projected in the form of a meditative, intensely detailed film that meditated on the origins of life and colliding worlds. The film was created in collaboration with the Cannes award-winning filmmakers Warren du Preez and Nick Thornton-Jones.



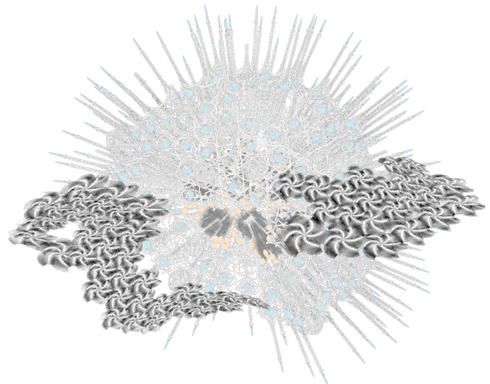
Non-Stellated Noösphere



Stellated Noösphere



Noösphere with Satellites



Noösphere with Canopy

Noösphere Configuration Options

Noösphere Scaffold Form & Geometry

Preceding Page

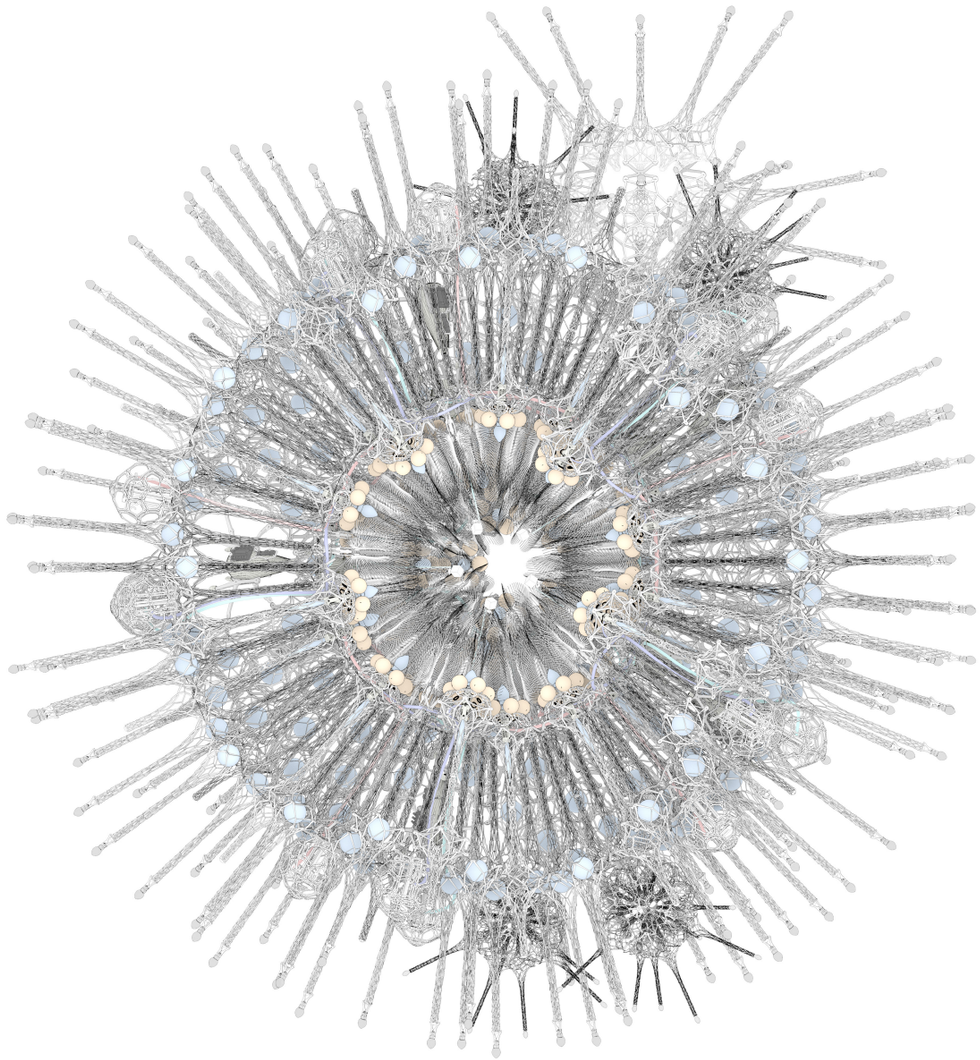
Noösphere sculpture, Amatria, Indiana University, USA, 2018

Facing Page

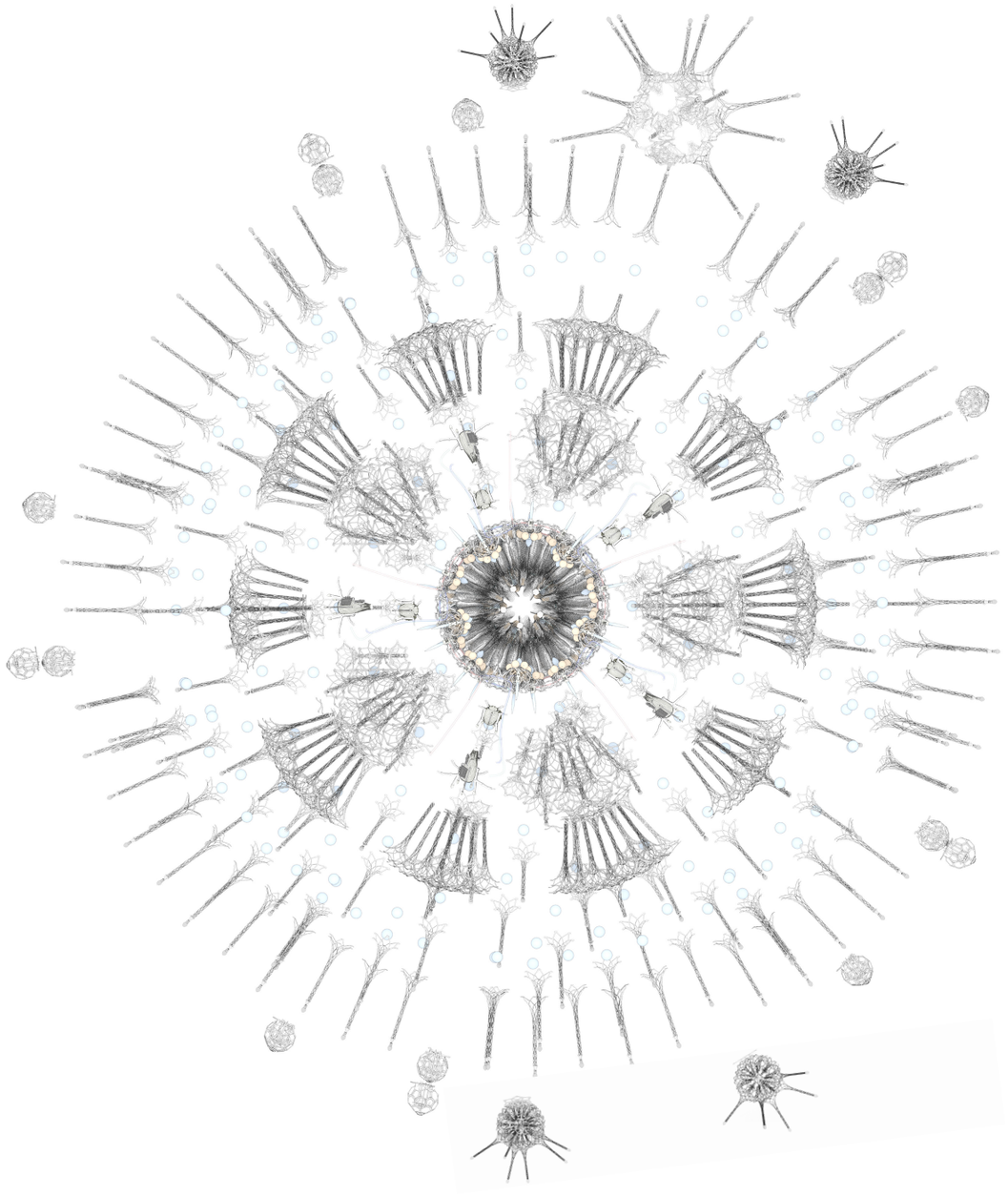
Noösphere sculpture, Transforming Space, Royal Ontario Museum, Toronto, 2018

The Noösphere series features experimental development of innovative architectural structure systems that could be used for creating highly efficient responsive buildings in the future.These structures include suspended halo-like shells and mechanical veils. Noösphere employs a shell and vaulting system made from interlinking expanded-mesh hollow struts, forming flexible membranes and doubly-curved surfaces for material efficiency. The surface design includes pyramidal units with varying heights and trumpet-shaped spines, employing lightweight branching structures.

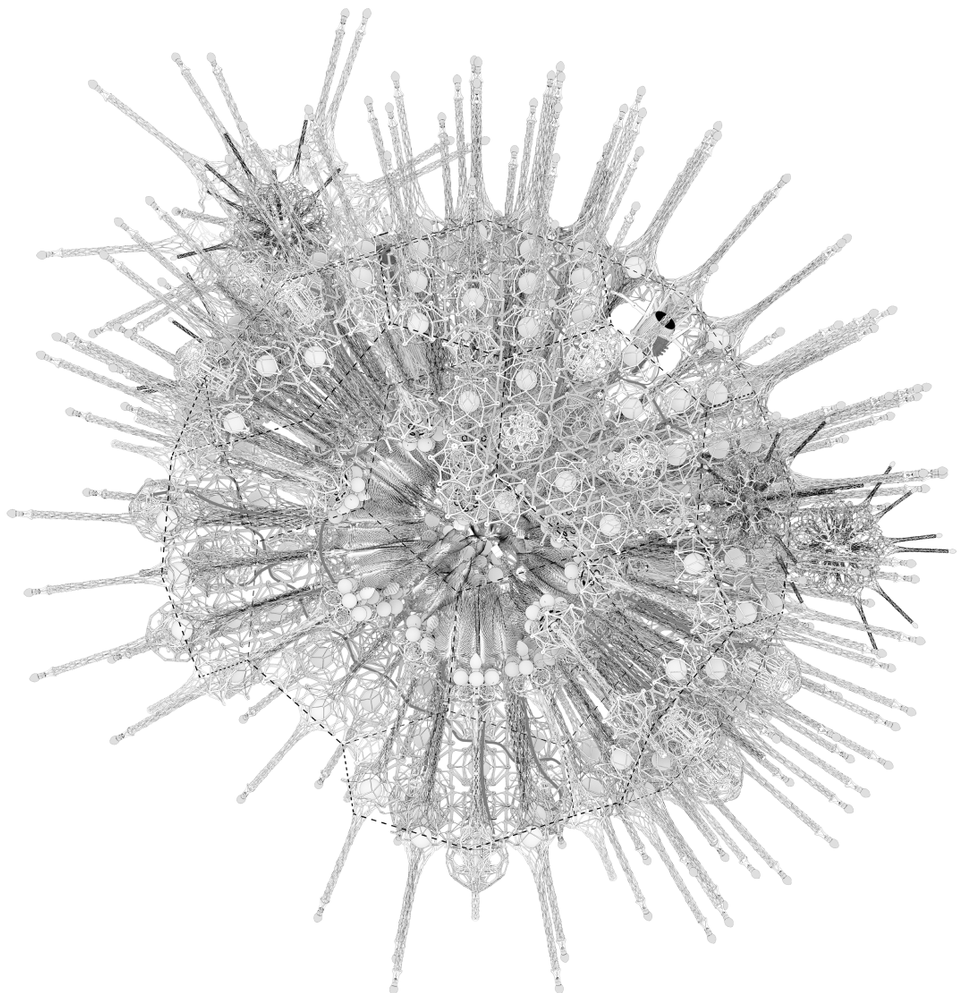
Billowing skeletal membranes extend the outer canopy surfaces, featuring spiraling organizations. Halo-like helical rosettes react to slight shifts in the surrounding atmosphere. The interwoven layer of the veils accommodates large displacements within its hung tentwork placement while responding to environmental changes. The structures minimize their material consumption by using precisely automated cutting, thermal and mechanical forming of expanded arrays of filamentary structures. The organization of these components is defined by punctuated oscillation and ‘quasiperiodic’ constantly varying geometries.



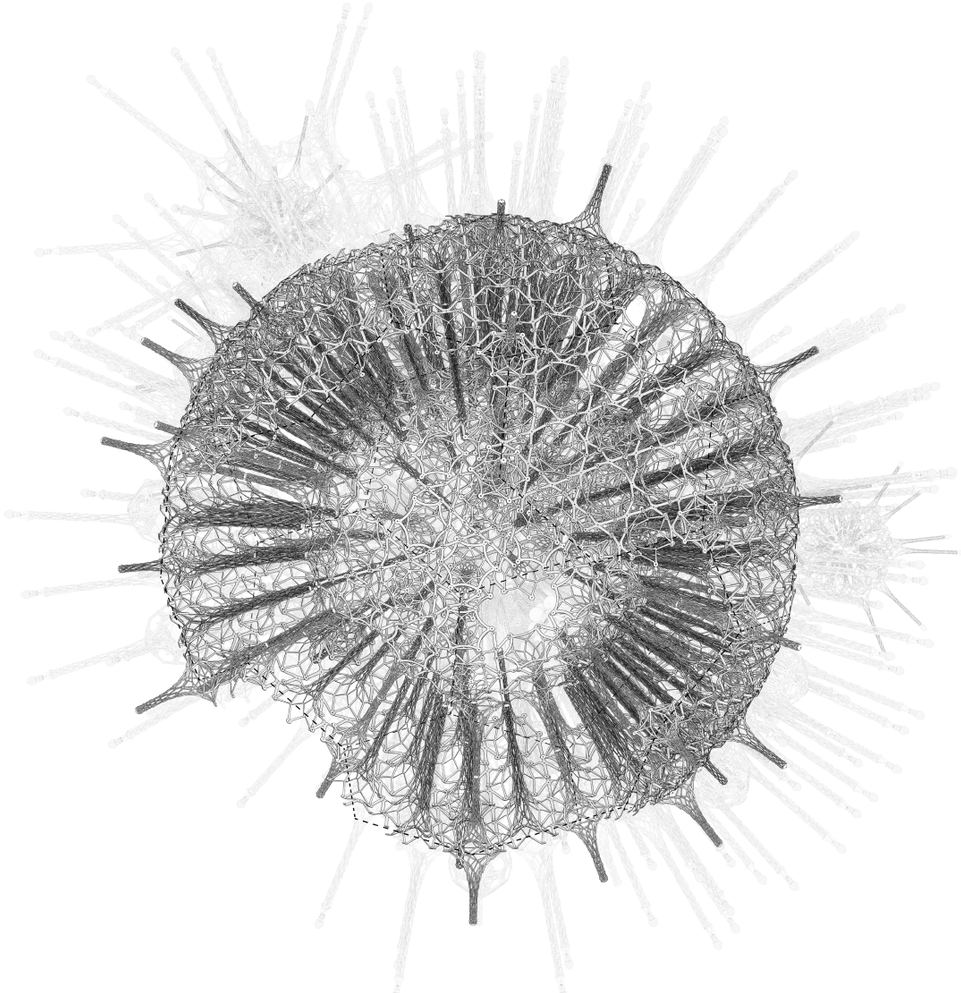
Noösphere Full Sculpture



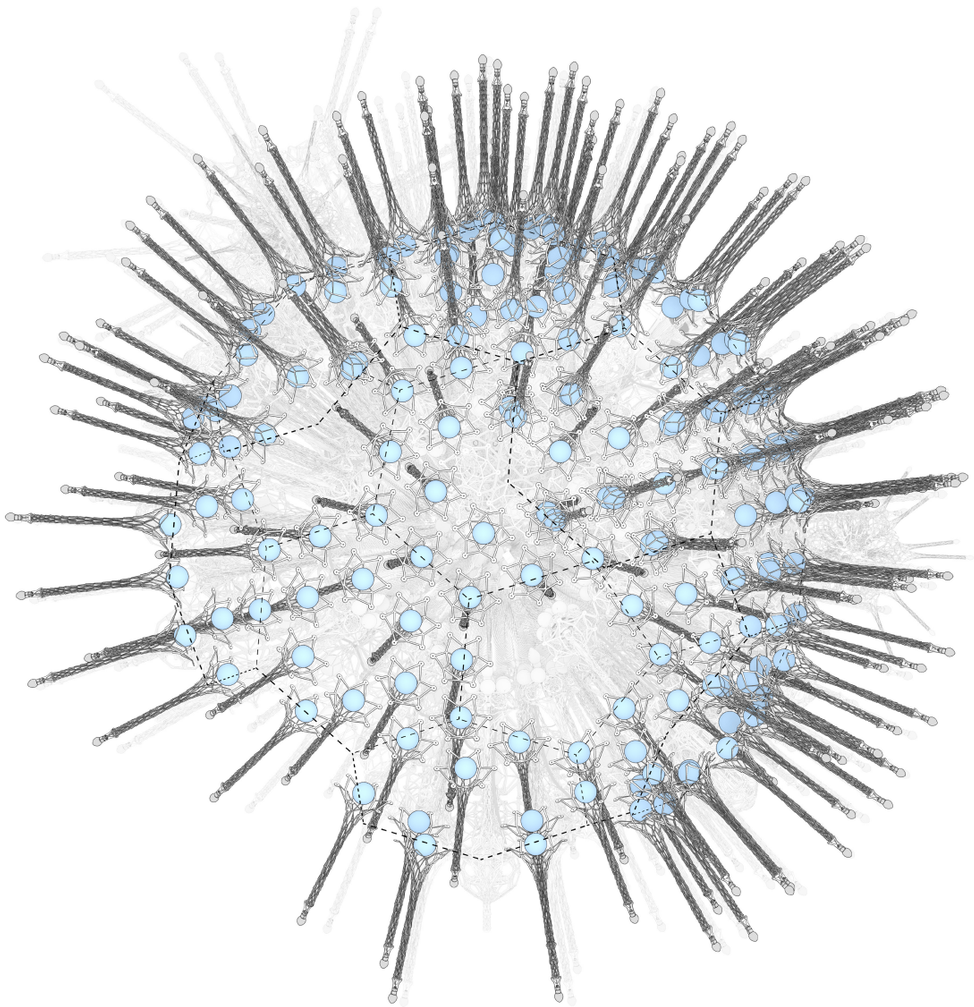
Expanded Noösphere



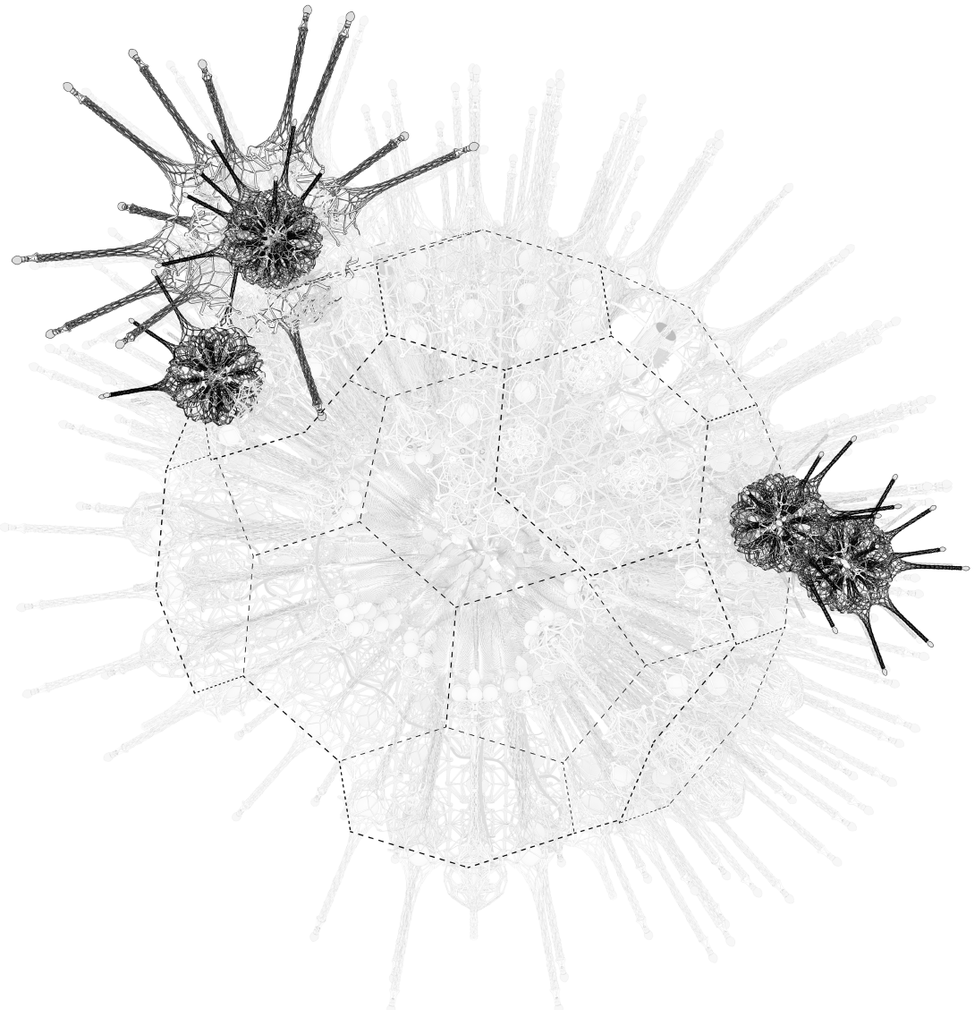
Noösphere



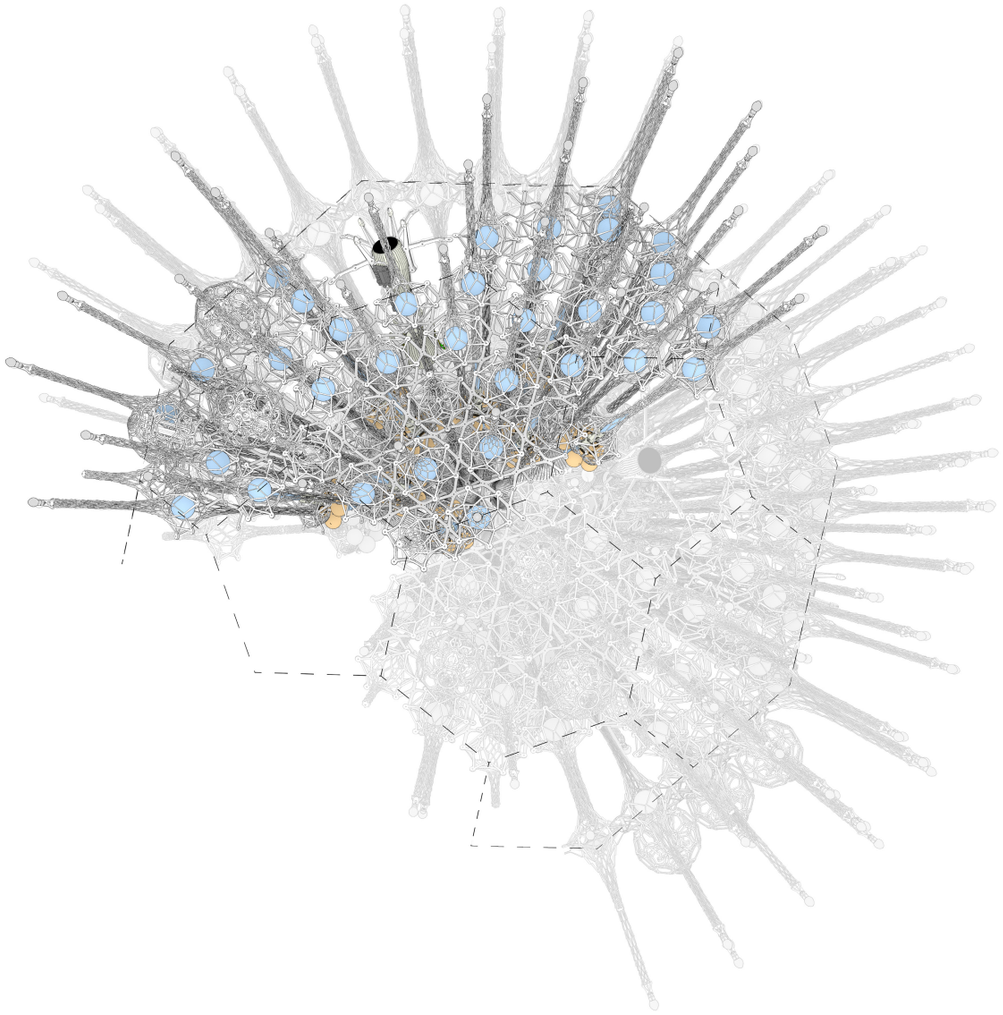
Structural Scaffold



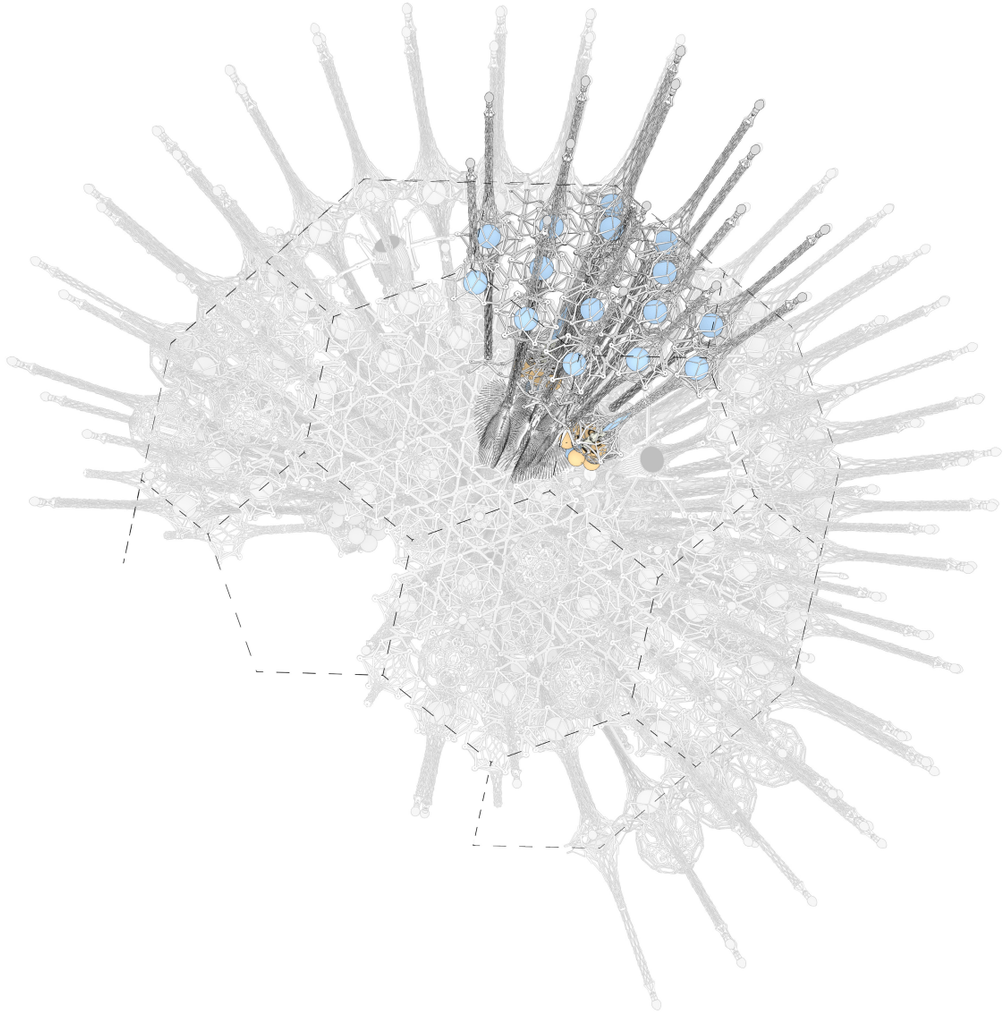
Dissipative Spines



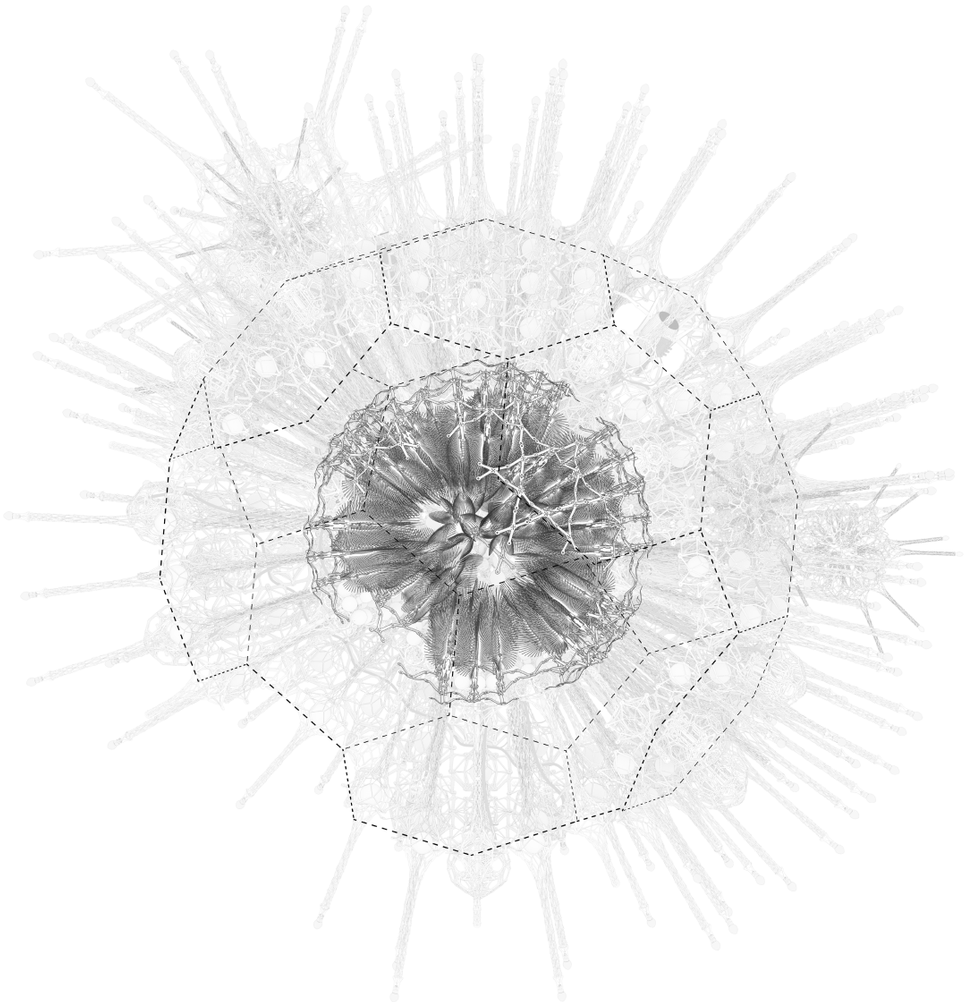
Satellite Cells



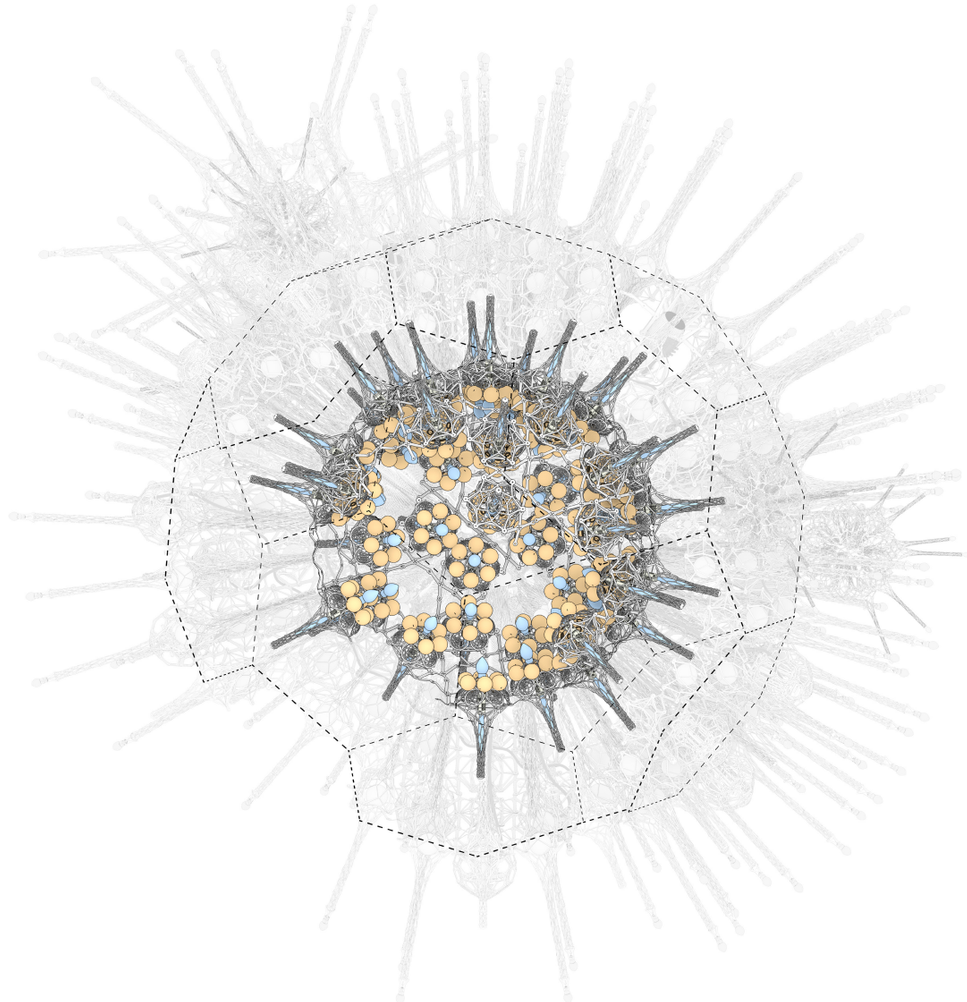
Triad Unit



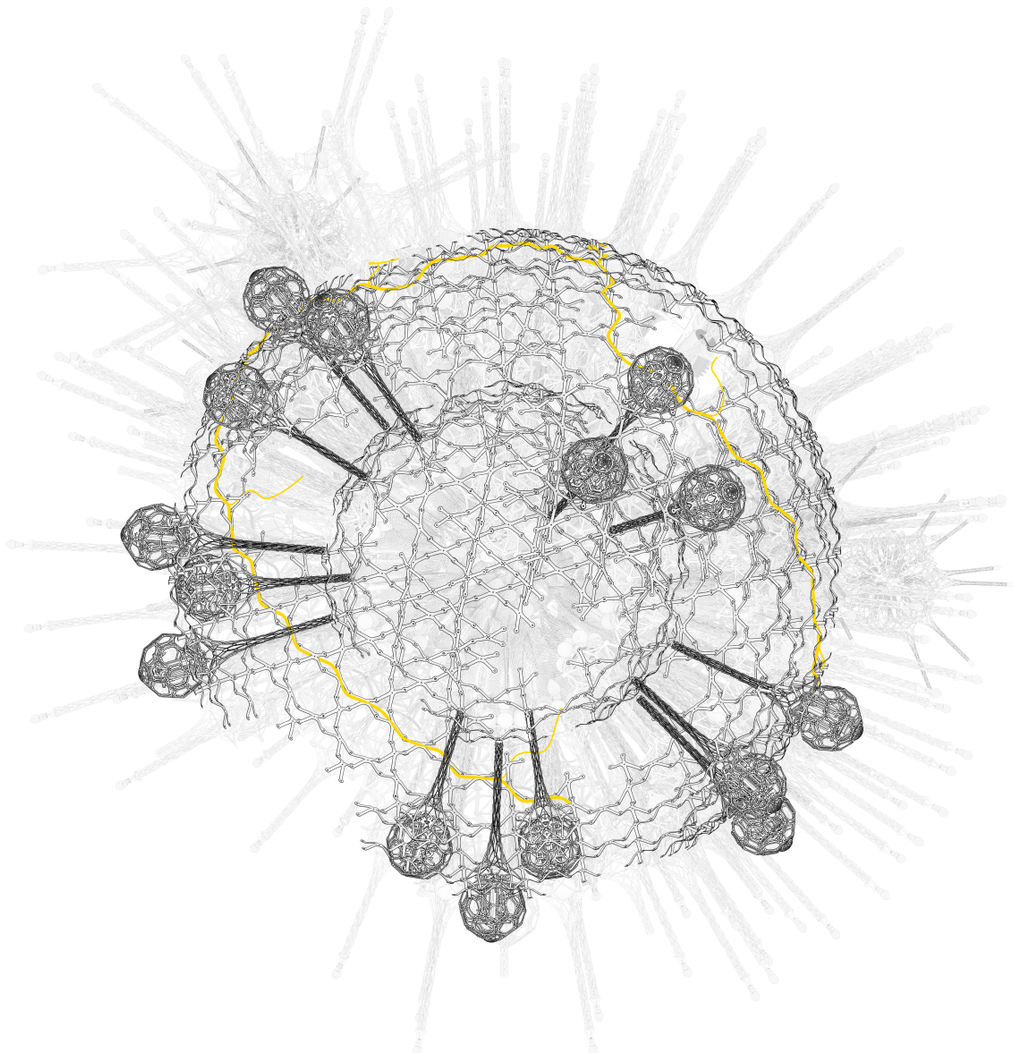
Sphere Unit



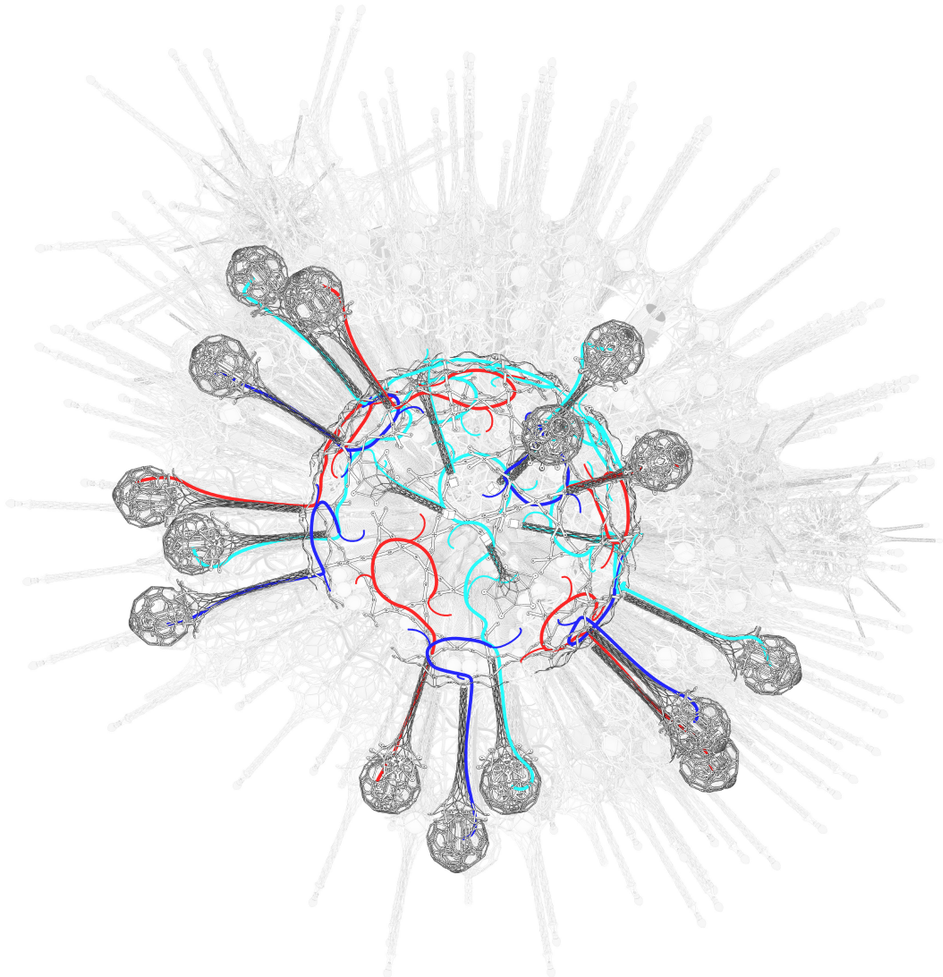
Vibrating Fronds



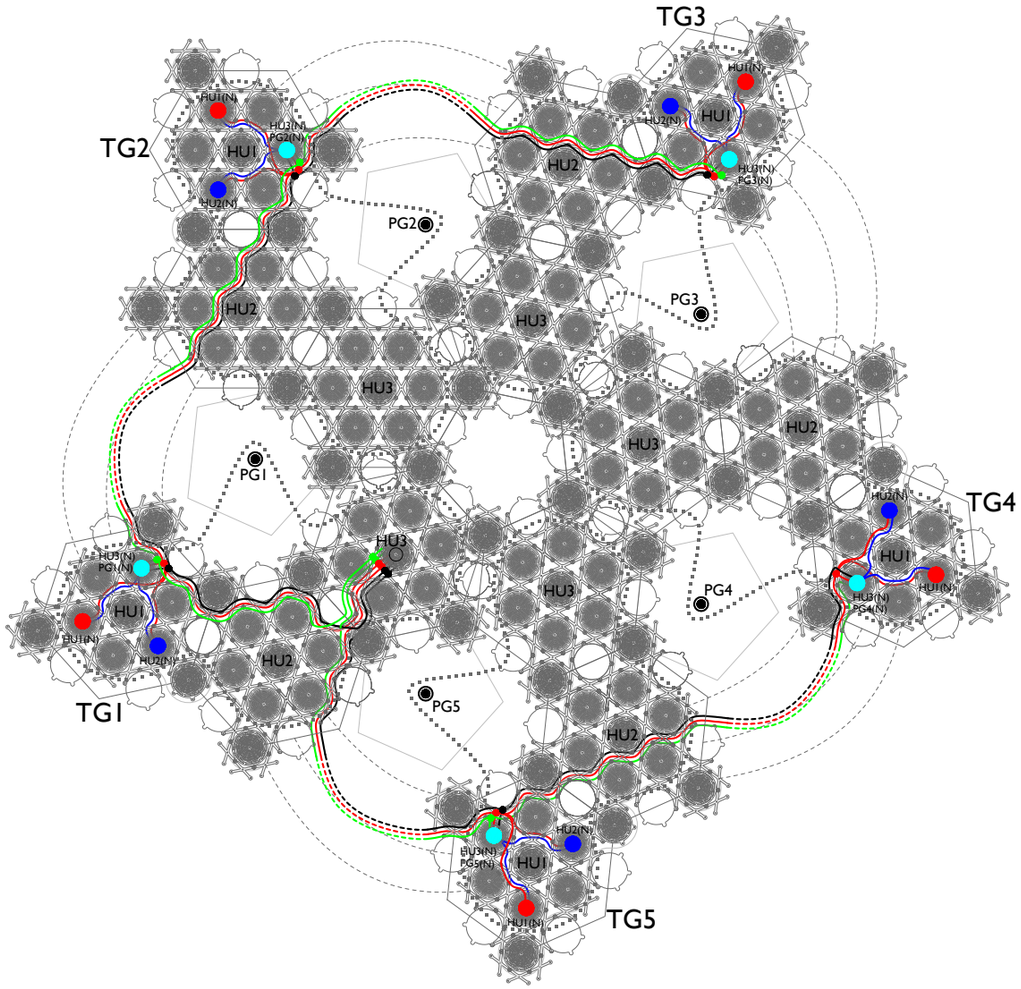
Illuminated Glass



Exterior Sphere Cabling



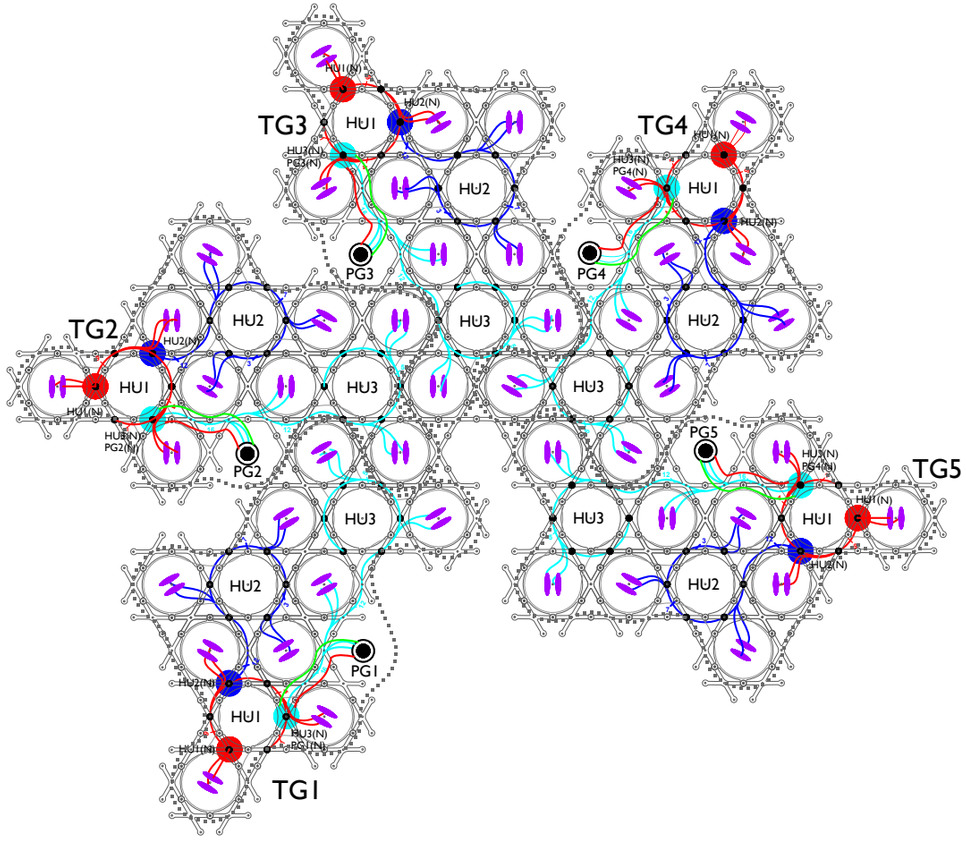
Interior Sphere Cabling



Exterior Sphere Cabling Plan

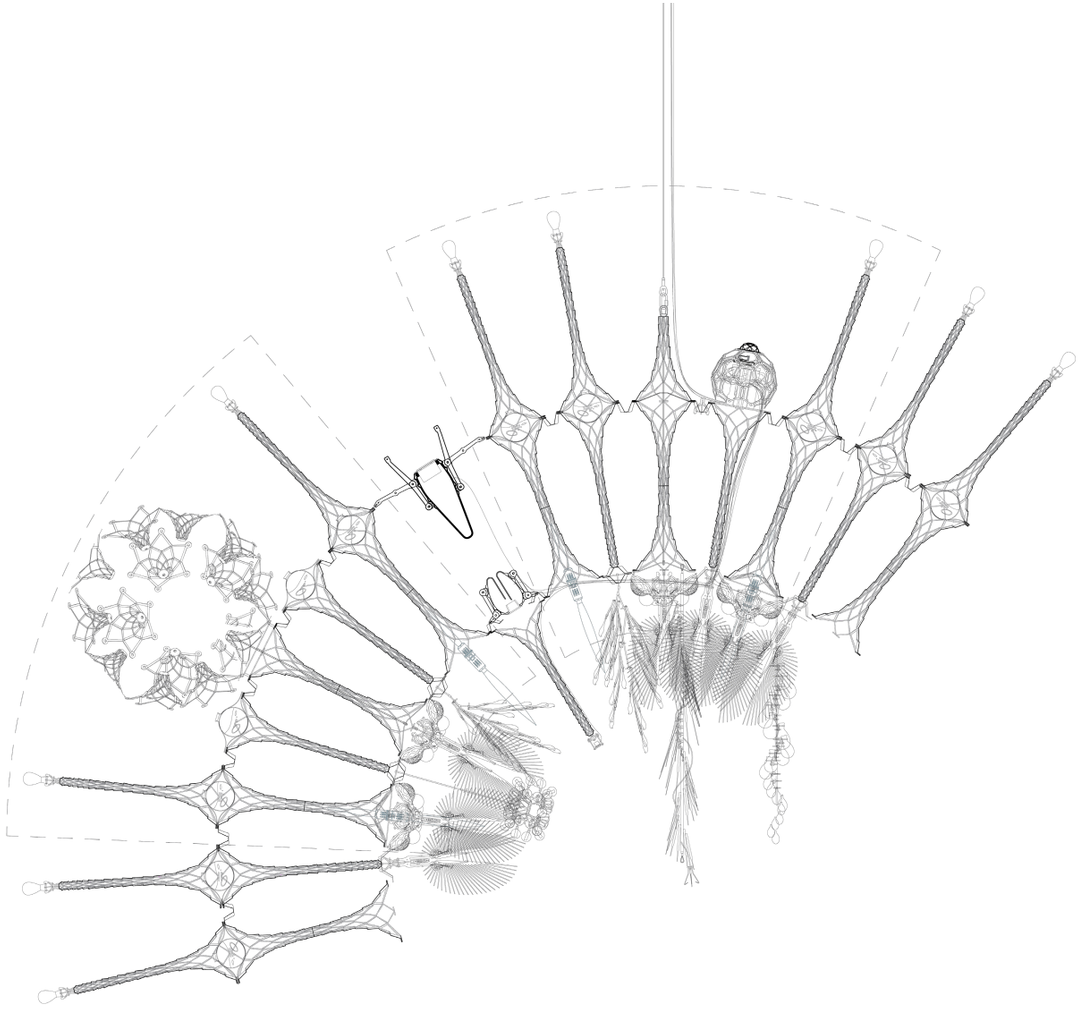
Primary Nest · Secondary Nest · Actuation Bundle · Cable Splitting · Cable Splitting

Ethernet · 12V Power · POE Audio · USB · *Not Actual Length · Umbilical Drop Point

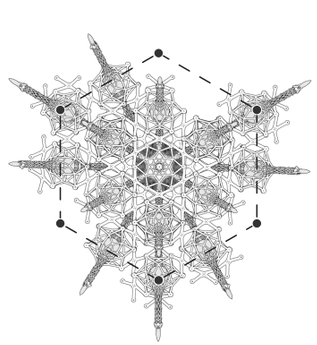


Interior Sphere Cabling Plan

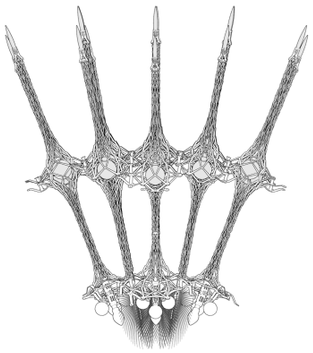
Primary Nest · Secondary Nest · Actuation Bundle · 4 Moth · Rebel Stars



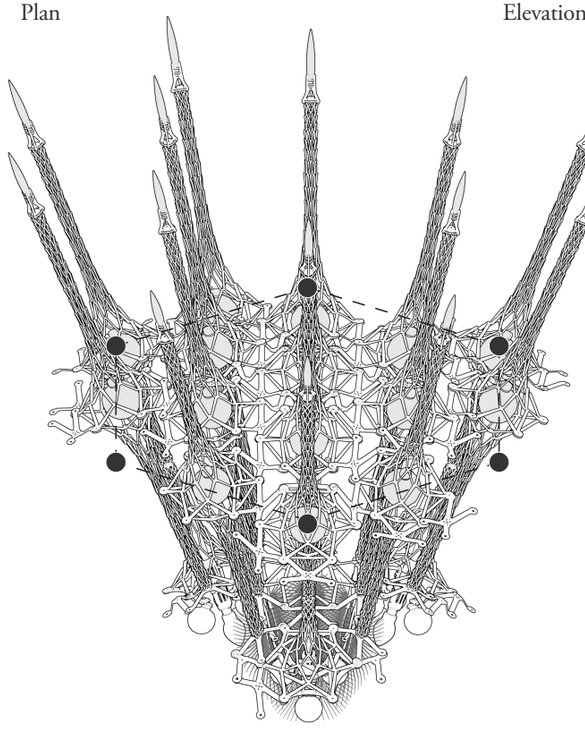
Noösphere Detail Section



Plan

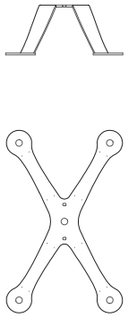


Elevation

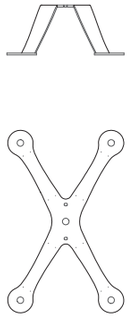


Axonometric View

Sphere Unit Views



Exterior X Plate



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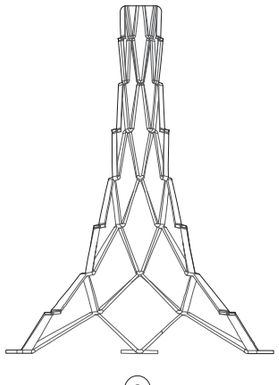
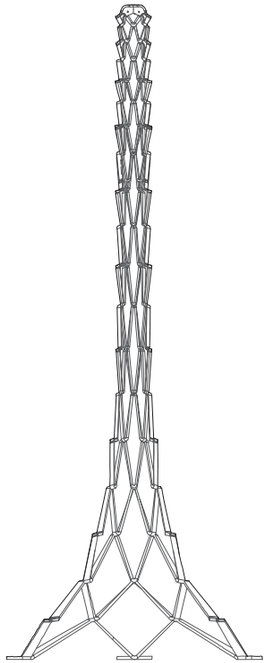
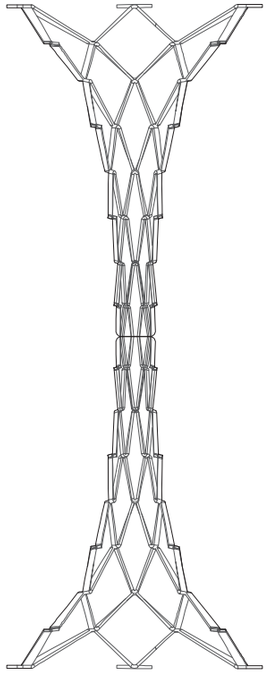
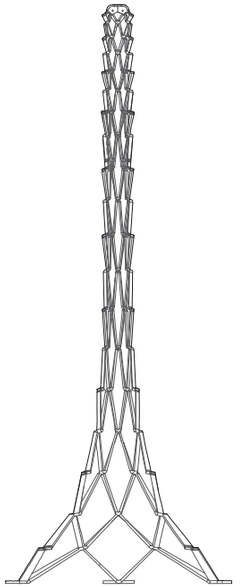
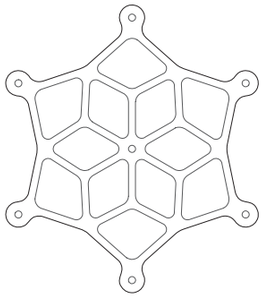


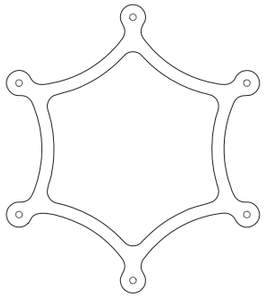




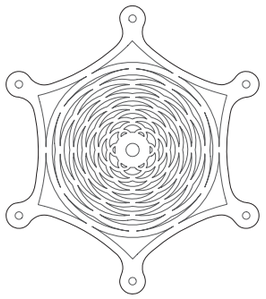




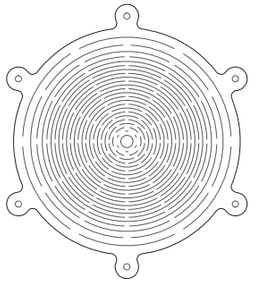
Spider Plate



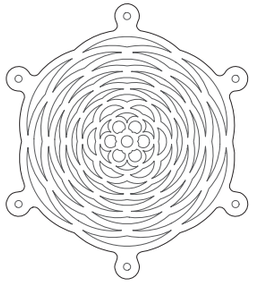
Ring



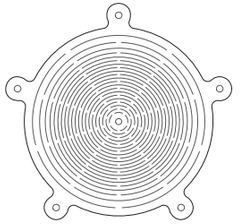
Short Spar



Long Spar



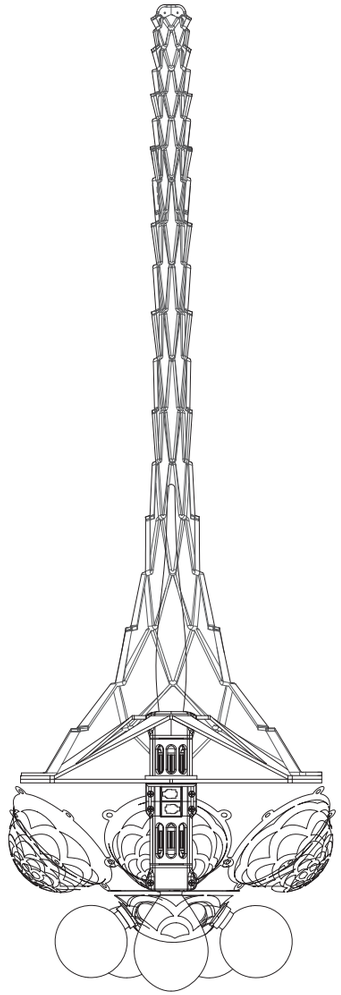
Double Short Spars



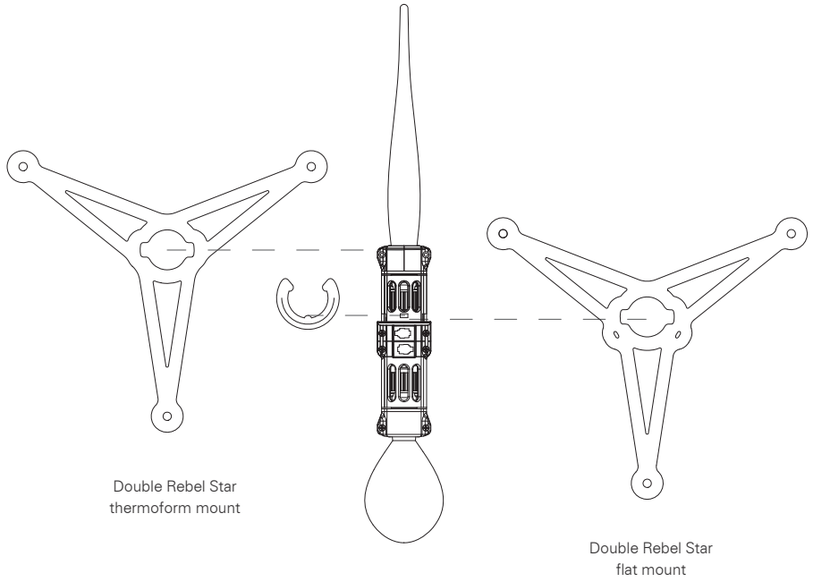
550mm GridEye Penta Spar

Noösphere Component Lexicon

Noösphere Component Lexicon



Illuminated Glass Spar



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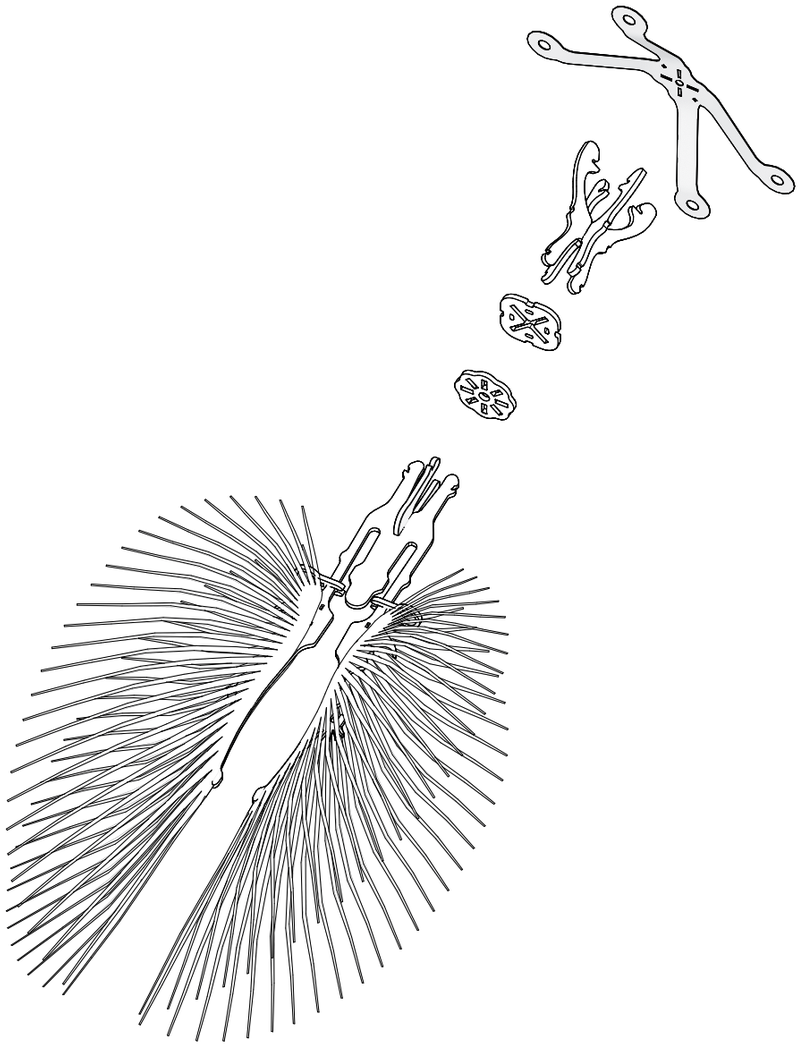
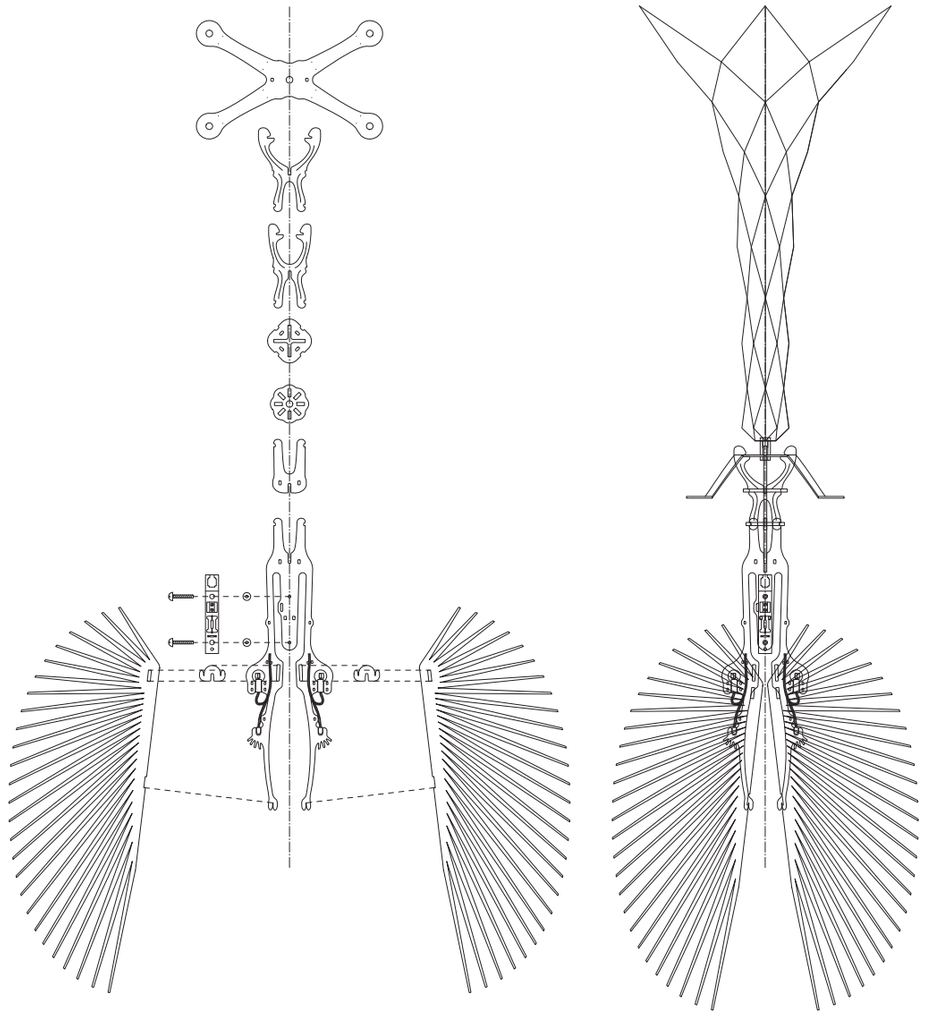
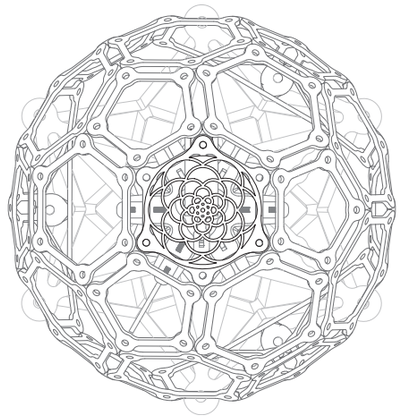


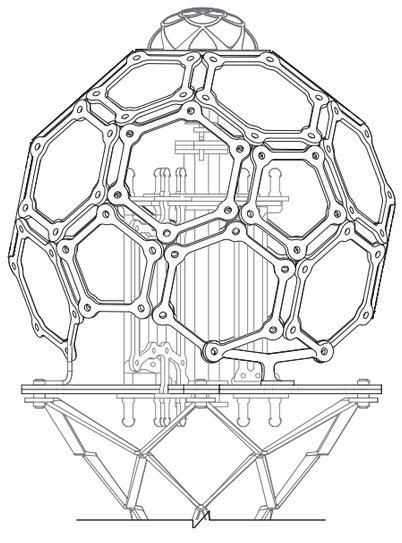
Vibrating Frond Assembly



Vibrating Frond Spar Assembly

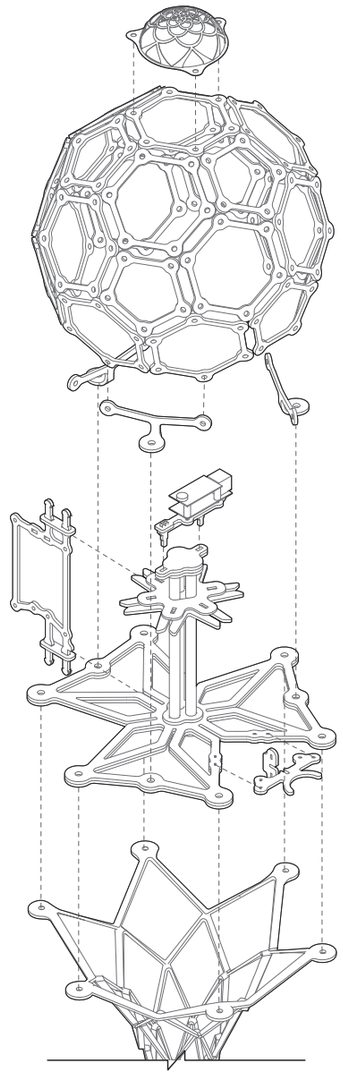


Plan



Elevation

Electronics Nest



Electronics Nest Assembly

Spatial Sound

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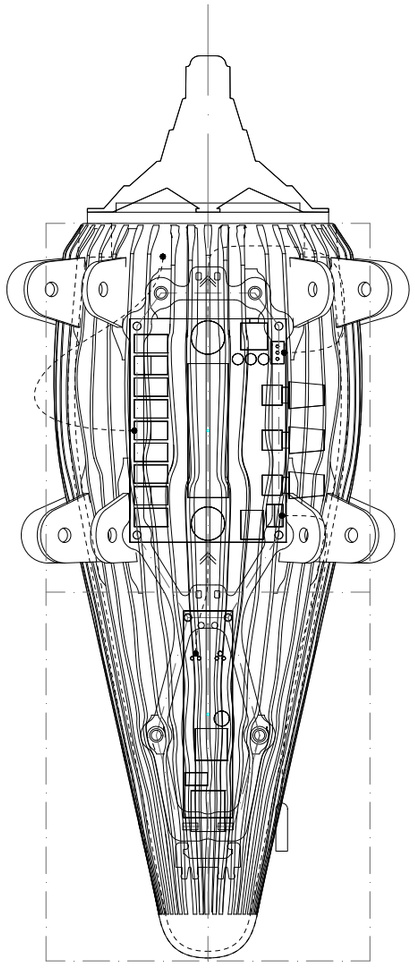
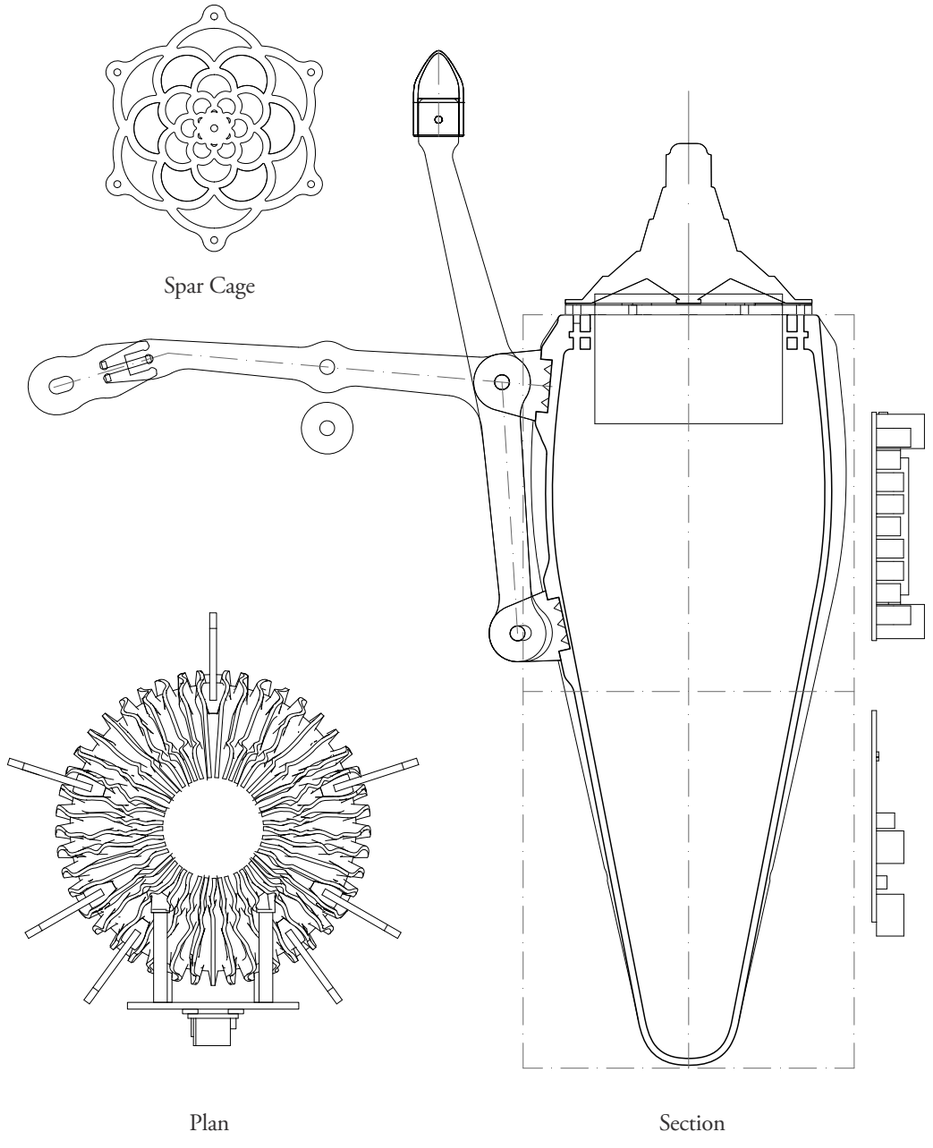
Omnidirectional speaker within Noösphere sculpture, Futurium, Berlin, 2019-2024

The spatial sound system of Noösphere creates a sculpture-like presence of sound in time and space. The physical installation functions like a spatial sound canvas, supporting sound holograms. The system features a modular spatial audio software framework designed to support the involvement of artists and technical collaborators. The LASG has partnered with 4DSOUND Technologies, an Amsterdam-based studio focusing on spatial sound as a creative medium to create immersive experiences and sound design tools for sculptures of different sizes, characters, and contexts. 4DSOUND is known for its immersive system which allows for evolving changes in three-dimensional positioning of sound, creating an expansive auditory experience that transcends traditional stereo or surround-sound systems. The composition within the Noösphere installation is led by artist Salvador Breed and engineer Poul Holleman.

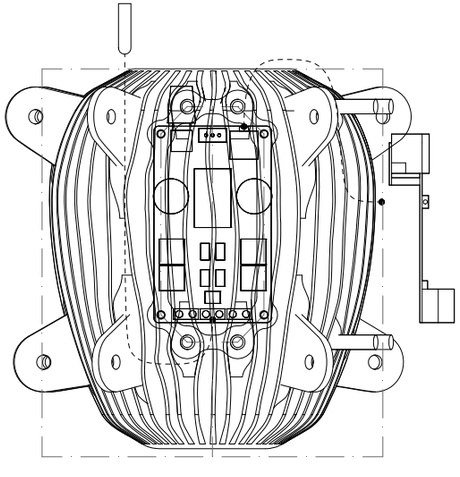
Noösphere employs an extensive array of speakers and custom software that enables sound to be positioned with precision within the space and surroundings of the sculpture, offering listeners a unique and enveloping sound experience. This technological framework supports the creation of a multi-channel acoustic soundscape producing a collection of individual sounds that can rise to intense crescendos or soften to gentle whispers in response to the viewers' movements and gestures .



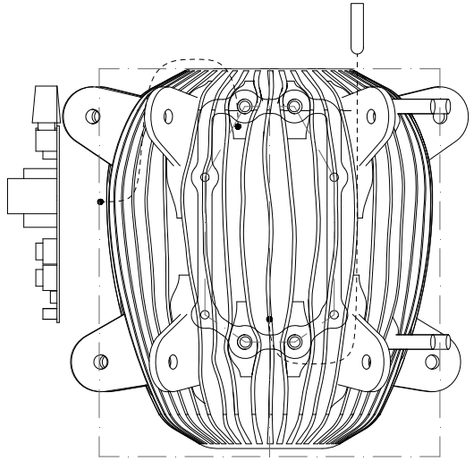
Omnidirectional Speaker with Amplifier



Omnidirectional Speaker Shell & Mounts

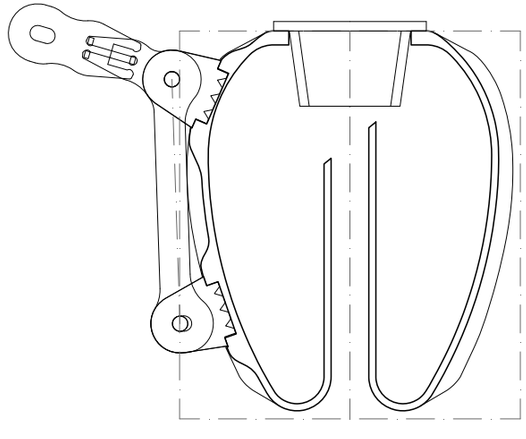


Front

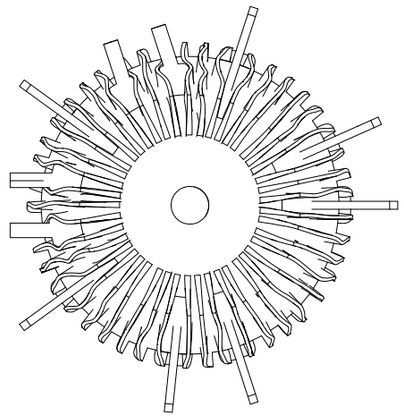


Side

Directional Speaker with Amplifier



Section



Plan

Directional Speaker Shell & Mounts

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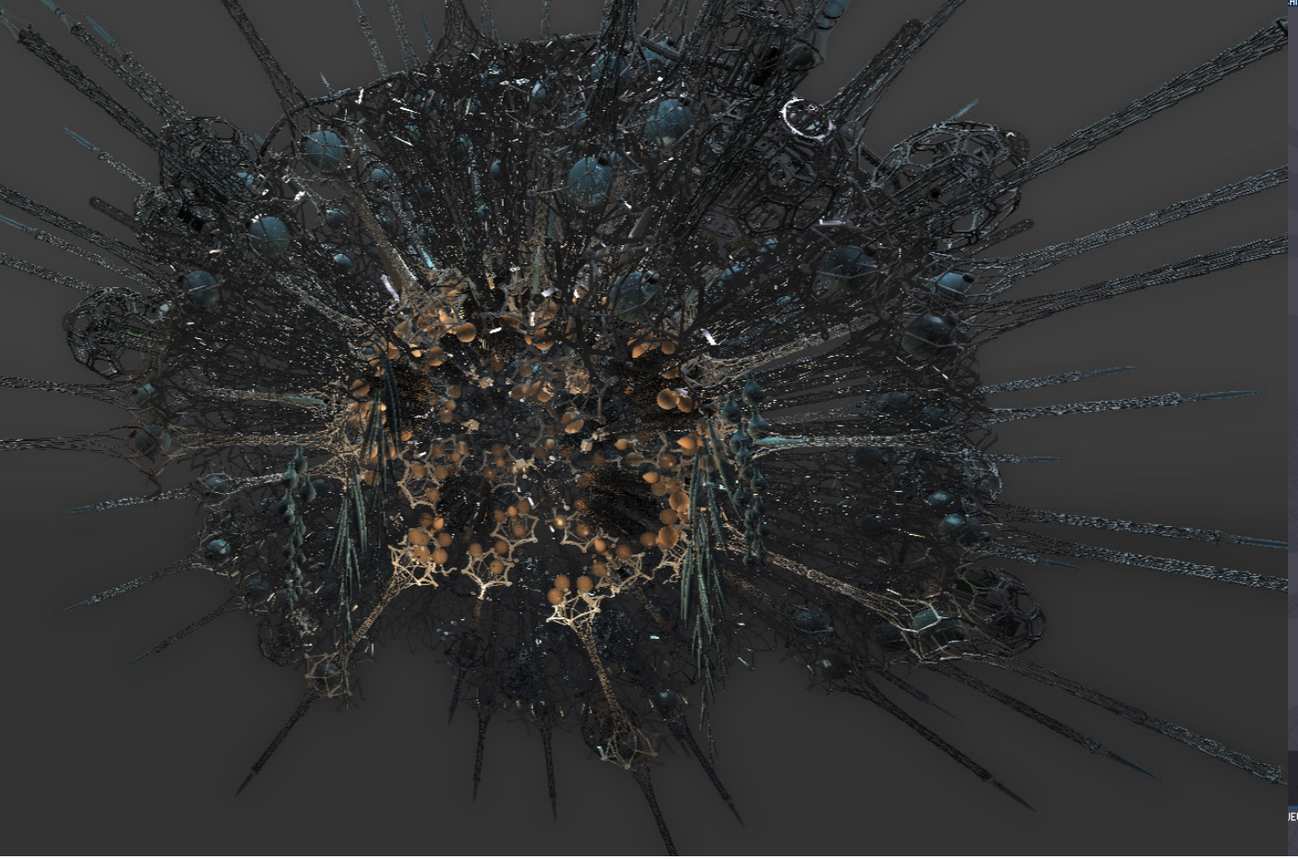
Electronics Nest within Noösphere sculpture, Futurium, Berlin, 2019-2024

Control Systems and Behaviour

The Living Architecture Systems Group has developed an electronic and software control system for Noösphere that uses a layered behaviour model. Behaviour is the collective activity throughout the installation, expressed by the activation and profiles of each electronically controlled physical and virtual device within the testbed environment. In parallel the group has developed software tools for composing testbed behaviour, accompanied by a custom control system that can be accessed with smart phones, tablets and laptops. This can include a range of controls from basic on/off and volume, scheduled periods of dormancy, and “performance” mode buttons.

Within these tools, control “profiles” are stored in embedded firmware on microcontrollers distributed throughout the sculpture. Profiles define how each individual device performs. These can be tuned to be long gentle gestures, short bursts, cyclic pulses etc. Each individual device can have its own response, allowing for a complex dynamic environment. The current distributed hardware and software architecture of Noösphere accommodates a variety of behaviour algorithms, coded as ‘Influence Engines’ which impact the behaviour of physical sculpture components according to their internal logic.



Influence Engines are parametric and can be added and customized for various sculptures, enabling non-expert artists to shape the behaviour and responses of a given environment by adjusting parameters using a graphical user interface. Influence Engines include various particle systems, mathematical models of wavefronts, and systems which pull in data from outside sources such as environmental sensors. True to their designation, each Influence Engine exerts influence upon the actuators within a sculpture, causing them to respond. The system also simulates the behaviour of the sculpture within a three-dimensional visualization . Within this modular system, new Influence Engines can be created as tools to experiment with new logic or to receive input from new sources of data.

Above

Screenshot of a web based digital twin of the Futurium Noösphere sculpture. Web based visualizations like this one could be used in future control interfaces for Noösphere.

Above

Screenshot of an early version of Testbed-Control software showing a simulation of the Futurium Noösphere installation. Device names are displayed when selected.

Human-choreographed behaviours within the testbeds employ the pre-visualization and control system as a comprehensive simulation of the components within the system, with visually overlaid invisible influences in 3D-rendered space. The simulation includes depiction of generative ambient influences such as wavefronts that move through the space, or localized influences generated by parametrically controlled particle systems that respond to sensor input and modalities of the sculpture. The parameters of this layered behaviour system can be tuned and shaped by non-specialized operators in order to create expressive responses and dynamic activity within the testbed environment.

The most recent series of custom testbed control software debuted with Futurium Noösphere in 2019 in Berlin. This testbed comprises a clustered group of shell structures that form interlinked spherical meshwork scaffolds. High-power LED lights, vibrating fronds, and high-fidelity omnidirectional speakers were integrated within the primary double-shell sphere scaffold, along with proximity and motion sensors and sound detectors. When viewers wave and gesture, a distributed system of some two dozen microcontrollers works in concert with a central control computer in order to orchestrate intricate patterns of rippling light, sound, and motion. The simplified structuring of groups, nodes, and devices within this testbed provided an opportunity to launch this new software and data exchange protocol.

Above

Screenshot of an early version of Testbed-Control software showing a simulation of the Futurium Noösphere installation.

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Noösphere at the Futurium Science Center, Berlin

About the Living Architecture Systems Group

This publication forms part of a series of work-in-progress reports and publications by Living Architecture researchers and contributors. The Living Architecture Systems Group is an international partnership of researchers, artists, and industrial collaborators studying how we can build living architectural systems— sustainable, adaptive environments that can move, respond, and learn, and that are inclusive and empathic toward their inhabitants. "Smart" responsive architecture is rapidly transforming our built environments, but it is fraught with problems including sustainability, data privacy, and privatized infrastructure. These concerns need conceptual and technical analysis so that designers, urban developers and architects can work positively within this deeply influential new field. The Living Architecture Systems Group is developing tools and conceptual frameworks for examining materials, forms, and topologies, seeking sustainable, flexible, and durable working models of living architecture.

Living Architecture Systems Group research is anchored by a series of prototype testbeds: accessible, immersive architectural sites containing experiments and proof-of-concept models that support living architecture as a practical model for our future built environment. These testbeds act as boundary objects that help researchers answer ethical, philosophical and practical questions about what living architecture means and who it is for within our societies and environments, creating sites of collaborative exchange that act both as research ventures and as public cultural expressions.

A series of far-reaching critical questions can be explored by using the tools and frameworks that are described within this specialized publication series: can the buildings that we live in come alive? Could living buildings create a sustainable future with adaptive structures while empathizing and inspiring us? These questions can help redefine architecture with new, lightweight physical structures, embedded sentient and responsive systems, and mutual relationships for occupant that provide tools and frameworks to support the emerging field of living architecture. The objective of this integrated work envisions embodied environments that can provide tangible examples in order to shift architecture away from static and inflexible forms towards spaces that can move, respond, learn, and exchange, becoming adaptive and empathic toward their inhabitants.

Noösphere
Living Architecture Testbed Sculpture

Living Architecture Systems Group

This publication documents the inner workings of the Noosphere sculpture. Noosphere is an evolving interactive spherical sculpture that acts as a powerful public beacon, a positive symbol of shared sustainable futures. The exhibitions of Noosphere have been seen by hundreds of thousands of in-person visitors in Toronto and Berlin and by millions of online viewers.

The giant suspended sphere of Noosphere contains a nest-like structure of intricate webs powered by artificial intelligence. High-powered lights pulse and shimmer while densely gathered fronds shiver. Arrays of high-fidelity, omnidirectional speakers produce a collection of individual sounds that together rise to intense crescendos and soften to gentle whispers. The expressive, open forms of the Noosphere sculpture provide valuable examples of next-generation paradigms for interdisciplinary research and design, helping to equip emerging generations of designers and creators with the skills they need for working with far-from-equilibrium environments.

The evolving sculpture is created by the Living Architecture Systems, an international group led by artist-architect Philip Beesley and hosted by the School of Architecture, University of Waterloo. This international partnership research partnership combines artists, engineers, designers and scientists from many organizations around the world studying how the next generations of experimental buildings and environments might grow, think, and care.

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https://media.lasg.ca/noosphere

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