

# Imaginations and engineering through bodily and digital experience with experimental matter for artistic outcome.

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## Abstract

This panel offers a space of comparison and reflection for three duos of artists and researchers on their interdisciplinary projects. The participants of the panel are both applied scientist and artist-researcher, with first-hand experience on the question. They elaborate on specific angle of interest. Although the genesis of the 3 projects shares a common basis, the comparison of their realization offers a nuanced portrait of the practice of research-creation as it can be done today, with accents placed on the symbiosis of imaginations across disciplines, approaches, and relations with the public. The diverse composition of the panel offers some outstanding comparisons panorama.

The panel is aimed to reflect on the art & science form of expression to be touching, imaginative, emotional, interactive, playable, and even joyful. The panel discusses imaginary and conceptual bounding, decision-making approach in art and science project, to compare possible accommodation between originality and relevance. It will inform the audience of the involvement of the public at different levels of the research, upstream or downstream.

## Keywords

Robot, quantum mechanics, interaction design, dance, theatre, mechanical engineering, computer science, Visual and media arts, Arts, literature and society, materials engineering and metallurgical engineering, augmented/extended reality

## Introduction to context

The three research-creation duos in this panel are recipients of the PRISME-ART grant, a research funding program by the Fonds de recherche du Qu ebec which aims to bring together researchers in the Sciences of Nature and Technology (FRQNT) with researchers in Society and Culture (FQRSC) to conduct collaborative research at the intersections of art and science resulting in, or comprising to some extent, artistic production. The goals of the program

are to promote interdisciplinary Networking, innovation, and the democratization of scientific research and artistic productions. However, interdisciplinary endeavours across art and science require unorthodox research approaches, specific considerations and far greater coordination. Such collaborations, from the grant application to achieving successful outcomes require, in addition to expertise, openness and generosity.

The research-creation duos were supported by Hexagram Network, the strategic cluster in research-creation based in Qu ebec. Aligned with its mandate, the Network organized meetings amongst its co-investigators and partner universities to encourage mingling and preliminary exchanges likely to lead to such collaborations, and to the development of successful interdisciplinary Arts and Sciences projects.

## Summary of the 3 projects

The first was initiated in 2021, two others in 2022.

Where is the work evolved so far?

1) INTRIGO, an interactive sculpture exploring quantum mediation experiences through augmented concrete + very short paragraph ; 2) DESSAIM, choreography for robotic swarms and humans, explores creative and artistic opportunities to create performative installations through the emergent behaviors of three robotic types of swarms interacting with humans, and transformed by various materials in plural sound and visual environments. ; 3) METAMORPHOSIS propose new expressive modes of interaction in theater based on augmented reality.

Project INTRIGO explores “quantum mediation experience through augmented concrete: a multidisciplinary approach at the intersection of sustainable matter and digital”. It is an **interactive art installation** that integrates sustainable concrete sculpture, augmented reality and blockchain to offer an immersive and interactive experience inspired by quantum mechanics (QM), weaving links between matter, humans and information. Such an installation requires a transdisciplinary team with experts in media arts, materials,

digital fabrication strategies, quantum mechanics and blockchains.

Our intention is to expose the stakes of QM, democratize digital art in its digital (i.e. media and NFT) and material (3D printing of a concrete work) forms. For that, the public experience is at the center of our conception. We mesh media art with engineering to highlight the key principles of quantum mechanics for the public in an interaction design and bring them to realize QM fundamental implications for the information technologies of the future following a playful and artistic approach.

INTRIGO global research-creation methodology is the crossroads between academic research and artistic creation (Paquin & Noury, 2018), leading to their hybridization. It is characterized by a non-dualistic conceptual and creative work. Consequently, the researcher become a creator-observer with a reflexive practitioner (Schön, 1983) posture.

Our methodology implies co-creation. The cocreation residency at Perte-de-signal art center, and subsequent workshop were time reserved to collectively immerse and connected, to drawing the future of the project We make decision as an assemble and act as a collective. Most of the decisions are made around the table with the core participants and students. In between collective session, each lab team its primary development.

In a more detailed explanation of our case, the player must understand some key elements of MQ to complete the challenge inside the interactive art installation. We have selected to main MQ aspect. The first is that the observation act the collapse of quantum superposition into a singular material reality (Heisenberg [1958] 1962, 54-55). That when the player connects to the AR layer. His position, movement, gaze, interaction, and touch make the installation shapes and mesh evolve as a quantum system described in terms of probability waves of wave-particle duality. The game start after the player uses his AR avatar to help him pass through two gateways to the same time, that is physically impossible. At this point, the player is aware to use AR to play at a quantum level. Next, the player needs to combine action in the physical and the metaphorically quantum space to win. The installation became multiplayer social space. Two or three participants play together and collaborate to understand and act in coordination to unlock the system and create a sharable NFTs collectible. Stop here. We won't spoil our game!

### **Choreography for robotic swarms and humans**

Expert engineers in robotics, computer science and biomechanics, artists in dance, movement, puppetry and object theater, as well as specialists in functional and expressive movement analysis or teaching/learning, study together the expressive possibilities generated by the variation of movements of aerial and terrestrial robot swarms. Recovered/recycled materials metamorphose their

appearance and environment, allowing the robot to become, together or individually, an expressive and poetic material in constant motion.

In a horizontal decision-making process, the art and engineering team draw on their respective expertise for the common goal of developing performative and expressive devices for robotic swarms and create meaningful kinetic installations.

Our research-creation methodology unfolds in artistic residencies at ETS spread over two years and four laboratory events. These co-creation events gather artists, researchers and students from both engineering and art for two weeks in a large experimental theater space. Altogether we explore the emerging behaviors emanating from robotic swarms (drones, table-top robots and rovers with robotic arms). We manipulate their expressivity by altering the environment in which the robots move and configuring the space, time and dynamics in which they perform with materials that transform them. On top of the visual rendering of these manipulation, the sounds emerging from the movements of each type of robot complete the choreographic writing with cues that cannot be easily perceived only from motion.

The works resulting from this project have the potential to change the public's perception of robots and even to generate empathy for the movement of these artificial beings and materials.

### **METAMORPHOSIS**

Metamorphosis is an science/art project exploring the new potential to use emerging AR/XR (Augmented/Extended Reality) technologies in a live performance work focused on the emotional impact of climate change. XR is an umbrella term describing emerging immersive technologies that utilize augmented AR headsets, binaural audio and haptics (simulated touch) that, unlike VR, merge physical and digital worlds. This original 30-minute XR performance without spectators adapts the Canadian climate fiction short story "Animate." Daniel and Laurie, the two lead characters, are climate refugees who set out on a mysterious journey through the Newfoundland landscape while news of climate catastrophes in the outer world is broadcast on the car radio. They are pulled towards Tablelands – a Mars-like area in Gros Morne National Park that exerts a mysterious force on them as the performance evolves.

Structured in different scenes, the performance involves two participants from the public wearing Oculus Quest 2s and utilizing the videopassthrough feature to enable a blending between the real space of the performance and the computer generated part. The performance combines radio drama relaying audio instructions to the two participants, an installation-like theatrical set the participants inhabit and interactive sound/haptic feedback.

The passthrough feature of the Oculus Quest 2 enhances the real world (delivered over a live video feed from

cameras embedded in the headset) with digital objects and virtual audio while letting viewers see and interact with the real physical environment around them - what is called "spatial computing" (Pangilinan, et al, 2018). The audio, haptic, and visual representations will create an emotionally rich, utterly strange artistic experience, while advancing a completely new form of XR-based theater.

### **Genesis of projects: coming together.**

In the design stages, art & science projects offer scientists and artists new ways to research or create and to produce knowledge or experience. This interdisciplinary teamwork leads to comparing different theoretical frameworks and harmonizing the respective definitions. Standardization is to be avoided, while polysemy is rather sought. From a more poetic point of view, imaginations and prospective visions agree on a future.

Scientific research acquires a new artistic dimension, which requires formatting, expressiveness, and an additional symbolic dimension. The "routine" of research is disturbed by its encounter with diversified thoughts, sometimes presented (with simplification) as divergent. These different conceptions between artists and engineers provoke negotiations, intersubjective adjustments, which lead to the opening of research, its evolution. Through the scientist's gaze, the artist sees the world from another point of view, perhaps voluntarily less immediately subjective, more direct, a gaze that strips the reality of its sham, to highlight its qualities used as artificial and artistic matter.

### **Intersectoral research-creation processes and decision-making**

The implementation of an art & science project takes very varied forms, collaborative or cooperative. It implies artistic residencies, creative session, visit of laboratories, meetings, training students to research. The methodology applied is an object of reflection. In the artistic field, the process is intimately associated with the work, with the gaze of the artist, with his signature. In the projects discussed here, the artistic process is intimately linked to the scientific and ingenious approach. What do invent methodological arrangements look like? What are the parts of rigor and letting go?

In practice, intersectoral collaboration reflects the subjectivities, know-how and life skills of a group with different intentions. The progression of the realization of the project leads to the clarification of the intentions and the interests of each one. Negotiation and constant adaptation are key elements to keep, even if it became more difficult to make changes once the project is under way. Choices are made, people take a position to ensure and assume influence (power?) over the construction of reality, and its shaping. Thus, the realization of the project through the material and technical constraints imposes choices. The idea and the initial form evolve to adapt to what is possible. Do these

production-induced changes imply regular renegotiation of the parties? It may go without saying that it is not an artist who makes the scientific decisions, due to his ignorance of science and engineering. Is it the same for artistic decisions? What are the possible accommodations? Shared decision?

### **The role of peers and the public in the design process**

The three research-creation projects conduct to an artistic work presented in a public socio-cultural context. This type of dissemination is anticipated in art, but it remains, to some extent, perhaps still uncommon in science. However, in the academics, outreach activities are more encouraged, now. On the other hand, the public is not yet used to participating in scientific presentations. Here, art can help passing on of knowledge through artistic experience. Through the experience of creation, the public will be made aware of theoretical or scientific notions revealing the qualities of the world. Therefore, art creation is a form of publication of results, attentive to popularization. This could be easily accepted.

In our different domains and because of their experimental nature, reaching a larger audience can be complex to achieve, because the research or art is being perceived as intriguing. More often, a small gauge of people, connoisseurs, or peers, accesses the works. To be more engaging, projects can offer way of touching the imagination, conveying emotions, being interactive, playable, and meaningful. To counter that, outcomes and process goes along with writing publications and documentation, to prolong their access time.

Other ways of democratized research can be achieved by reserving a space for action within the project for the public. The public can be involved at different levels of research, upstream in the elaboration of the project (define goals, inform on context), or in the flow of the making (cocreation, testing). Ahead of the diffusion of the finish result.

Settle the research at its beginnings within a community of practice (artistic) can strengthen collaboration and guide the research on actual needs. The next step can be reached by workshop or co-creation residency, through team building and practice. The constitution of the team is crucial to harmony and inspiration. It must include a diversity of points of view and interest. During the making, the knowledge circulates among the team, in many directions. Here, the dissemination of information and the sharing of vision reach only a very small group of people, but with a profound impact. The making is well known for its ability to imprint the memory. Furthermore, this mobilization of conceptual framework and methodology cross the team, the participants, and the student make the case study vivid.

The measurement of the impacts can be problematic. This leads to highlighting the effects of research on practice

settings. And reciprocally, to a better appreciation of the contribution of communities of practice to research. Impacts measurement can be discussed. Does the size of the public reach constitute a proof of research and creation excellency? To a certain extent, the consideration for the public brings to the question of the influence of this will of democratization in the scientific research

## Conclusion

The panel enabled us to distinguish similarities in the participants' testimonials. They all demonstrated that they had mastered the practice of scientific or artistic experimentation, accompanied by reflections on this practice. The projects are structured by objective. However, the objective-based approach has its limits in the arts, as the expected outcome is unknown at the time of grant application, which is more unusual in science. To be considered, art & science research projects must at best be polysemous, or make reasonable detour. The use of intuition and imagination, which is more specific to the arts, could be experienced as a point of tension in an interdisciplinary art & science team. But it's quite the opposite that we've observed: the artistic vocation of the project allows us to take more risks, and have more fun.

From the outset, each research-creation group developed its own specific co-creation strategy. This strategy is based on a common vision established through the sharing of knowledge. The exchange of ideas between artists and scientists established a mutual understanding of the project and the imaginary world evoked by the project. This stage of team-building, by bringing visions together, was built like a common territory experienced together. Understanding challenges and establishing a shared vocabulary. To achieve this, co-creation approaches were used. For example, cognitive mapping exercises helped build shared definitions, with the result of organizing a common space punctuated by images that guided the design of ongoing projects. This design stage requires negotiation, listening and openness to other sensibilities and postures, which takes us "outside our bubbles". The co-creation residency is a favorable context for this open-mindedness. On this occasion, the academic milieu is transported into spaces dedicated to art. These practice environments are renowned for facilitating changes of perspective, scale, role, surprise and provocation, as well as a more "artistic and horizontal" organization that values the sharing of emotions. So, within the group, emotion can be experienced as a "wave that tunes imaginations", a dear event. The next step is to create a prototype. It engages an iterative decision-making process that models itself at points of connection between expression and objectives, in a zone of balance of intentions, interests and practices in art and science. It's not an opportunity to produce an otherwise impossible artistic project, it's a way of producing and seeking to communicate knowledge differently. The light of science harmonizes with the shadows of creation in shades of color.

A limit to be taken into account and established from the outset of an artistic and scientific project between team members is the management of discoveries that go beyond the initial framework.. The interdisciplinary imagination is a forward projection that generates new ideas that go beyond the initial expected results. The limits of what belongs to the project then arise. That is, should new ideas that were not part of the original project be reserved for a future project, or enrich the current one?

The panel demonstrated that experimental matter such as quantum mechanics, robotic swarms or collective immersion are complex. Studying them requires the mobilization of a variety of research tools: the body and movement, performance, technologies, etc. The collaboration of engineers and artists produce spread artistic results to new audiences. A study of the direct and indirect impacts of artistic and scientific projects must be carried out, particularly with regard to assessing the impact of projects on culture and the public.

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