Connecting Theater and Virtual Reality with Cognitive Sciences

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Connecting Theater and Virtual Reality with Cognitive Sciences

Positioning from computer science and artist meeting

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Abstract— **This positioning paper presents arguments in favor of collaboration between artists and computer scientists in touch with cognitive science. Each part met the other for a technical collaboration during one theater experimentation named « il était Xn fois ». The article starts with the scientists position relative to the link between cognitive sciences, virtual reality and artificial intelligence. This section highlights the need of autonomous entities to improve presence in artificial world and presents enactive artificial intelligence which aims at producing strong autonomous entities. The second part presents the purpose of the theatrical experimentation "il était Xn fois", which was publicly presented in 2009 by the theater dérézo. The last section is a synthetic view of what should complete artistic and computer scientists area.**

Keywords-component; virtual theater; cognitive science; enaction, phenomenology, sense-making;

I. INTRODUCTION

Among the areas which can benefit virtual reality, two are particularly concerned by this paper : cognitive sciences and virtual theater. The cognitive sciences seek to understand human knowledge. They produce models that can be exploited to develop virtual reality applications more relevant to human sense-making. Enaction is an area of cognitive sciences in touch with phenomenology [12,16]. Phenomenology conceives, among other things, that the constitution of sense comes foremost from the interaction and the interplay between an agent and it's perceived environment [15]. [6] comments on the participatory aspect and on coordination as a basis for the construction of meaning in an enactive perspective. The actions of the other are as important as the actions of a subject in contributing to the enaction of its knowledge. This point guides some functional and dynamical properties for virtual reality systems and particulary for the developement of interactive virtual agents in interplay with humans. These features correspond in part to the notion of "enactive artificial intelligence" which emphasizes autonomy, resistance, agentivity, identity, openness and interaction for artificial systems [7,10]. However, one challenge is to find use cases relevant to develop such experimental models because they need a large part of "freedom" during their evolutions. They are not based on classical computer sciences approaches relying on rules fact and deduction principles. They are based on self-organisation and artificial life concepts.

In the field of theater and, more generally, interactive arts, various studies have made use of virtual reality technologies [11,5,1,4]. The diversity of this work starts from the use of virtual sets for real actors and goes up to the total immersion of the audience in a virtual world where they are actors [20]. Maintaining the illusion, the emotional context and the presence of virtual elements is the challenge of current artists [17]. This notion of *presence* [19], becomes even more complex when the virtual scenery is populated by virtual actors. The co-presence between a real actor and a virtual actor is the connecting theme of the virtual theater with the paradigm of "enactive artificial intelligence". The remainder of this paper argues in favor of this positioning.

The paper is composed as follows: section II introduces the concept of enactive artificial intelligence and the positioning relative to it, of computer scientists which develop virtual reality application. The next section presents the conceptual stances and realization of the theater derezo through the experimental work "il était Xn fois". Both presentations show the common interest of meeting artists and scientists. These common interests are summarised in section IV.

II. INTERACTIVE AUTONOMY FOR VIRTUAL REALITY

According to phenomenology and enaction, sense making follows from the interaction between an agent and an object or between different agents. According to this positioning, cognition is an appropriation of sensorimotor invariants and knowledge is co-constituted during this appropriation [12,15,23,16]. To take into account such phenomenon in the virtual, one must populate the virtual worlds of artificial entities capable of co-evolution with users. These entities are both resistant but must exhibit

invariances to support the constitution of sense. To obtain intersubjectivity between real and virtual actors, we postulate the use of artificial models whose foundation is based on phenomenological and enactive considerations. An artificial enactive entity "must have the capacity to actively regulate its structural coupling in relation to a viability constraint" [10]. Actually, artificial life and robotic are the field which give rise to an enactive inspiration. For artificial life, the challenge is to set up autonomous models lying on autopoiesis concept. Such systems are compounded of elements which are generated by the system itself. Generally, simulations lie on cellular automata [14] but this proposition is very limitative. Indeed, it confines the concept of viability to the persistence of a topological aspect of the automata. At last, autopoiesis simulation neither addresses the notion of co-evolution nor interactive machine, coupled with a human user or with other autopoietic systems. Existing approaches insist on the autonomy which is obviously fundamental to clarify in the enactive perspective, but which isn't sufficient in itself, for a human-machine interaction perspective. In robotic, pieces of work linked with an enactive view, address the problem of the self-organisation of a dynamical system [8,21]. The aim is to find principles which can lead to the setting up of sensorimotor invariant. Basically, dynamical models such as recurrent neural networks are used because they approximate complex systems and they maintain dynamics without needs of something like input control. Environment is not more than an element that disturbs this dynamics. In [7], we identify some limits of actual works on enactive artificial intelligence. We also argue that virtual reality applications should push back some of theses This proposal is based on the following arguments involving irreversibility, ontogenesis and sense-making.

A. Irreversibility

The irreversibility of co-evolution is often overlooked in enactive artificial life. It is also the case of the evolution of the environment, which follows the actions of the agent. All these elements are neglected in favor of initiating an adaptivity to external changes, i.e. those which do not follow the actions of the agent itself. We suggest that the agent should actively modify an environment which, in turn, should also evolve. This principle is based on research suggesting that an entity's environment is made up of other similar entities [9].

Ontogenesis

Even if current models of autopoiesis and enactive robotics are complex in the sense that we call upon the notion of emergence in order to characterize their general behavior, their ontogenesis can be considered relatively simple. Either the principles of autopoiesis and stability are the sole focus of attention, to the detriment of the evolution of these principles or, the ontogenesis of the agent is defined using an evolutionary approach. However, the Darwinian inspiration behind the evolutionary approach is not compatible with an explanation of ontogenesis as it evaluates a whole agent. The agent is ready to function and fulfill the task that it has been selected for. That being said, if we want to progress in terms of capacity, and to broaden the cognitive domain of artificial agents, we must take into account the fact that the more complex agents are, the greater the ontogenetic component of their behavior is, compared to the phylogenetic component. From an enactive perspective, evolution is considered more as a process of auto-organization than a process of adaptation. It is a hard problem to construct enactive artificial agents. This problem is so tricky that we suggest associating evolutionary approaches with *guided online learning*, during ontogenesis of such agents [13].

B. Sense-making

Let us imagine that the previous step has been achieved and that we know how to obtain a virtual agent capable of co-evolution. Let us also imagine that we could imitate the environment of such a system in the same way as the system itself. There would be a co-evolution of these two entities. Both systems could engage themselves along "uncontrollable natural derivations". Enaction considers that a subject's world is simply the result of its actions on its senses. Thus, the presence of sensorimotor invariants evolving at the heart of an artificial system is the machine's equivalent of "virtual sense-making" in the virtual own-world. What would this sense-making represent for an artificial system co-evolving with another artificial system? We must be wary of anthropomorphism, which is inappropriate here as the construction of meaning and sense for such machines cannot be compared to those of humans. We argue that meaning, coherent within the perspective of Man using the machine, and evolving from the cooperation between Man and machine, can only emerge through interactions with a human observer. This by no means leads us to question the value of experiments in evolutionary robotics for the understanding of fundamental cognitive principles, but rather to attempt to address the problem of sense-making. We must nevertheless take precautions, keeping in mind the potential impossibility of attaining such knowledge, just as [8] argue for the notion of autonomy. We simply wish to explore the leads which might enable us to come closer to one of the aims of artificial intelligence: the confrontation of a human user and a machine [22]. We hypothesise that, from an enactive perspective, one relevant approach would be to explore the sensorimotor confrontation between Man and machine. In this context, we believe that Man must feel the "presence" of the machine which expresses itself by a sensorimotor resistance in order to construct meaning about itself. This idea of a presence, much like the TURING test, evaluates itself subjectively. This has notably been studied in the domain of virtual reality [2,19] and enables us to link phenomenology and enaction-based artificial intelligence. Thus, we argue that the human's participation in this co-evolution will enable both him and the machine to create meaning. If Man is not a part of this loop, from his point of view there is no intelligent system. Inversely, with his participation, the

coupling causes a own-world to emerge for the user. This raises the issue of the mode of interaction between Man and machine.

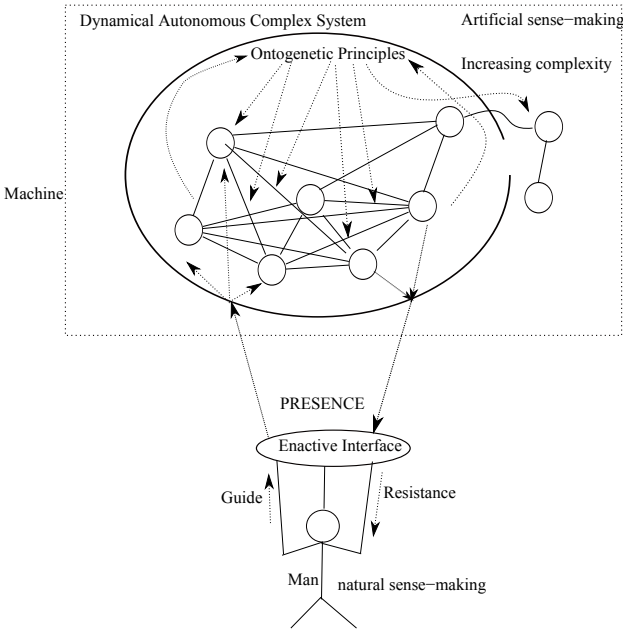

Figure 1. Artificial entiy based on enaction metaphor.

The final objective is to design ontogenetic mechanisms for complex dynamical systems which will be guided by people. This objective is illustrated in figure 1. Artificial entities are complex systems enriched with ontogenetic mechanisms which guide their evolution via an ”en habitus deposition” of their interactions [12]. This guidance can be conducted via a simulated environment, but must include human interaction. We think that it must be done using virtual reality interfaces. Such interaction, in an enactive perspective, lead to the the understanding of the co-emergence of the sense during an interaction. This reflection echoes theater area concern. These common concerns was revealing during a technical collaboration between the troup derezo and scientists for the occasion of the theatral experiment “il était Xn fois”.

III. IL ÉTAIT XN FOIS

"Il était Xn fois" is a staging as part of a research-creation project "Virthéa [25]. This project promotes the synergy of scientific and technological inputs for creativity. Upstream from this work, there is a question about the evolution of technologies and their uses. They become instruments for the submission rather for the development of person. The company Dérézo defends the re-appropriation of the tool by the free and easy man: the artist. She questioned the possibility of using technology to preserve free will, emotion and creation.

"Il était Xn fois" has been presented three time to the public. A film illustrating the main phases of the project is viewable on the site [24]. The staging begins with a first part on the internet. During this session, actresses interact, thanks to video, with some of internet user. At the end of this part, a place of rendezvous was unveiled for attend the second part.

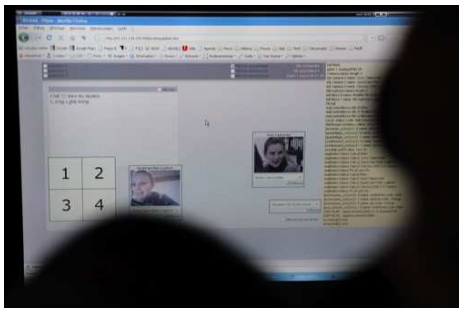

Figure 2. First par of “Il était Xn fois”, in real time on the web.

"Il était Xn fois" associates light, sounds, and videos with the body movements and the real space. "It's a tale that calls the characteristics of dream, imagination and unconscious. It is the story of an individual inner adventure, an itself initiation, by the interrogation of the multiple double and representations of the self". " Il était Xn fois" imposes a digital writing for and by the actor. He plays with random and learns from machines that learn in return. The concept of co-constitution between real and virtual inherited from phenomenology is here glaring.

Of course, one goal is to overcome the technological aspect. Whether it be "forgotten" for the benefit of the theatrical and emotional aspect. Here again this point is in touch with the need of presence during interactions, object of concern for researchers in virtual reality. Here, the artists highlight this concept by indicating that it corresponds to a forgotten of technic. It is worth to notice the emphasis of emotional dimension and the suggestion that forgetting is not necessarily synonymous with realism. In this regard, a good book can account for emotional credibility. With the technology of virtual reality, the technical complexity is added to the emotional rendering.

Figure 3. Second part of “Il était Xn fois”, 3 interactive screens.

Technically, the cameras capture the bursts of light pens, which allows the drawing of shapes on large screens (Figure 3), sensors allow actresses to trigger sounds, varying the speed or intensity of these sounds. A central element of particular concern to working with virtual reality specialists, is to use a jumpsuit of motion capture allowing embodied interaction between an actress and her "double", projected on screens (Figure 4). It is here that the technical collaboration has taken place. One recognizes the concern of enactive embodied cognition. The importance of the body in search of meaning.

Figure 4. Actress in motion capture sweet and her avatar.

In touch with artistic matters, one challenge is to present the appropriation of the avatar by the actress and the empowerment of the avatar vis-à-vis the actress. All these elements echo the scientific problems recounted in Section II on the guided ontogeny of autonomous entities.

IV. CONNEXIONS

In summary, among the links between science and theater identified during this study of the connection between research in virtual reality in a phenomenological and enactive perspective and the theater experimentation "il était Xn fois", we note the following:

- The play "Il était Xn fois" insists on the importance of the coupling between the system and the human for sense making. This is posited as the basis for enaction. It transforms the question of the credibility in a forgotten of the virtual.
- It addresses the theme of autonomisation which is also a focus of scientific research on artificial enactive systems.
- Derezo's virtual theater aims to address the fact that man can "learn from the machines which can learn in return". This provides a clear parallel with the concepts of co-evolution and co-constitution of phenomenology.
- The dérézo theatrical approach seeks to represent the unrepresentable. This agree with the concerns of enactionnists who consider the notion of representation as a simple theoretical tools unfounded and limiting our understanding of cognition.

Nevertheless, theater addresses many other dimensions, among them the notion of creative engagement [3]. This commitment is poorly integrated in paradigms such as enaction and is a cue to better understand what to put into models to improve the concept of virtual reality. Conversely, the inherent complexity of enactive autonomous entities is not necessarily what is wanted for an effective theatrical aesthetic. This opens prospects of finding compromises between the principles of enactive artificial intelligence and the use of virtual reality.

V. CONCLUSION

Virtual theater is an original use case of virtual reality. Realtime co-evolving introduces some problems that are less prominent in other applications of virtual reality. Problems of "sense making during interaction" and presence are central preoccupations of cognitive sciences and involve constraints on virtual world models that can be tested by artistic applications. It is the perspective of the meeting of the authors.

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