

# Continuum Resonance

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## Behind the scenes

Text by Daito Manabe + Sinan Bökesoy

**An exhibition “Continuum Resonance” expands on traditional concepts of interactive music, sound synthesis, and generative composition, offering a new perspective on the interaction between space and sound.**

Inspired by a new facility design supervised by architect Tadao Ando, Daito Manabe has created novel artworks centered on the themes of music and space. The exhibition showcases innovative sonic art and visual art by using “PolyNodes” generative audiovisual system, co-developed by Manabe and Sinan Bökesoy of sonicLAB.

The software “PolyNodes” adopts an advanced approach that maps the temporal characteristics of sound to three-dimensional space, visualizing them as geometric structures. The multi disciplinary foundation of this installation project stems from the concept of music and architecture fusion proposed by Iannis Xenakis.

This project is the result of a synergistic collaboration between Manabe's background in mathematics-based media art and sound art, and Bökesoy's expertise in composition and generative sound synthesis, exploring new methods of expressing sound and architecture.

“Continuum Resonance” incorporates human movement, and embodies the attempt of transcending the dualism between observer and observed. It maps the spatial information of human body with multi-scale approach to “PolyNodes” sonic architecture, which enables continuous manipulation from microscopic to macroscopic layers of its sonic structure.

Set in Tadao Ando's architectural space, “Continuum Resonance,” where audience movement within the space controls system parameters, aims for an organic integration of architecture, music, mathematics, and human dynamics.



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## Fusion of Architecture and Music

In both architecture and sound composition, the process starts with defining fundamental elements—like the basic units of sound or architectural features—and arranging them within specific constraints. This approach treats sound as a structured form, shaped and analyzed in detail, much like architectural design.

For example; Olivia Mattis introduced the metaphor of crystal in relation to the Phillips Pavilion. (1958, an iconic designed by I. Xenakis and always inspiring the following generations ) This metaphor highlights how a crystal's unique external form emerges from the arrangement of its internal atomic structure, showing how simple units can extend through space to create complex forms. This idea applies to both architecture and music, where compositions can grow and form like crystals. Xenakis's piece "Concret PH" (1958), performed at the Phillips Pavilion, used tape manipulations of burning charcoal sounds, reflecting the design of the Pavilion's walls. The "P-H" stands for "Philips" and "paraboloïdes hyperboliques," while "concret" refers to both "musique concrète" and the concrete used in the Pavilion's structure. It shows a strong link between architecture and the organization of sound with in the performance space.

The visual comparison between the Phillips Pavilion and a sample geometric structure from "PolyNodes" invites a question: Is this similarity a coincidence, or does it reflect a universal approach to designing with sound and space? It is this universal aspect which strikes us when following our inspirations, the composer greats such as I. Xenakis and their formalized approach, and using today's tools of creation where many of these inter-connections are revealed and new structures upon these timeless theories are built. In this context, the exhibition "Continuum Resonance" of Manabe delivers the bridge between the virtual generative forms of "PolyNodes" to the physical realms of architectural space and acoustics.

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“PolyNodes” is a generative sound synthesis application that analyzes input recorded sound to reveal its temporal characteristics across macro, meso, and micro time domains. These characteristics are akin to the geodesic points of a landscape, where shapes are fractal, and the level of detail depends on the scale of observation. The macro, meso, and micro regions of sound represent different time levels within sonic structures. As explored in Sinan Bökesoy’s thesis, “La conception du macro son par le formalisme,” the creation and management of complex sounds is a multi-layered, dynamic process, and he has demonstrated this in several software applications, such as “Le Modèle Cosmos.” Complex sound objects are crafted by layering and mixing numerous individual sound sources across various time scales, revealing intricate interactions between these three levels of sound. “PolyNodes” establishes a unique bridge for achieving this.

Through this analysis, we achieve a unique 3D spatial representation of the data — the “PolyNodes” geometry. This geometry functions like a network, allowing us to navigate and create continuous sound transformations from the input sonic material. The triangulation between nodes (the temporal onsets) forms virtual pathways where macro, meso, and micro agents, each with their synthesis engine, move and interact using the input sound material. Unlike an opaque or “black box” system, “PolyNodes” is an interactive structure (via virtual DSP objects distributed in space) that is audible, visible, and controllable. Additionally, “PolyNodes” can partially deliver its generated data to communicate with other applications in real time, enhancing its interactive and integrative capabilities.

### A Historical Examination of Interactive Installations with Audience Participation

Audience-participatory installations have evolved since the 1960s Fluxus movement, developing alongside technological advancements. From the pioneering works of Nam June Paik and John Cage, through the introduction of sensor technologies by Myron Krueger and David Rockeby, to contemporary works utilizing AI and VR/AR technologies, the history of this art form is rich and diverse.

Today, this concept has transcended the art world and is routinely employed in the gaming and entertainment industries. Motion sensor games like Nintendo Wii and Microsoft Kinect, interactive theme park attractions, and participatory digital art exhibitions have become commonplace.

However, most current works feature direct and easily understandable relationships between the audience and the artwork. In contrast, artists like Daito Manabe are exploring more complex and indirect forms of audience participation. Their approach investigates mechanisms where audience behaviors influence multiple parameters within the system, intertwining complexly to produce unpredictable outputs.

This approach deepens and diversifies the relationship between the audience and the artwork, enhancing unpredictability and emergent properties. It offers viewers new insights and experiences, providing fresh perspectives on the relationships between art, technology, and humanity.

By utilizing machine learning techniques for image analysis, object recognition, speech recognition, natural language processing, and other multimodal analysis, it is possible to acquire various types of data. This enables the control of interactive installation parameters in complex ways that alter the behavior of the entire system, rather than through simple one-to-one correspondences.

As AI-driven feature detection technologies continue to evolve, it is anticipated that these complex and indirect forms of participation will become more sophisticated, giving rise to novel artistic experiences.

## Intersection of Mathematics and Music

The term “Generative Audio Synthesis” or “Generative Music” refers to processes where computers assist in sound design and the creation of sonic structures. These processes can be fully automated but also remain under the control of the composer. Since the 1950s (even before personal computers were available), mathematical models inspired by natural processes have been used artistically by 20th-century composers in their musical creations. Advances in acoustics, electronic tone generators, recording techniques, and transducers have influenced new trends in sound design and instrumentation, shaping new musical genres. With the arrival of personal computers, digital audio, and related software, a deep interaction emerged between composers and these tools for computer-assisted sound design and musical creation. No single tool dominates over others, as each continues to be perfected, revisited, and updated with new technologies and designs. Every compositional tool focuses on a specific process, algorithm, or technique, offering expertise, control, and variety in that domain. In this context, we believe that the current or future trends in generative AI will not replace or render existing tools obsolete—just as no instrument could replace both the violin and the cello simultaneously. The future of the violin is the violin; it didn’t take millions of years for nature to craft it from a tree, but it has been developed and perfected over centuries by humans as a musical instrument.

“Generative Audio Synthesis” and “Generative Music” still have vast potential for experimentation and development. Old practices should be revisited with new technologies, studied, and experimented with—this is the only way to truly understand the process. “Generative Audio Synthesis” not just about the complexity of its models, algorithms, or AI. Instead, it is defined by how effectively these models map and interpret key sound design concepts, such as timbral evolution, sonic interaction, and structural details of audio. Its essence lies in capturing and expressing the principles of sound composition, whether through simple or complex systems, while reflecting the mindset of its creators.

## The Geometry of Space and Body

As a pioneer in the expression of space, body, and mathematics, the achievements of Oskar Schlemmer (1888-1943) are particularly noteworthy.

Today, it has become common to treat the body geometrically using programming, CG, and motion capture technology. Even with everyday devices like iPhones, it’s now possible to associate the body with graphics, accelerating the democratization of these expressive technologies. However, as early as the 1920s, Schlemmer was already pioneering attempts to perceive the body mathematically, develop a mathematical approach centered on geometry, and extend this into actual three-dimensional spatial performances, rather than static two-dimensional works or sculptures.

Schlemmer created innovative expressions that extended the body using costumes and stage designs, transforming it through geometric patterns. In his representative work “Das Triadische Ballett” (1922), he covered dancers’ bodies with geometrically shaped costumes, abstracting and geometrizing human movement to explore new relationships between body and space. Although within the scale of stage design, Schlemmer’s achievement in relating spatial and architectural concepts to the body using mathematics was groundbreaking. This innovative approach was made possible by the interdisciplinary environment of the Bauhaus design school. Under the Bauhaus philosophy of “total art,” Schlemmer fused different fields such as art, dance, architecture, and mathematics, opening up new horizons of expression.

Schlemmer’s pioneering efforts continue to influence contemporary digital art, interactive installations, and even virtual and augmented reality fields. The concepts of “geometrization of the body” and “mathematical relationship between space and body” that he explored in the 1920s are now being realized more precisely and interactively through today’s technology. This exhibition attempts to interpret and further develop Schlemmer’s ideas in a contemporary context. In addition to the approach of architectural and musical space, I have digitized the body, incorporated architectural space as a concept for dancers’ movements, created choreography, and then transformed this choreography into visual imagery.

One of the work “Synthesis of Body-Space-Music” is created in 360-degree video, typically viewable through VR headsets. However, for this exhibition, I’m using a special studio where images are projected onto walls and floors, allowing viewers to experience the work from the same camera perspective used in creating the CG imagery. This enables complete immersion in the CG space and allows viewers to experience the work as three-dimensional imagery with the naked eye.

Furthermore, by placing architecture, CG, and the music generation synthesizer “PolyNodes” in the same space and allowing them to influence each other, I attempt to update the relationships between architecture, music, and the body.

These efforts can be seen as a deepening of the relationship between body and space that Schlemmer explored nearly 100 years ago, now using contemporary technology. By reflecting on Schlemmer’s achievements and utilizing modern digital technology, we can pursue new possibilities in body expression and spatial design, discovering further creative developments.