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Abstract

The project of “Musical and Spatial Electro Opera” COSMÖS was initiated in 2019 by composer and musician Frederic Bousquet, founder of the musical ensemble INVENTOR, with the engineer and space designer Olivier Boisard, co-creator with Pierre Marx of the concept of space station “Apogaios” (presented at IAC 2012, IAC-12-E5.2.1).

There are fundamentally two different ways of considering space: the first one as an observer or explorer, facing the beauty and diversity of the universe, trying to understand its meaning as a philosopher, describe and explain it as a scientist, or express and dream it as an artist. The second way is proposed by engineers or architects, motivated first by the will to build new human creations in space - villages on the Moon or Mars, giant inhabited spaces stations, manned spaceships sailing to the farthest points of the solar system...

These two approaches combine and do not oppose each other. The purpose of COSMÖS is to stage the diversity and complexity of this human adventure, and share it with the public in a multi-faceted / multi-media show : texts and music are performed by the group INVENTOR whose originality is to bring together exclusively creators (Inventors) and musicians playing on new original musical instruments - either acoustic or digital - issued from contemporary instrumental craftsmanship; on this music is built a space universe presented in 3D computer graphics, complemented by interactive animations piloted in real time.

The COSMÖS musical and spatial show was composed over a period of 3 years, from 2019 to 2021, and performed on several occasions, notably at “La Seine Musical” (île Seguin, near Paris, 2019 and 2021), “Le Reacteur” (Issy-les-Moulineaux, near Paris, 2019), “La Genette Verte” (Florac, in the French Cevennes Natural Parc, 2021), and during an exceptional concert organized in August 2021 at the Royal Castle of Amboise, as a Tribute to Leonardo da Vinci. Our paper describes the genesis of this project, its concept, its developments during the creation and staging phase, its possible developments using Augmented or Virtual Reality techniques during the show, and - first of all - the way this live multi-media performance interacts with the public - of all generations - and communicate on the space adventure and its challenges through the emotion of music and images.

Keywords: Space Art, Music, Cosmos, Opera

1. Introduction

“All art is message. It can be addressed to a wider community, whose knowledge varies according to whether they belong to the same or a different group, as well as according to age, sex, degree of initiation, social status and many other parameters.(...)” Clottes, Jean (2018), Pourquoi l’art préhistorique ?

What is the message sent by space exploration to the Earth? In search of new creative, intellectual, and material resources, what is the terrestrial “DNA” of Humanity? What should we take into space from our beliefs, our systems of thought or our educational systems? Paraphrasing Nietzsche, Frédéric Bousquet introduces the subject of the Opera Electro COSMÖS as

follows: *“If the Earth were an egg, Man would be a bird”...*

2. Genesis of the Project

To communicate in a musical show with a large audience, we wanted to refer to some fundamental poetic and architectural concepts: the space elevator, a lunar village, a lunar philharmonic, a giant solar sail, or an underwater human base below the ice floe of Enceladus, the icy moon of Jupiter, The “musical and spatial electro-opera” COSMÖS was co-initiated in 2018 on these bases, by composer and musician Frédéric Bousquet, founder of the musical ensemble INVENTÖR, with engineer and space designer Olivier Boisard.



Fig. 1. Olivier Boisard and Frederic Bousquet, COSMÖS concert in the Royal Caste of Amboise, France, 2021

Both share a common interest for solar sails, a mode of space propulsion combining technology and poetry. They met through the association *Union pour la Promotion de la Propulsion Photonique* (U3P) in 2003, and then created many concerts-conferences, notably at the *Aero Club of France*, at the French engineering school *Polytechnique*, at the *Palais de la Découverte* in Paris, or at the *Forum des Sciences* in Lille ...

Quite naturally, the idea was born to create together an original "electro opera", a fresco of the great space epic, historical and prospective. The artistic ambition of this musical show is to inscribe itself in a common imagination. The creation of COSMOS draws from the space perspective : history of the space adventure, new architectures, new concepts, new graphics, new sound gestures, new sounds, towards a visual and a musical exploration.

The common objectives are multiple and contribute to share a passion for space: the space adventure is both the discovery of the universe, but it is also the creation by man of new worlds, dynamic and in perpetual mutation, oscillating between abstraction and concretization, between discovery and anticipation. Thus, the graphic and sound arts are poly-sensory vectors to seize, send and understand individually and collectively the messages accompanying transitions to future realities. These disciplines are also at the heart of paradigm shifts in their approach : music as a tiny part of the sound environment, graphic facilitation as a tool for transmission and project management. The COSMÖS project proposes a transversal and interactive approach, somewhere between graphic listening and auditory graphics, towards the quest for the marvelous and the fantastic resources of space exploration.

3. Conception of the Electro Opera

During the preliminary study of the project, COSMÖS took the form of a contemporary inter-media DeepTech Electro Opera. The show is based on the projection of images set to music and mixed in real time, performed indoors or outdoors, in a classic or event format. COSMÖS is an ambitious project, because the writing of a booklet, the creation of space images and musical pieces, have the wish to lead to an artistic show accessible for the general public, but also to an educational and cultural action through which each of the participants, scientists and artists, will be able to express themselves individually and/or collectively.

The Opera was composed from 2018 to 2022, at the rate of one act per year, followed by the Overture and the Finale, completing the operatic form. Olivier Boisard's 3D images and animations are mainly creations aiming to integrate a video DJ process, the realization being interpreted in real time by the director creator of the audio video streams in connection with the musical computer manager, himself on stage.

Finally, the sound creations - combining soundscapes, musical creations and songs are performed by the musical group INVENTÖR, founded for this project, consisting of the musical ensemble of musical instrument inventors and companies flagship of innovation in instrument making.



Fig. 2. First Cosmos Poster, 2019-2020 season

Frédéric Bousquet, opening speech for the 2018-2019 cultural season, as an associate artist at the Genette Verte theater : *"Culture is the soul of the people. It is everyone's business. I am happy to see that so many of us are here tonight to open this new season. The arts have the power to deliver us, to guide us through the ages far more than the representations we make of them, to transcend our human condition; and music, in particular, has the power to abolish the boundaries of time. The sound signals that reach us are not just entertainment or wonder: the first musicians were hunter-gatherers, the sound of bells symbolised power, military music is composed to accompany the fury of*

boots. This is why the term "sound arts" has appeared, because almost everything is qualified as sound: soundscapes, sound images, signatures, environment and heritage; music, of course, but also dialogue with nature and between people: the sound of a summer night, the sound of snow, the sound of a cave, the sound of a shepherd's song, the sound of the whistle of a thrush ("musician"), the sound of the water. It is also the sound of the neighbor's television, the noise of objects and appliances of all kinds, etc. Sound arts, sounds, vibrations of which the body can only be a receptacle. The "Immersion Sound Arts" program that we are offering you aims to renew our sonic and visual emotions through sensitive experiences. Enjoy your journey into the cosmos! "

4. Structure and Booklet of the Electro Opera

"COSMÖS" is a fresco of the present and future conquest of space: Space Elevator, Space Hub, Space Stations and orbital Solar Power Stations, Moon Village and Lunar Philharmonic, Solar Sails, Underwater manned station in the Jupiter's moon Enceladus, ...

The booklet includes writings by authors, quotations from scientists and astronauts, extracts from logbooks and codes of conduct, and references to vanities. Its writing is coordinated by Frédéric Bousquet, author of the libretto for the comic opera "Voyages dans l'inconscient de Jérémiah Horrocks" (Transit de Vénus 2004), who also structures the plot through the division of the scenes and the definition of the characters: captain, navigator, technicians, scientists and artists, artificial intelligence, etc.



Fig. 3. Space Elevator, Olivier Boisard

In the first act, TERRAMORPHOSYS, the "Moon Village" team embarks from Earth to a lunar orbital station thanks to a space elevator. The exploration of the Moon's begins with the "e-Hello" robotic Rover.

In the second act, MOON VILLAGE, the first settlers move into troglodytic habitats. They progressively generate a domestic and industrial architecture,

necessary for the study and industrialization of the Moon, for the exploitation of its new resources.

As the INVENTÖR ensemble inaugurates the lunar philharmonic, the soprano « Ginger Holst » takes off from the stage and sees the Moon, electric. She decides to embark on a journey to outer space.

In the third act LUX ÆTERNA, an interplanetary journey in the solar sail UTOPIA leads the 'mutant generation' to Enceladus. Its oceans of ice are a metaphor for a frozen Earth memory - the terrestrial DNA of our beliefs, culture and education system - which is melting away in the midst of a rush of the instantaneous, and whose codes are hard to decipher.

Their exploration on board an "Ice Orbiter" aims to suggest the presence of life strains, towards the regeneration of a new world. This libretto is not intended to be fully sung or dialogued, which is why "COSMÖS" takes the form of a comic opera. With its polyglottic writing, universal language, any part can be extracted to inspire or feed the creation of songs, sound materials, projected words.

COSMÖS / Inventor		CONDUITE
N°	TITRES / SCENES & MUSIQUE	SON
OUVERTURE (2018)		
1	SCENE 2 : ALLUMAGE	SOLOS : ELECTRO DUALO EUPHONE SYLPHYO OU GUEST PERCUSSIONS CHANT
ACTE 1 : TERRAMORPHOSYS (2018-2019)		Voyage vers la Lune
2	CHANT 3 : COMPTE A REBOURS	
3	CHANT 4 : SPACE INVADERS	
4	SCENE 5 : SURVOL	
5	SCENE 6 : ORBITER	
6	CHANT 5 LADY MOON	
7	SCENE 8 ALUNISSEUR	
ACTE 2 : MOON VILLAGE (2019-2020) / La colonisation de la Lune		
8	CHANT 6 : ROVER	
9	SCENE 2 : TUNE HELL	
10	SCENE 3 : PENETRATOR	
11	SCENE 4 : TENTACLE	
12	SCENE 5 : L'HABITAT LUNAIRE	
13	SCENE 6 : PHILHARMONIE LUNAIRE	
14	SCENE 7 : CONCERT UNDER STARS	
15	CHANT 8 : ELECTRIC MOON	
16	SCENE 10 : ALBA	
ACTE 3 : LUX AETERNA (2020-2021) / Au lieu de rentrée sur Terre, départ vers Encelade		
	SCENE 1 REVOLUTION DES ENFANTS DE LA TERRE	
	SCENE 2 RENAISSANCE	
	SCENE 3 DESTINY	
	SCENE 4 GENERATION MUTANTE	
	SCENE 5 CLEPSYDRE	
	SCENE 6 LE SACRIFICE DU PRINTEMPS	
	SCENE 7 PATE SPATIALE	
	SCENE 8 LE JARDIN DE LA TERRE	
	SCENE 9 INSPIRATION ULTIME	
	SCENE 10 ENCELADAE	
	SCENE 11 DONNER ET PRENDRE LA VIE	
FINALE (2021-2022)		
	FINALEFROM SPACE (HYME)	
	SCENE 12 EPILOGUE	

Fig. 4. Structure of COSMÖS



Fig. 5. Poster of COSMÖS, Act II – image Olivier Boisard

5. Music and the INVENTÖR musical ensemble

Founded in 2018, INVENTÖR is the international and variable geometry musical ensemble of musical instrument inventors and innovative instrument building companies. With a "club-enterprise" of some fifteen French flagship companies, INVENTÖR* has become a privileged ambassador of contemporary instrument

* - Musicians / Sylphyo® : Florian Becquigny ; Full Aeronautic Titanium Euphone® - World Premiere - : Frédéric Bousquet ; Spacedrum®, Ludophones®, Metal Harps & Percussion : Cyril Cambon ; Dualo® : Sergueï Becoulet or Arno Jouffroy ; Singing & Looper, Sound Mask® : Clémence de La Taille ; Yamaha Augmented Violin : Laure Schappler ; Karlux : Jean-Marie Colin ; Korn Bass : David Defois ; Sound Design, percussions : Mahut ; Vocal, Sound Mask® : Natalia Nerchevskaya ; Computer music & electronics : Jérémie Perrouin ; ZEF violin : Olivier Samouillan or Aurélien Bertrand ; Rare instruments including lithophones : Jesse Stewart. Artist directors: Video creation: Nassimo Berthommé; Spatial imagery creation: Olivier Boisard; Light creation: Vincent la Rocca; Visual device: Artisans numériques (Bruno Mompère & Maxime Thibault R.N.G.A.); Multicasting & spatialization: Julien Guillamat; Stage direction: Philippe Corbier- Administration: Diffusion, tour administration & communication: Stolon Art & Science; Sound: Ziggy or Corentin Abeille or François Yvernât.

building. The instrumental ensemble is based on a sextet, and includes many guests, who are invited to join the ensemble according to sound, geographical and sensitivity priorities.

In order to facilitate their integration, improvised sound and music tracks are left free within the collectives compositions. Unheard-of sound sources and new sound gestures lead INVENTÖR to compose "prospective music".

In an aesthetic close to contemporary & electro music, the COSMÖS repertoire is composed of 29 musical pieces alternating soundscapes, contemporary pieces and songs.

They use a dedicated sound database, coming from instrumental inventions and acoustic and digital sound synthesis, but also from anamorphoses of heritage sounds taken from the natural and cultural landscapes of the Cévennes National Park. Spatialized diffusion adapted to immersive listening (vibrating harnesses) as well as to interpretation on acousmonium.



Fig. 5. Poster of COSMÖS, Act III

INVENTÖR's instruments represent the most contemporary and advanced aspects of global instrument building. Between cyber design objects and sound sculptures, they are the essential actors of the scenography. The musicians' costumes are made up of vibrating harnesses that allow them to do without stage sound equipment. In line with Olivier Boisard's visual creations, it was agreed that elementary and natural geometric shapes would be favoured: fractal, circular, cylindrical, hexagonal and hemispherical. Projected on a central circular screen, Nassimo Berthommé's creation uses mainly the spatial imagery created for COSMÖS by Olivier Boisard, alongside various visual sources: textures of materials, cultural landscapes of the Cévennes, live music, emulated sound gestures. The alternation of figurative and abstract signals allows everyone to evolve within collective and intimate landscapes.

6. Space Design by Olivier Boisard

Olivier Boisard is an independent consulting engineer and space designer, winner in 2011 of the first international competition “*Architecture and Design of Space*” organized by the Jacques Rougerie Foundation, at the Institut de France, for the project of space city for 10.000 inhabitants Apogeios, co-created with Pierre Marx (presented at IAC-Naples in 2012).

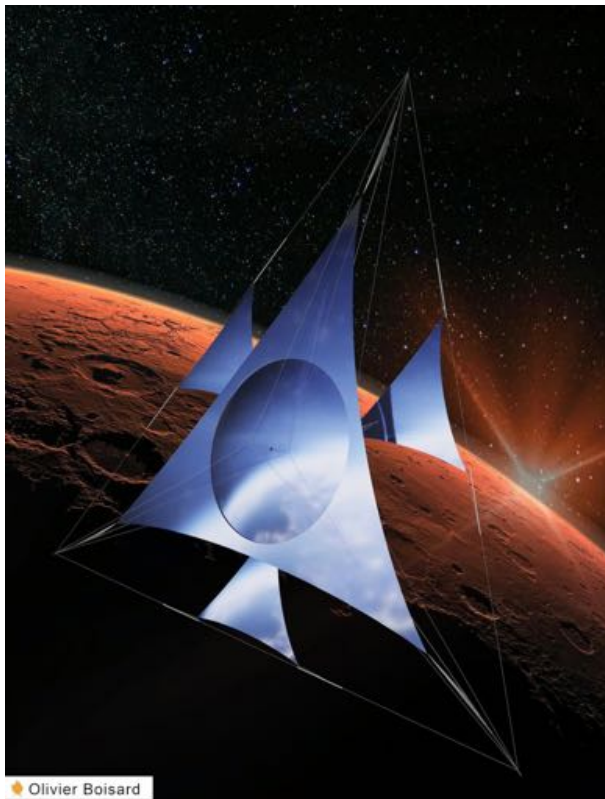


Fig. 6. Giant Solar Sail, Olivier Boisard

Olivier Boisard designed all the original architectures presented in COSMÖS, respecting a scientific and technological realism.

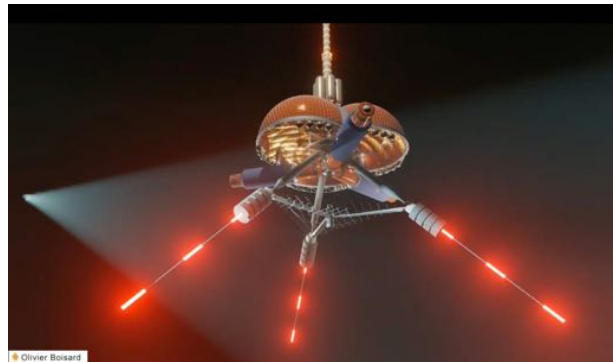


Fig. 7. Submarine Station in Enceladus, Olivier Boisard

7. Conclusion

We sometimes hear the question : "but why go into space when there are so many problems to solve on earth? A cliché to which we can answer: "because the Earth is the most beautiful planet seen from space".

What the creation of the Opera Electro COSMÖS suggests can be summed up in these essential points: the place left to artists as actors in space exploration bringing their view of our blue planet, the place of aeronautical materials in the instrument making and the manufacture of works of art, the need to produce a "general public" and interdisciplinary synthesis, associating public and private initiatives of space prospective ...

And the dream of mysteries in the underwater abysses of Enceladus...

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