The Future of Virtual Reality and Telepresence

HIROSE Michitaka and MINATO Chihiro

Positioning Virtual Reality and Telepresence

MINATO Chihiro (MC): Firstly, I'd like to ask how you see virtual reality (VR) relative to telepresence?

HIROSE Michitaka (HM): When you say "VR," there are typically two things which you are referring to. The first is what we might describe as the narrower meaning of VR, a world of total fantasy. Computers simulating worlds which do not actually exist, and that sort of thing. The other, or broader meaning of the word "VR" is when computers are employed to mediate experiences between actual places, which then comes to include concepts such as telepresence.

Yet, if you begin by considering the individual's existence, you can see that VR can be considered a form of telepresence, because first you have the individual present in a place, yet facilitated to experience other worlds. In other words, when this "other world" actually exists, this becomes telepresence in the narrow sense of the word, while when this "other world" is a virtual computer simulation, it becomes VR in the narrow sense of the word. Depending on the perspective, we might say that either includes the other, or even that they are mutually inclusive.

MC: In other words, reality and virtuality are not clearly delineated; rather, reality is revealed to be composed of many layers, and the means for traversing them are discovered through applications of VR technology.

HM: That's why I use the word "telepresence."

MC: When using the word "telepresence" it is important to first define what you mean by "presence." This "presence" phenomenon is not in itself self-apparent. We've until now chiefly thought of presence in terms of visual perception, but there is obviously much more to it than that, such as described by "affordance," and other ways of thinking about pre-apprehensive phenomena. It is for this reason that we need to reconsider what we mean when we say that "human beings exist," or that "things exist, and what humans recognize are often them." Once we've done this, telepresence ceases to be a mere technology. Rather, it is an opportunity to gain a new approach to how we look at culture—human cognition and perceived experience.

HM: I find it interesting that the original concept of VR came from the field of software engineering, whereas the concept of telepresence came from remote control robot. In this sense, it comes from the field of engineering, and I find it interesting that it is called to the service of artistic endeavors (such as the attendant ICC telepresence exhibition *Portable Sacred Grounds*).

MC: I agree. Also that a concept from such a specialized field came to inversely embrace all of culture.

HM: Seen from a technician's viewpoint, "VR" seems to be a broader word, whereas "telepresence" is an extremely limited technical term. Yet it is not clear which carries the conceptually broader meaning, which includes the other in its phylum....

MC: Again, this exchangeable, mutually inclusive structure which you mentioned earlier.

HM: More like they're chasing each other's tails. (laughs)

Conditions for Conjuring Reality

MC: I've just come from experiencing the VR in the CABIN© (Computer Augmented Booth for Image Navigation), a telepresence research environment which you developed. There were scenes of computer graphic simulations of racing through urban environments, yet I was very surprised to feel myself as a mystic flying through space. I guess I'm still a bit excited from the experience, but I felt that this kind of reality really goes to the heart of what VR is all about. Surrounded left, right and above, seeming reality on all sides. Of course, computer calculation speed is one of the keys to this experience, but suppose that for an instant the computers were not able to keep up with my actions, and that when I looked up I found myself in a temporarily suspended space—caught in a kind of gap because some of the elements which I require to constitute my reality had vanished. Could you please

describe the elements of your invention or the essential point to be considered to constitute the *reality* which I was just experiencing?

HM: That is an extremely difficult question.... What we can say, however, is that recently it seems we're coming to the realization that there are *many* realities. For example, the reality that you experienced in the CABIN is probably better described as a visually induced sense of presence. Because the CABIN features a display field mapped across five planes (left-right-up-down-forward), the CABIN user is offered an extremely comprehensive field of view. This is perhaps one of the "points" which you referred to. Unlike, for example with the TV, you are no longer *outside* of the medium looking in. You are immersed in the medium--immersive telepresence. Being *within* the imagery in this way, being assaulted by imagery from all sides, allows you a "first person" experience. If we describe the television as a third party medium, then we can describe VR as a first person medium.

Being able to see in 3-D is also an important factor in creating a sense of "reality." Having a sense of depth in the imagery makes things appear to leap out at the user. In other words, it is important to have a world before your eyes in which 3-D depth plays an important part. The level of detail is another "point." High-definition television seems more real than normal TV. It is also important to think of interactivity in creating a sense of reality. Moving your head left and right, you see objects nearby moving more dramatically than objects in the distance. In the CABIN this is also replicated, so that you're not only seeing things in 3-D with a sense of depth, but this interactivity makes your sense of "reality" seem to multiply. What most people praise about the CABIN system is the way in which it utilizes these elements of computer graphic technologies. The same effects can be achieved theoretically using HMD (Head Mounted Displays), but with HMDs, the user often experiences a kind of motion sickness, because you're trying to make the images move in response to the head's every motion. This problem is solved in the CABIN.

MC: Because there is a delay in the HMDs....

HM: Precisely. Raising one's head in an HMD, the images don't follow in real-time. This is an important difference between the CABIN and the HMD. Because the imagery is already being displayed on the surrounding screens, there is no need to change the imagery with each movement of the head. With the HMD, you always need to be concerned with accurately updating the display field. With the CABIN, you only need to update the fields when the head changes its translational position, so the burden of representation is halved. With the HMD, you need to always assure that the head position and data are continually in real-time synch. Computers are generally not fast enough to equal the task. This dormant half allows for quite a perceived difference.

MC: When I first entered the CABIN, I noticed that the four-cornered room was completely different than the world of the HMD. If one follows the history of VR, I think that its logical predecessor was the 360-degree domination of image found in 19th century panoramas. From the ceilings of baroque, South Germanic and Northern Italian chapels, each are 360-degree panoramas of sort. Whether containing the faithful or not, anyone raising their eyes "towards heaven" was surrounded by these images. In this sense, being contained in one room seems to be another extraordinarily important point. The condition of a body—surrounded in a synchronicity with the image--seems to create a key element to such "realities."

HM: When beginning to study VR, I considered what elements my system would be required to have. The first was presence, the second interaction and the third was simulation. The connection between simulation and reality may be difficult to understand, but say, for example, that you were to throw a rock in VR. It is clear that the rock's trajectory must either seem accurate, or be shown as a lie. It must behave as reality would behave.

MC: It must behave according to the physical laws as we have experienced them, or we will cease to believe it as reality.

CABIN (Computer Augmented Booth for Image Navigation)
Exterior View

HM: As such, there are many instances of things which must behave within acceptable reality tolerances. Of course there are many instances where elements of reality must be letter perfect, and then there are elements of reality which can meld into the broad visual field. Other elements of reality will only become apparent when actually engaged. This is why when you ask the question "what is reality?" I can only offer that there are many.

MC: In the 1980s, when VR first appeared, there were a number of new reality-specific research fields which sprang up. Now, however, it seems that we've shifted to yet another era, where we are inversely using VR to emancipate people from their assumptions about reality.

HM: Artificial Intelligence may be one good example, but at the moment of its conception, what was most pronounced were its *missing links,* and they formed the basis for the research that is going on today. VR research is still dominated by discussions about the visual field, but additionally, research into aural, haptic and other forms of "presence" have also emerged. I find it interesting that the moment when our senses are able to be synthesized using engineering methods is the same moment that we return to seeking new propositions

about exactly what our senses are.

MC: While it seems like we are dealing with issues of the "real world," in fact, we are actually dealing with those of the human interior. Or to put it another way, gaining further insights into the incredible extent to which we had no idea about what we are.

HM: We come to many practical applications for research into sound. There are many technologies presently available to us, such as digital processing technologies which can simulate the resonances of being in a cathedral while a choir sings, or technologies for having a sound seem to emanate from a virtual object placed directly in front of us. With haptic technologies, much of the research is still in a more interim phase. It seems that the sense of touch is really just beginning to be brought into the digital realm.

MC: The visual faculties play an inordinately important role in helping the human brain recognize reality. Another is the sense of touch. I've heard it said that the greatest concentration of nerve endings on the surface of our skin is in the tips of our fingers.

HM: Surface sensations are said to be almost equal in the visual and haptic domains.

What Information Input Technologies Have Brought About

MC: Technologies important to VR include those concerned with how to simulate the senses, and another branch are concerned with sensors for accurately apprehending our movements.

HM: The fact of communicating the body's movements directly to the computer is, in a sense, rather an epoch-making leap forward. Until this point, people were forced to communicate *semiotically*. Typing in commands, for example, was an essential stricture.

MC: The keyboard itself typifies communicating information through language, doesn't it?

HM: The concept of operating the computer through spatial manipulation really dates back to the invention of the "mouse" interface. Then I'd say that the next really important leap was with the data glove. It was the first interface without any presuppositions attached to it.

MC: Not only in terms of operating the computer, rather, one might even say that concepts of "learning" and "manipulating objects" also took qualitative leaps forward.

HM: I think that our culture will change to some extent as a result. Our culture and knowledge have heretofore relied entirely on being converted into symbols before being recorded or exchanged. Now, however, the information inputted via the data glove requires no such translation into the semiotic world whatsoever. Information without any meanings attached can be inputted directly from sensors tracking 3-D space into the computer.

MC: When I wrote my tictile thoery (Tokyo: *The Thinking Skin*, Seidosha, 1993), the data glove was still at the point where you could still only use it in conjunction with the HMD in primitive walk-through VR simulation worlds. Still, I was impressed at that time with the epoch-making nature of our sense of touch being a departure point for information exchange. Just as you mentioned a moment ago, an infant cannot manipulate a computer using a keyboard. A person would have to be seven or eight years old to even begin. With a data glove, a three-year-old can input. This difference offers us a cultural distinction, in that the new generations will be able to succeed semiotic history—and that is a real revolution.

HM: If you think about it, that which could previously not be expressed with language was not allowed to exist in our culture. Japanese dance *buyo* just wasn't in the fold! (laughs) Yet with recent motion-capture technologies it can be inputted in its entirety. With these kinds of new methodologies, new forms of culture are certainly available to us.

Interactive with molecules simulated by CABIN

MC: I would agree. They tend to be considered in terms of particular kinds of sensors, but I believe that they include broader and more profound meanings.

Technology Reaching for the Origins of Physicality

HM: The movements of the body are all related to issues of *physicality*. The visual senses tend to deal with issues of *mentality* alone, but *tactility* brings with it a profound sense of physicality. One has to actively reach out to touch something, and in this way, the sense of touch includes a more complete sense of physicality into the realm. Touching something with an injured finger hurts. This is something which we ourselves measure. So within

issues of tactility there are no distinctions between the interior self and the outside world. Information from within the brain passes through the body to reach the outside world, and returns though the sensory organs. They are all connected. This is the basis for new theories of the senses and of intelligence. Actually, this is not limited to discussions of tactility, but of all of the senses. The more you move your head, the more the retinal images change.

MC: These distinctions of the interior and exterior are mere conveniences inherited from the visual world of the renaissance, which we have somehow appropriated into

our daily lives. What is interesting is that through using advanced technologies like VR, we are forging experiences which break with these habits.

HM: I agree completely. Theories such as "affordance structure" [reciprocal compatibilities], which have gained such currency lately, are based on such ideas. One of Japan's leading authorities on this theory, Professor SASAKI Masato also forwarded a similar interest in tactile sensation. My earlier reference to "the wounded finger" was actually an example I heard him mention.

The other day I heard another interesting thing: "Computer technologies began from the visual field, then proceeded through sound and towards the sense of touch. This is the precise opposite of the evolution of life forms." It's a form of retrogressive re-potentialization, returning one step into ancient times to find a new point of bifurcation for two steps forward into the future. Simulating the events of the past like a sort of time machine.

MC: That's an interesting phenomenon.

HM: Using the word "evolution" creates the illusion that there is a straight line which can lead either into the future or the past, but it's not so. Thought about from a computer interface development perspective, we're seeing an increasing number of dimensions unfold. What until now was seen as moving along a two-dimensional interior, has in fact gained a third dimension, and so on.

MC: It is in this context that I get the feeling that the time-space continuum inheritance of the 15th to 16th centuries is in transformation.

HM: This may not have to do directly with conceptions of what *is* or *is not* real, but I have been quite fascinated by GPS (Global Positioning Technologies) lately. Through wearing a wristwatch we have for many years been able to enjoy real-time synchronicity with where we are according to time vectors, yet, now with the GPS technology we are able to experience an equally profound sense of space synchronicity. Always knowing your exact coordinates! This kind of placement mapping

technology is an essential link into the world of VR.

MC: I mentioned to you once that the sensory apparatus in the CABIN seemed to me like a crystal ball, but this also carries an ancient tradition, that of observing worlds which appear in visionary apparatus such as crystal balls. In Islamic mysticism the world is seen condensed in a single drop of water, like imagining for a moment that one drop of water on your car windshield could be expanded to the point where an entire universe were apparent...except for the fact that the CABIN contains nothing. What are we to do at this point!? (laughs) Your placement mapping information retrieval systems' data processing becomes extremely fast, I suppose?! (laughs)

Between Virtual Reality and Reality

MC: Steering the conversation back to telepresence, it's that it only requires the concept of presence that you are able to seem both here and somewhere else at the same time. For this reason, it is not absolutely essential that this is something which began with VR. Rather, this is something which every person who has ever made a telephone call has experienced. As long as *here* and *there* are connected in some manner or another, only the smallest leap of the imagination will take one into the realm of out-of-body experiences, mystics and other phenomena.

At this juncture what I find interesting is that, in either case, one never seems to fail to eventually return to the original place. In all of the literature there are no examples I'm aware of where the individual crosses over. For example, in shamanism, they beat on drums until they fall into a "blessed" (trance) state, even losing consciousness in some cases. The shaman's body remains with us, but their soul has gone somewhere else. Eventually, however, the spirit always comes back to the body it originally resided in. It's as though it were all borderless, though once they've gone they always come back. I find this fascinating.

HM: With VR, you often hear of people becoming disoriented and not knowing where they are, but nobody loses sight of the fact that it is their body that

Walking through a virtual city created by CABIN

carries the experience of reality. Returning to your self is a sign that the unreal world we've fabricated is not yet enticing enough to mind coming back from, I suppose. There are some essential differences between the worlds of the fabricated and the actual. In the VR field recently, "mixed reality" technologies have been garnering a lot of attention. Perhaps your line of thinking touches upon something in their approach, in that it is not a matter of virtual reality and actual reality mixing, but rather of speaking of both at the same time, or of following their parallel course in one's observations. A virtual reality grounded in the actual world, you might say.

MC: I once heard an interesting story: Until the 70s,

consciousness was considered a point after which linguistic faculties had developed, and infants were considered "pre-conscious." It was only after the popularization of video cameras that infants were seen to be consciously moving their hands, fingers and eyes. Through recording infants' hands and finger movements, and their changes in expression, and then analyzing long periods of this footage it became clear that they were occurring in a type of coordinated effort. They found verifiable awareness in infants as young as one or two months old. They are still looking into what the nature of this "consciousness" is, but what relates to your conversation is that the hand movements seem to be

the key to unlocking this puzzle.

HM: The VR effect is synthesized by computers stationed nearby the CABIN space. When they malfunction, we get the sense that you mention, of seeing our hand in the wrong section of the room, conflicts in our awareness of how things ought to behave. The user is forced into reconfiguring their body.

MC: There is certainly a moment where physicality and reality are dismembered.

HM: When confronted with gaps in reality fault tolerance, we are forced back into relearning what we learned as infants.

MC: And our hard-won concept of our body image gets torn to shreds! (laughs)

HM: And it works both ways; that this body image is consciously toyed with, and that it is made unfit by pure chance. Artists are often in the former position, taking stereotypes attending body apart in order to reveal the fact of the body, our subconscious images of it, and bring it up before us to experience anew. The latter is something that researchers like myself encounter regularly when trying to work with the body image. There are a lot of interesting experiences to be had in developing something like the CABIN.

To return to our original discussion about reality, I recently infuriated a philosopher by proposing the same questions to him that we've been discussing. (laughs) "The problem of the nature of reality is something that philosophers have been debating since antiquity, and I don't appreciate your reducing the issue to such easily solvable terms." (laughs) He was concerned that vectors of such weighty issues can be shaken by technological advances, and odd means of disproving them simplified. As soon as one philosopher asserts that "what we can reach out and touch is reality," we can ask: "then, is what occurs in a haptic display reality?"... In this sense, VR proves to be a bothersome presence. (laughs)

MC: Well, it certainly seems like a good stimulus to me.

(laughs) At least it is a technology which tosses some interesting monkey wrenches into long standing presuppositions.

HM: That's why, said another way, this is the time for philosophy to come to the fore. Not confining their questions to their own periphery, like the ancient issues of whether or not the world is round, questions that had little seeming resonance to the rest of us. Today, of course, it is important, from an engineering standpoint, to ask whether or not the world is round. Asking, for example, what is the shortest distance between two points on the globe requires that we factor in the curvature. Drawing a line on a map will not produce the correct answer. Calculating air traffic routes is a good example. This curvature becomes an extremely pragmatic issue. The time differences that occur due to this curvature, too, are something that was beyond the experience of nearly all humans a mere century ago. Today, knowing time differences well enough to obey the etiquette of not calling someone in the middle of the night is assumed, and being called an idiot for doing so entirely justified. (laughs) Saying "sorry, I forgot about the time difference" is bad form. The kids of today are, in a sense, well acclimated to electronically altered bodies or realities or what have you.

MC: Telepresence serves to eliminate things like time differences or the necessity of traversing spatial distances.

HM: As an alternative to motion. And in this sense produces a physical experience which betrays intuition.... I wonder if the question should be phrased as telepresence providing an alternative to motion, or rather as a parallel to motion?

MC: I think that things have gotten to the point where it is time to reset the parameters of reality and existence, from the global level to the level of our neural structure. It's an interesting and challenging age that we live in.

Technology Approaching Humanity

HM: The GPS systems which I mentioned earlier used to cost

in the 10 millions yen (roughly six figures US$). And today they are available for a few hundred dollars. The CABIN system which you experienced earlier is still a laboratory research tool, and as such, extraordinarily expensive, but I'm sure that their prices will come down until the point when one day, all of a sudden, they'll become ordinary household appliances. Seems like that sort of thing is happening all of the time. (laughs) Only a few years ago just when you'd have thought that voice recognition programs were a completely inaccessible technology, and now you can pick one up for a few hundred dollars.

As things get cheaper and smaller, issues of portability and mobility come into play. In this case, the human is the one doing the moving, so it becomes, in a sense, the opposite of telepresence. The body moves out into the world with the informational world attached. As computers continue to shrink, they approach the size of their counterpart body members, and an entire array of new issues arise. For example, how to adjust the visual parameters of the HMD, how large of a data glove is appropriate, what to do to customize for differing body types.
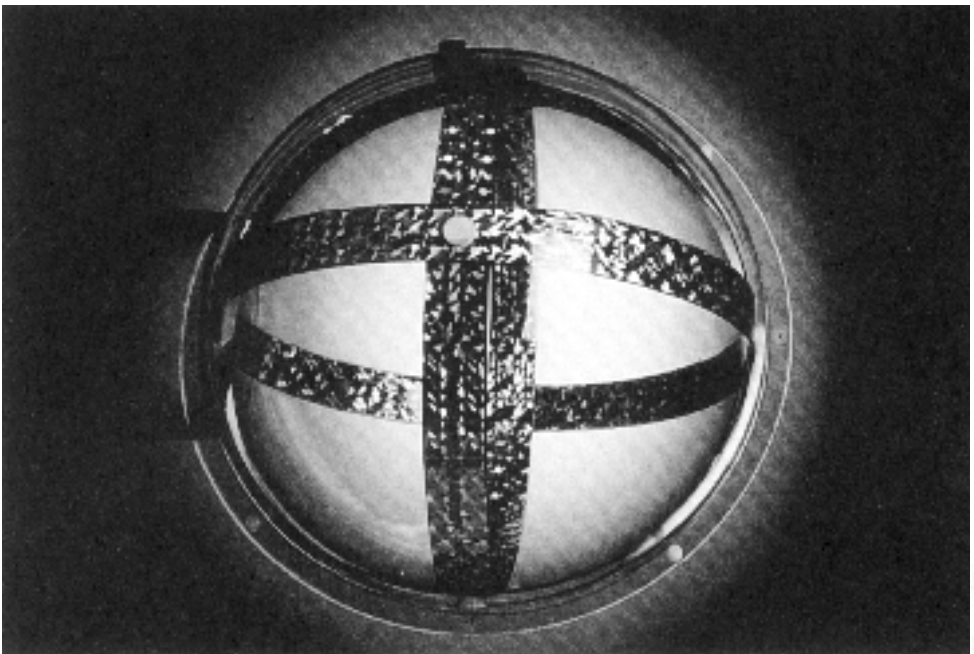
MC: The problem of how to treat approximate values....

HM: Yes. Computers continue to miniaturize, eventually becoming something like glasses, where each person would have one prescribed just for themselves. I'm sure that they will soon become "personal computers" in an entirely new sense of the word. In fact, we're already seeing the emergence of wearable computers.

Another interesting technological facet is that as the range of activity increases, our present technologies will become unusable. The sensors in the CABIN, for example, are only capable of operating within a 2.5-metre radius. You can use a GPS on a scale including Tokyo and Osaka, but there is no such thing as a sensor that handles a range anywhere close to that. So imagine that we need to develop applications for walking around within a specific building, or walking around a university campus, you can see that there are so many issues that need to be dealt with first.

MC: Another interesting technology in this sense is ultra high-

Magnetic 3-D position Sensor (Long Range version)
(from *What Is Virtual Reality*, Diamond-sha)

resolution photography, which can--even from a satellite orbit of 800 kilometers--still photograph with enough precision to capture a human hand. It is still extraordinarily expensive, but in the near future will be used in civilian applications, such as precision documentation in museums and the like. High-resolution reality.

I think that you can break reality into three basic categories. The first would be expanding reality. Science in general follows in this direction, in that the more science searches, the deeper into the further reaches of history it extends. Archaeology is a classic example of this. Continually in the process of finding things that hadn't previously been known to exist, archaeology is in the field of expanding reality. The second classification would be increasingly detailed reality, or micro-reality. The third would be contradictory reality...a reality that becomes increasingly ambivalent in relation to the future. A reality that is incongruous in the direction that it seems to take.

HM: Such as in simulation?

MC: Yes, I think so. What was until now known to be simulation itself, yet in its increasing potential to be simulation and nothing more than simulation, still, at the same time, has the power to create reality which also needs to be considered. It seems that reality has really expanded to this point.

HM: Even we in the field of VR tend to consider VR as a form of simulation. To use an earlier day's phrasing, simulation is a model of reality. The problem is when the model supercedes the reality, as can happen in our field. Many architects, for example, have been using VR-type simulations in developing their urban designs. They are testing out their ideas in cyberspace, and developing spatial concepts appropriate for cyberspace. Of course this is still taking place within simulation technologies, but within the space of their discussions that city exists in their consciousness. What's interesting is what happens *then*. Because, say, one of the shops scheduled to open in that city opens up a homepage on the Internet, and begins doing direct mail sales, for example. The city begins to function even though it doesn't *exist* yet.

Then, in time, the actual city comes into form. This is a form of simulations which clearly supercedes simulation.

MC: If I'm not mistaken, the concept of simulation comes from associations of the body and its double or shadow. And "image" as it is understood in the west is a two-dimensional rendering of the actual figure. In other words, the shadow of the original. As a subsidiary existence its status is of a lower nature. First you have the authentic reality, and then its image naturally follows. Or in the case of building a city, the traditional process is to project a number of these shadows upon the potential phenomenon. What you describe is a shift in this very thought process.

HM: I would describe it as the virtualization of actual space. The urban environment traditionally constituted of architecture or built objects. But when computers and network technologies enter into the picture, the urban space itself ceases to be developed as a thing, and begins to be developed as a *condition*. When things have come this far, what is important is not whether some element was simulation or not, because it is all the same at that point. In this sense, it is as though they begin with beta versions of the city, which, through a gradual process of development, produces something which is the sum of real elements in the planning process.

MC: That's why we don't know what comes next with simulative forms of reality. It could be that we've only attached the real to the project as a kind of final process step. (laughs)

HM: Even if we consider simulation as a lower class of existence, there are things with factual meaning and therein reality which, if recognized, then provides a viable intellectual value--then it is only normal that we should accept this as the emergence of a separate dimension. We have to speak of this dimension in cultural terms, because it speaks to what human beings are looking to. It could be that the youth of today are not at all as fixated on reality as we are. They're perfectly happy with the coarse imagery of video games. The sad thing is that we were brought up on TV. We want things to look a little more *real*. I think that there is a huge cultural gap there.

MC: Probably so. Reality and telepresence both come down to issues of the ability to imagine, if you ask me. Thank you very much for taking the time today to speak with me.

[This dialogue took place at the University of Tokyo on April 8, 1998.]

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