# La Solitudine delle Moltitudini
## (The Solitude of the Multitudes)
*Video installation and electroacoustic cantata for 16 female voices on fixed media (2023-24)*

Music by **Marco Buongiorno Nardelli**
Video art by **Alice Grishchenko, Gabor Kitzinger, Albert-Laszlo Barabási**
Soprano and lyrics by **Júlia Coelho**

Submitted by:
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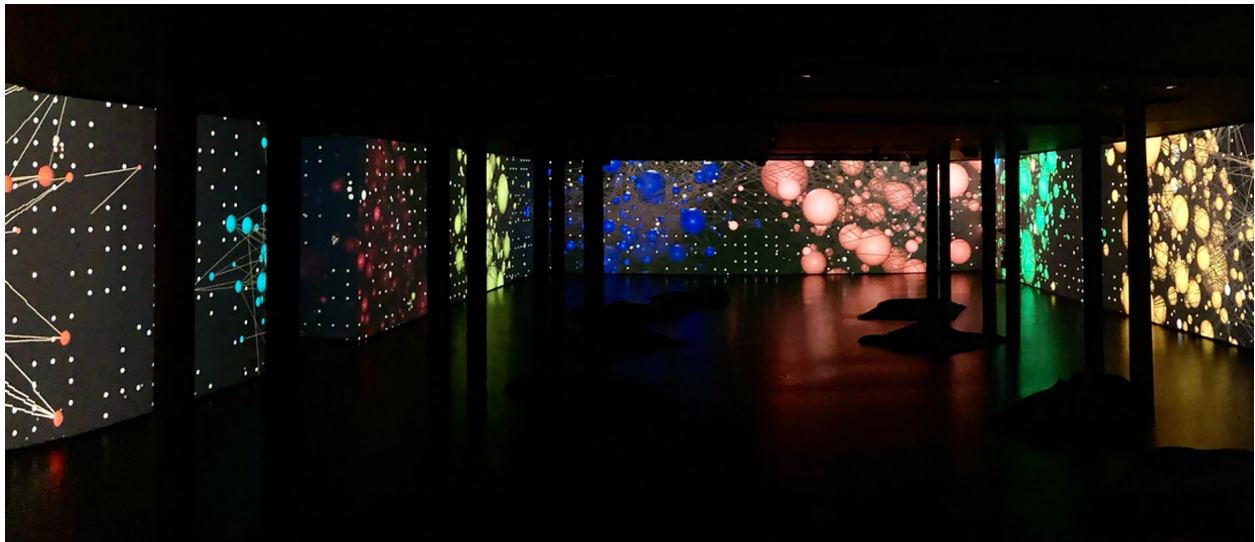
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"La Solitudine delle Moltitudini" in the immersive room of the MEET Digital Culture Center, Milan, Italy, 2023

"La Solitudine delle Moltitudini" is an immersive room audiovisual composition originally developed for the exhibition "The Art of Connection – Albert-Laszlo Barabási" on display at the MEET Digital Culture Center in Milan Italy, between February and April 2023 as a 15-channel video, 10-channel audio work and since then has become a staple of their immersive room experience programs. The present version for NeurIPS was developed for and presented at the CURRENTS 2024 festival of new media art in Santa Fe, NM (https://currentsnewmedia.org/festivals/currents-2024-art-technology-festival/) .

The work is based on the theories developed by Albert-Lazlo Barabasi, a pioneer of network science, who with his research contributed to the discovery and development of models that make visible the hidden order behind complex data systems. Network analysis methods exploit the use of graphs or networks as convenient tools for modeling relations in large data sets. If the elements of a data set are thought of as "nodes", then the emergence of pairwise relations between them, "edges", yields a network representation of the underlying set. Pairwise similarity relations between nodes, defined through the introduction of a measure of "distance" in the network, determine when individual nodes are connected (i.e., in a social network people are connected according to their acquaintances, collaborations, common interests, etc.).

Networks and their formation form the visual texture of the animations by video artists Alice Grishchenko and Gabor Kitzinger, but also the inner structure of the music by Marco Buongiorno Nardelli: "La Solitudine delle Moltitudini" is a metaphor of our increasingly interconnected world, where data and information shape our perception of self. This ecosystem is represented both graphically and musically, by graphs and networks, that provide the main visual material and are at the foundation of the generative score.

The score consists of graphs made of an ensemble of nodes connected by directional paths that are used to combine the sound material in an infinite combination of possibilities. Each node contains specific information on what sort of gesture the system will perform, and it is executed in response to the images of the immersive video. Once a single graph has been executed, a new graph is generated, making the performance virtually infinite without presenting the same material more than once. Graphs are constructed using various models for the generation of networks following a timeline that culminates with the model for the generation of scale-free networks, a model that incorporates two important general concepts, growth and preferential attachment: growth means that the number of nodes in the network increases over time; preferential attachment means that the more connected a node is, the more likely it is to receive new links. Nodes with a higher degree have a stronger ability to grab links added to the network. The resulting topology is fundamental in the analysis of many real networks, including networks that represent the evolution of musical compositions, a realization that is at the foundation of Marco Buongiorno Nardelli's compositional practice.

The score incorporates elements of AI generated sounds through a synthesis method mediated by a proprietary recurrent neural network (RNN) model based on the SampleRNN architecture of Mehri et al. (2017). The model was trained on the same samples recorded by the soprano Júlia Coelho for the installation, and thus does not use any data from third parties. The AI generated samples are integrated in the fabric of the composition exploiting the same geometrical structure of its pitch and rhythmic spaces to create a subliminal trace in the imaginary of the viewers,

The score is generated by a computer-assisted compositional framework that combines code (www.musicntwrk.com) with live processing in Ableton Live. The video is produced in Unreal.
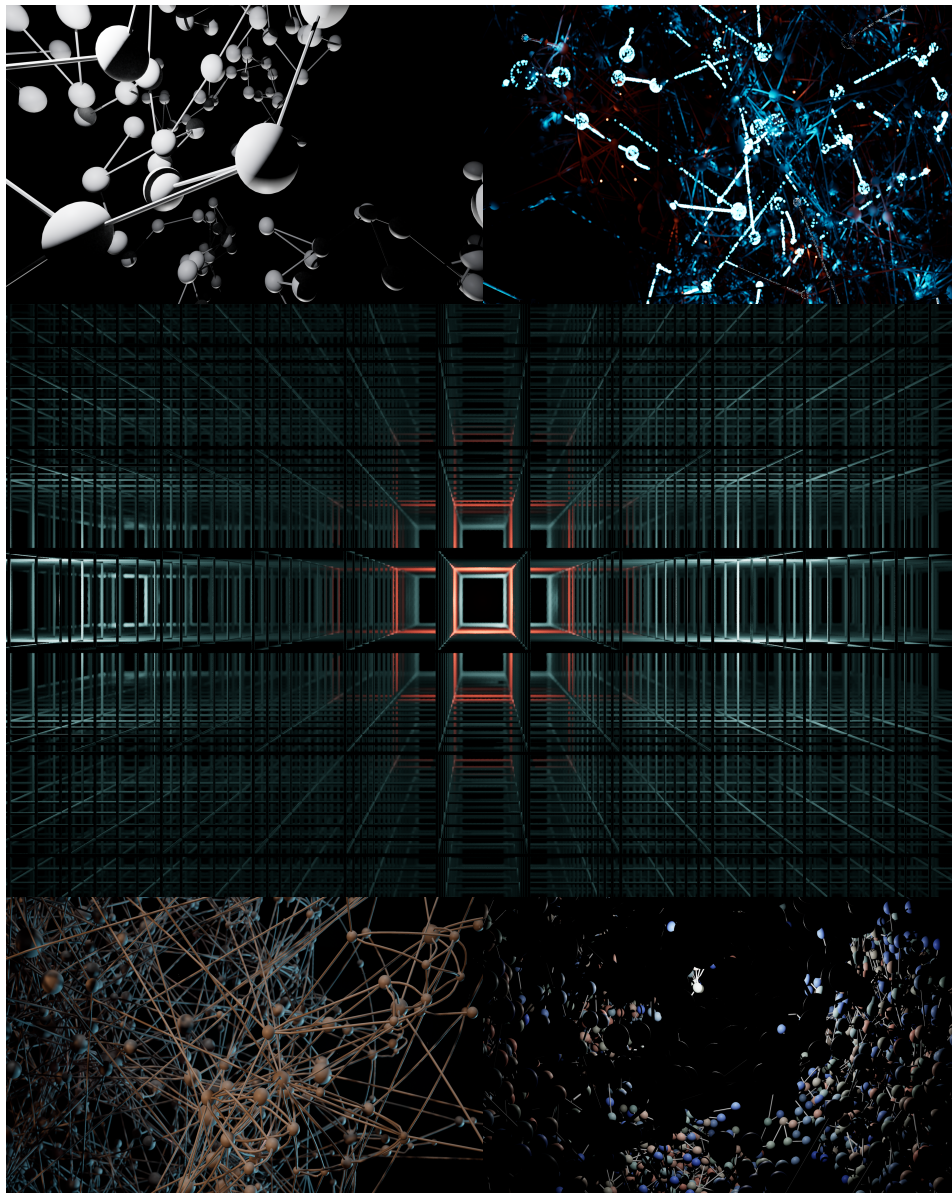


A few stills from the video.

Given the size of the video files (>2Gb), we list below the permanent links where these files can be downloaded:
1. Single channel version:
   https://www.dropbox.com/scl/fi/hewkndlo3q5hrmgzm04v4/Center_HD.mp4?rlkey=1duf56e6hh1rahn4i0xzyazzv&dl=0
2. Three channels (immersive) version:
   https://www.dropbox.com/scl/fi/we9gbreohswzggq45lp1a/threeCameraComp.mp4?rlkey=mvts4lnfp1bw8xibx78g0a2eh&dl=0

Artists' bios

**Marco Buongiorno Nardelli** is a composer, installation artist and computational physicist who brings a platform for Art/Science integration rooted in his profound and extensive expertise in development of scientific and artistic software and his vision for sustainable community software development. He is Regents Professor at the University of North Texas, with academic appointments in both the Department of Physics and the Division of Composition Studies, a member of iARTA, the Initiative for Advanced Research in Technology and the Arts and CEMI, the Center for Experimental Music and Intermedia, and an External Professor at the Santa Fe Institute. He is a pioneer in the application of complexity theories and big data tools to the structure of music as a generalized mathematical space, and he is internationally recognized for his music and new media installations. His most current interest is the creative use of generative deep learning tools in his compositional pipeline.

**Alice Grishchenko** is a design generalist and has experience with illustration, animation, data viz, game design and virtual reality. She received her MFA in digital animation and interactive media from the Ohio State University. Between 2017 and 2021, she has worked as a data visualization specialist at the Center for Complex Networks Research, Northeastern University. She has contributed to a variety of projects at BarabásiLab, from »Nature 150« to visualizing the human genome and 3D-printing data sculptures. Currently she is an independent contractor working mainly with academic scientists in data visualization and artistic data rendition.

**Gábor Kitzinger** is a video artist and member of Hungarian visuals studio, Glowing Bulbs. He started vj-ing in the early 2000's and joined Glowing Bulbs in 2006; together they designed several large-scale architectural mappings and did numerous vj performances around the globe. For his solo video art, music videos and sound-reactive A/V shows he creates abstract and colorful 3D animations, and often appears at exhibitions with his stylistically similar sculptures and paintings.

**Albert-László Barabási** is a network scientist, fascinated with a wide range of topics, from unveiling the structure of the brain to treating diseases using network medicine, from the emergence of success in art to how does science really works. His work has helped unveil the hidden order behind various complex systems using the quantitative tools of network

science, a research field that he pioneered, and lead to the discovery of scale-free networks, helping explain the emergence of many natural, technological and social networks. Albert-László Barabási spends most of his time in Boston, where is the Robert Gray Dodge Professor of Network Science at Northeastern University and holds an appointment in the Department of Medicine at Harvard Medical School. A Hungarian born native of Transylvania, Romania, he received his Master in Theoretical Physics at the Eötvös University in Budapest, Hungary and Ph.D. at Boston University.