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Annie Luciani

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Why and how Convincing of the Reality The case of artistic situation

Annie Luciani -Acroe-ICA

I would like to ask here three questions about some artefacts or simulations of the Reality we have to produce for Virtual or Distant Worlds:

1. Why our artefacts have to convince us that we are in front of them as in front of the reality ?
2. What are the sensori-motor minimal conditions to create the feeling of the «conviction of the reality »,
3. how do we can implement them in a computerized environment.

We would also propose the assumption that the artistic production process is the more basic and universal case to discuss about these questions and that it plays as a model of all the human activities.

We would take support of the concept of Multisensoriality with the specific place of the Gestural (often called Haptic) Interaction and of the concept of Dynamic Expressivness as a mean to control, to produce and to create.

As an introduction, we would like to draw up, even if it will perhaps be evident for some people, some simple but pertinent properties, for our purpose, of the main sensori-motor channels human beings have at their disposal to receive and emit informations :

- Our sensorial channels are mainly acoustical, visual and gestural (or haptic),. This later combines the TPK perceptions, Tactilo – Proprio – Kinesthetic perceptions
- our effector channels to emit information are only two : our gestural actions (motricity of the hand, the body, etc) and the voice.

Because voice communication is very often considered in a lot of works (speech synthesis, speech recognition ...), I don't consider voice in this talk.

So, if we except voice, I would like put the focus on the idea that the "gestural channel", understood as all our means of motricity (hands, body, muscles ...) is the only way for us to emit something to the external universe.

If we consider that his external universe is only composed of :

- human beings (oneself or others)
- the physical world, which can be natural world or artificial worlds such as machine built by us.

Whatever this "vis à vis" is, and whatever the information you have to transmit to somebody or something, without the voice and the speech, we can notice that :

- human beings cannot create directly ALL the visual and acoustical information they can perceive (only in a very restrictive way : the image of our own body or the sound of our own body!!!)
- we must use our hands or our body to create visual, acoustical or gestural information in the aim to communicate with the external universe.
- and, we need to use the physical universe, as an intermediate physical object to adapt the physical informations produced by the hands and the body in acoustical, or visual information able to be received by eyes and ears.

That is the fundamental notion of « Instrument », understood as in the term « Musical Instrument », that is, **Primary Overall**, a physical object, This primary function is to adapt the mechanical information produced by the only emissive channel that I have, my body, to optical or acoustical informations perceived by my eyes and my ears.

and it is not a restrictive definition but a core definition : Because the hand cannot speak to hear, I must to call the physical universe **itself** as an instrument in the communication process,.

First of all, because of this fundamental, biological and ontological need, we have to take care of the properties of the real-like artefacts we built to communicate and create.

So speaking, To achieve this primary function, I am just going to define, not what it is called « sensorial modalities », but in fact, sensori-motor loops, that are basically :

- gestural action / gestural perception loop
- gestural action / visual perception loop
- gestural action / acoustical perception loop

Here, we can add another remark : the gestural channel is the only channel to be intrinsically a sensori-motor channel : inputs and output in the same time and at the same rate. The gestural perception cannot absolutely be distinguished of the gestural action and vice et versa. You act on a stone to feel its weight and you feel its weight when you act on a stone.

It is the reason for what its study is too complex, and what probably the tools we develop today around the concept of Presence can also bring some knowledge on this « modality ».

And now, if we look at some elementary quantitative data, we remark that, in all of our tasks, usual and not, (equilibration or playing violin):

>>>>> The gestural action / gestural perception loop runs more faster than the two others and it calibrates them :

- The time bandwidth is about 300 or 500 Hz for the free gesture, it becomes about 1 KHz for the manipulation of quite rigid object such as the manipulation of this sheet or the string of a cello with the pulp of my finger, and about 4 or 5 KHz for the manipulation of very rigid object such as the collision of my nail on this table.
- the delay of the others is calibrated by the sensation of stimuli simultaneity. For exemple for the vision, it will probably maximized by the frequency of the ocular strokes i.e. less than 300 Hz and audition is approximatively the same.

The minimal conditions for the gestural loop is :

- less than 1ms delay between gestural inputs and associated gestural outputs
- about 10 ms delay between gestural inputs and associated visual or acoustical outputs

To evaluate these data, we have performed some measurements with a high quality force feedback device and multisensorial real time simulator. I will show you some simulations.

This means that the synchronisation process between intersensorial loops is under the control of the gestural process. This means that our clock is our body with its active-reactive frequency bandwidth.

That explains probably that the gestural loop is not « la cerise sur le gâteau », a « plus » towards Realism, but probably the core of the question.

It probably plays as an **Absolute Anchorage** of ourselves in the world, Real or Virtual. It is probably one strong and deep condition of the feeling of the Reality..

This means also that, in the implementation of the multisensoriality in computerized environment, the master, the crucial point, would be the « Haptic Device ».

ERGOTIC FUNCTION

The next step in my reasoning, is to point a functional specificity of the gestural loop, derived of its property to be intrinsically perceptual and effector channel.

In the Gestural or Haptic Modality, we can distinguish three fonctionnalités :

1. the Epistemic functionality

As the seeing and the audition, which are only perceptual channels which receive data, the gestural channel is a way to know : inertia, rigidity, resistance to the displacement, mechanical material or mechanical structure of objects.

-> and that is the epistemic function of the gesture

It can be used such as an Haptic Display. This function is not widely developed in computer environments. It begins only. But it is used in our material tools. For example, when you find the balance of your audio recorder using the slider on the button, without seeing.

2. the Semiotic functionality

As speech and voice, we can use the gestural channel only as an effector :

-> that is the semiotic function of the gesture

It is the functionality mainly developed in computerized environments, through mice or keyboards. The specificity of this kind of action is that the content of the gesture is not conveyed in the achieved task : When you point the banana, chimpanzees look at the finger but human beings look at the banana.

3. the Ergotic Functionality

Differently than the three other communication channels, the gestural channel is mainly an Action/perception channel to perform tasks in which the action and the perception are completely linked, and in which energy is conveyed from person to external universe and from external universe to the person. This exchanged energy modifies and transforms the physical world : objects are displaced, deformed, broken, destroyed, built, etc. If you want to perform these kind of tasks with accuracy or efficiency, you have to feel and act in the same movement, in a strongly closed action and perception.

-> that is the ergotic function of the gesture.

This kind of interaction is the favoured way to support expressiveness :

Expressiveness during the interaction process, Expressiveness in the performed tasks

That is here a breakpoint – How does Expressiveness emerge ?

When we perform a physical task by means of symbolic language, for example « QUERTY », the dynamic of your symbolic writing has no influence on the achieved task : for example Drill a hole in this table.

But in ergotic interaction, the dynamic content of the interaction is conveyed into the achieved task. A highly personalized information is engraved in the two other sensorial resulting data (visual or acoustical) : For example, when you broke a plate of chocolate, the nature of the break depends on your dynamic of breaking. When we hear a violin, it is difficult to know if the instrument reveals the investment of the musician or if the instrumentist investment reveals the instrument.

That is a breakpoint, because it allows us to distinguish between two kinds of communication process :

- the pure symbolic communication
- and what we called « the instrumental communication »

Human beings interact with the external universe, composed of other human beings and of physical objects in two complementary ways :

- Symbolic interaction
- Physical interaction

The interaction between human being and natural objects of the nature is **ONLY** a physical interaction. Human being acts physically on the physical object with his body and perceives this object by his acoustical, visual and proprio-tactilo-kinesthetic perceptions. This interaction is a strong physical closed-loop interaction. This interaction is naturally multisensorial : at least, visual, acoustical and gestural.

The interaction between human beings can be **physical** and **symbolic**. Symbolic interaction is interaction conveyed by all the languages that we have developed, verbal or not : speech, symbolic gestures, writing, the deaf and dumb language, the gestic of the musical conductor, etc.

It is easy to think that symbolic interaction conveys symbolic communication. But what it is less easy to imagine and what it is often forgotten is that physical interaction between persons and physical objects conveys also symbolic communication between human beings. That is the case of Music, of Painting, of Sculpting, of Animation.

And it is what we called « Instrumental Communication » : In instrumental communication, physical interaction is the way to support symbolic communication between human beings.

We produce highly pertinent and sensible informations to other people by acting physically on an object. This object, which can be a trivial usual object, acquire thus, the role of « instrument », in the same sense that « musical instrument for the musician » or

that the « marionnetton for the marionnettist », the plasticine for the sculptor », the brush and the colored pastes for the painter ».

When a musician plays violin, he is in a physical interaction with an object and by the way of this physical interaction, he produces symbolic information to other men, which is Music. The player and the listener communicate in a symbolic way. The subtlety of the message is created, is localized in the physical interaction itself.

During this kind of physical and symbolic investements of the instrumentist, all the functions – epistemic, semiotic and mainly ergotic - , are in playing.

Rostropovitch informs the cello : semiotic

The cello informs Rostropovitch : epistemic

Rostropovitch put the strings in vibration by spending his energy : ergotic

The result is :

« Rostropovitch reveales us the cello »

« The cello reveales us Rostropovitch »

« Both reveale us the musical intention »

SO, What is now the difference between utility situations and artistic situations?

Is there a difference between utility physical situations such as to hold an object, to prune a tree, to drill a hole, to cut something

And Artistic situations such as to play violin, to carve a plate, to mould plasticine, to draw with charcoal.

In the two cases, the physical conditions to perform the task are the same : we have to feel the instrument we manipulate with the same accuracy, the same multisensoriality, the same complexity of interaction. They are the same physical conditions, for example, the same response time of reactivity to grasp an object to drill a hole or to manipulate the bow of the violin. We cannot lower the physical conditions of the performance for utility gestures and upper them for aristocratic gestures.

The difference is in the fact that, in utilitary situations, the instrumental interaction plays only in the production process and in non utilitary situations, they play also in the communication process.

The main difference is in the fact that the trace of the way, the manner, the dynamic development of the performance is carved in the outputs for the second in a significant way and it is not mainly significant in the case of utilitary situations. Real Music that arrive to our mind through our hear contains clearly, explicitey, readily, the investment of the instrumentist. The important fact in the drilling of a hole is ONLY that the hole exists.

Because of this, we often concluded that the physical conditions of the performance, for example the physical requirements for the haptic devices, have to be better for the musician that for the manual worker.

Somebody thinks : Why to spent a lot of money for this kind of simple outputs ?

Other people thinks : Why to spent a lot of money only for Arts, which are less important than our security for exemple.

Both are wrong because the physical conditions – that is money – are the same for the two cases.

FIRST :

That must be the same, and both at the level needed by the musician.

SECOND :

1. Because of we don't feel, the trace of the physical dynamic investement in the symbolic output (symbolic because the output is : the task is performed or
2. ^{not} Because in Artistic performance, you feel immediatly this trace,

Artistic situation becomes a good situation to evaluate immediatly the thrueness, the rightness of the interactions and to evaluate if the physical and human conditions of the interactions are right.. And it is interesting to take artistic situations as a model of human complete activities, to bench the technologies we want to developp.

THAT is the first conclusion of my talk

I will show you some examples now.

Most of them have been realized several years ago, and I chose them to show that the conviction of the reality is not conveyed by the realism of the image or the sounds. But by another thing : in which the main roles are devoted to the gestural action / perception loop and to the dynamic correlation between this loop and the two others.

1. First of all : a pedagogical sequence on force feedback / 3 sequences on which the person gesturally feels with sufficient accuracy, elementary materials : quite rigid, very rigid without damping, and finally the feeling of a spoon moving in the honey pot.

You can remark that, without seeing and hearing, it is easy, if the action-reaction loop is correct, accurate, well tuned, to convince the user to the reality of the object he has under his fingers on a broad set of experiences. It is obtained because of the quality of the force feedback device : its runs and the simulation also at least at 1 KHz, with a displacement resolution about 1 mm and with a very low noisy force.

2. That is the same system – force feedback and simulator - which allows the playing of plucked strings. Notice the quality of the sound evolution due to the three instrumental plucking, rendered in a very accurate manner.

3. Granule

:

The sounds and the images would be considered as very very bad today. They would be considered as not sufficient to convey Realism. Despite of this, this situation seems to us and to the player a real situation with only distortion in the sound and the image badly retransmitted by a bad media. In fact, the conviction of the reality is supported by the organicity of the playing, the quality of the gestural sensation and the quality of the gestural – visual – acoustic loops rather than each separate modality.

4. That is the same system in this bowed string playing. Notice the quality of the dynamic « Nuances » of the playing, changes in timbre, variations in the dynamic of pizzicati, etc. The player is convinced to the reality of the bowing and of the presence of the string under the bow. EVEN IF the morphology of the BOW is very different that a REAL BOW. In fact there is an important geometric anamorphosis. The geometry of the scene is completely different that the real scene but the dynamics of the interactions is strongly similar.

5. Even if the sound is not nice to hear.

That is the same friction playing but with another physical parameters of the objects. The player continues to be convinced of the reality of the presence of the glass under his fingers. That is due to the high quality of the correlation between the gestural inputs and the gestural and acoustical outputs, and not on each separately.

6. In the same way, The grace of this marionette is due to the gestural sensible manipulation. The marionette is a simple but pertinent physical object, well felt and well manipulated by its marionettist.

7. That is the same remarks in this animation, even if the visual rendering is very poor. The physical interaction, that is the dynamic and energetic, and ergotic investment of the animator, is explicitly engraved in the movements, giving to them expressiveness, accuracy and fluency.

8. Now utility situations with the same philosophy. Please look at with attention and comparatively with the previous sequences:

8.a. First inserting components ; the person has to insert physical deformable objects in the box, through a hole. She uses virtual graspers. And She feels gesturally all the scene.

8.b. Second, tasks under constraints : she feels the labyrinth and it is possible to not visualize it. The labyrinth represents places on which she must not go.

8.c. Finally cooperative gestural tasks. Users have to cooperate to insert a bar in another and the set of the two in a hole. They use a virtual graspers.

What can we say on these examples ?

The complex examples such as marionette or playing violin seems well and easily performed by the user. But the utility gestures : put something in a hole, seems roughly managed. They seem awkward gestures.

Why ? It is not possible to increase the quality of the system : objectively, we have under the fingers the same physical situation as in the reality in terms of physical requirements (time reactivity, amplitudes of forces and displacements, etc.)

In these sequences, as in the bowing of the string, in fact we chose a real-virtual instrument which is not immediately adapted to the task. The virtual part simulates a grasper and the real part, that is the force feedback device, manipulates the grasper with a number of freedom lower than needed. With the stick, we displace the articulation point of the grasper in 2D and with another key, we close and open the grasper. It is not possible to manipulate the rotation of the grasper around its articulation point.

We have shown that it is possible to manipulate with efficiency and « elegance » this grasper, if we imagine that we are an artist of this manipulation, for example by throwing dynamically the grasper in the space as a fisherman throws its fishing line. Some workers in excavation sites have this kind of expertise. We can observe them. But the persons on the video did not chosen this kind of behaviour or performance to achieve this task. Because they considered this task as trivial task. Then, the message is : to perform efficiently utilitary tasks, please acquire an artistic-like physical behaviour, in others words, simulate an artist, simulate a sculptor, simulate an actor, etc.
It is not a joke ! ! !

To convince of the reality, we must to have some minimal conditions on multisensoriality and the way to spend energy : This suppose that we have in front of you, instruments which allows us these kinds of simulation and close-interaction, particularly in their dynamical behaviour and in the quality on the instrumental interactions they propose to us.

But we have also to conform yourselves the better that you can ! ! !

The last multisensorial situation, more recent, with better rendering for images and sounds. But globally, it is not very different from the previous, regarding to the Presence of the World for the User.

In conclusion, to perform a task whatever is, which could be a complex task, with symbolic and physical issues, we have to assemble some elements which allow the minimal components to exert our physical and symbolic expertise together. The better case, because it is simultaneously :

1. complete : physical and symbolic,
2. explicite : you read explicitly all the components of the production process in the mediatized sensorial outputs.

Is the artistic situation.

CONVINCING of THE REALITY

But first of all, in sequences I show, it appears that we have, not the reproduce the reality, not to implement a mimic of the reality, but to give the minimal elements to convince of this reality by assembling rightly the correlation of our senses from which the identification of the physical object can emerge. We have to create the conditions of the emergence of the reality.

Then, Realism can be replaced by thrueness, rightness
And physical immersion by a kind of Cognitive immersion.
The violin player in the video is in front of his virtual instrument but the
physical and dynamical conditions we have implemented for the playing, create
for him a kind of cognitive immersion in the violin playing. He believes to be
with a violin.
Not a mimic of Violin but its pertinent features.

That is obtained by putting the best quality on the physical gestural interaction
loop and on the temporal correlation with the evolution of the sounds and of the
images, rather than on the morphological static rendering of these two media,
considered separately. That is Instrumental Communication and
Multisensorial Interaction.

**I think that, if, in our virtual worlds, we put sufficient instrumental
experiments of objects, in some places, with a sufficient high quality, even if
it is not directly needed by the achievement of the task, the reality of these
universes and the reality of our place in these universes, will emerge
strongly at us.**

That is my second conclusion.

Now I would like to show you that a too strong realism or mimetism can disturb
the appreciation of sensible effects.

1. Dunes

That is a sequence without gestural interaction. That is a simulation of Dunes, or
Sand or Granular Material Behaviour.

You see that a pertinent features of these very interesting effect is well
rendered : avalanches, collapses, etc, in fact dynamic behaviours which are
dangerous for us and which causes frightness

But In spite of these dangerous behaviours, Sand, Dunes, evocate also calm and
quietness in the smootness of their lines.

With the same underlying dynamics, if I represent visually the roughness of the
sand, I represent their dynamical changes causing drama.

If I represent visually the thinness of the grains, I represent better the quietness of the behavior but I lost the drama of the sand. Where is the compromise ? ? ? That is the same question when I look for sonify a sequence.

2. Horloge

That is another very realist sequence, without realistic visualisation and realistic sounds, movements and correlation between the two.

PHYSIS and MATHEMATE

Some words on the modeling of the physical objects called in this talk « instrument », always in the aim to cause in the user a strong conviction of the reality.

I would like briefly to say you that, this virtual physical object must not be a copy of the real object. We have to develop Physical Model, not in the sense of Physicist but in the trivial and ethymological sense of PHYSIS.

Physis in the sense of ancient Grec : as being done, by opposition with **Mathématé** : as « being designed, being built » by us.

A « Felt Physics », a « sensible Physics » which is qualitative and quantitative but for our senses, to be evaluated by our senses : a real physics for the sensible effects. That is for me the deep definition of the notion of « instrument » I introduced before. And that is the physical models we have used in the sequences you saw.
I will stop here.