[Interview Location]
[Length of Interview]
[Format of Original Recording]

Gianmarco Veruggio

An interview conducted by
[Interviewer Name]
with
[Names and identities of any other people who were
present and active participants]

[Interview Date]

This transcript was produced from a poor quality audio source (ambient background noise) and the recording includes a subject with a heavy accent. As a result there are more "_____"s and "<inaudible>"s than in a normal transcript. – Production Transcripts

Q: So I need you to start by introducing yourself. Tell us where and when you were born.

Gianmarco Veruggio: Okay. I was born in Sanremo, Italy in the flower area near France near Cote d'Azur in 1953. I went to the Classical High School in Sanremo. Then I got an engineering degree in Genoa. My interest was mainly in computer science. So I started with simulation. My master's thesis was on a ship handling simulator, a totally computer generated imagery for a ship handling simulator. And if you can see that the years, which are 1978, 1979, those are panoristic [ph?] thesis. In fact we had some industrial interests in our thesis and there were projects to be with the simulator based on our thesis. At that time I remember there were very few examples of computer generated imagery for simulators. I remember the CRF [ph?] in New York was perhaps the only one fully developed and on that technology. It was a very interesting part of my life. It was a side to official activity at the university just to earn some money. At night time I was developing software for video games. The first software video games in Italy I remember were very interesting.

Q: What were the games?

Gianmarco Veruggio: It was the time of Space Invaders. Just the first examples coming. I remember because the first generation, like the Wall, like Pong were based on a big board with a TTL integrated circuits. And at a certain point they started to produce a board with a microprocessor inside.

Q: Intel.

Gianmarco Veruggio: The first in 1988. Yes. When we got this board we realized that it was possible just to change the software and to produce different. So in Italy a small company started to produce this clone. And we were able to develop software for video games. It was very amusing. <laughs>

Q: Any famous titles that you made that were popular?

Gianmarco Veruggio: No. Probably at our level. But I remember that –

Q: So in Italy.

Gianmarco Veruggio: Yes, in Italy there were with the games that were installed in the bars.

Q: Something Italians would remember?

Gianmarco Veruggio: I remember we made a very, very successful one that was called "Fool Race" because it was a sort of Pac Man but with small cars instead of monsters. So you were driving a car counter clockwise while all the other cars from the machine were running clockwise. So you had to avoid. That's the reason of "Fool Race." You were running in the wrong direction. And I remember perhaps a thousand of the video games were sold by the company. Not Nintendo or Sega, but anyway for a small company located in Sanremo it was a success. It's a very amusing time of my life.

Q: For the ship handling software did you think of that as a robotic system at the time? Or was it mostly a software application?

Gianmarco Veruggio: Only software. It was fully software. We developed graphic package, it was substantial. It was very basic because we had a graphic device and we had just three instructions. Set color, set inks, set Y [ph?]. And then this was the way to light a pixel on the screen. Now, open GL and all. Nothing. So we wrote our own open GL in a certain way. We had to. We started from the day I worked from Remo [ph?] with Sutherland [ph?]. It was very famous at the time. The first algorithm was to draw a line on the screen. At the end we also had to solve the problems of geometrics and overlapping of solids, the shadowing of surface and set a buffer. All software on a mini machine, it was an HP21-NX, where it was a very small computer I don't have a movie now. But it was very impressive.

Q: And in terms of the actual software it was probably a lot more difficult before the days of GPS to navigate a ship automatically.

Gianmarco Veruggio: Absolutely. Because it was necessary to create all the basic software you can use. We had nothing. We had to program an assembler. Because you know computer graphics is very computer time demanding. You have a huge amount of calculations just to calculate a picture. And for our real time animation you need to produce at least 10, 20 images per second. So the efficiency of the software is of paramount importance. So that's why we started programming. We changed also the firmware of the machine to be able to do some iterations more quickly. So it was a very, very software computer science thinking. Just software. It was my first love, spending nights writing code.

Q: So how did you become interested in robotics?

Gianmarco Veruggio: It was many years later. Because after that I worked in automation and control. I was involved in controlling for instance some part of a ship. The link is given by the ship handling simulator. Then I joined the Naval Automation Institute and I started working in naval automation. And then I was involved in marine and maritime data collection system and operation. We did some experimental work with radars and oceanographic apparatus. For some 10 years I worked in many different fields all related with the sea. And then I remember it was 1989. I saw an underwater robot and I decided to start underwater robotics.

Q: What was the robot you saw?

Gianmarco Veruggio: It was a very small robot. Actually it was a robot because it was a remotely operated vehicle by Marine. It was called Philippe Bot. It was a small sphere with just propellers and a little camera. It was totally manually actuated by the operator. And the electronics were very basic. Probably it was totally analogic controlled with normal software. So the idea was to use that robot. It was a robot used by the Italian CNL but it was not working. It was out of service. So I decided to use just the marine part of the robot and to repeal all the electronics inside. And that was the beginning of my activity. It worked. My idea was successful. At the beginning it was a very low cost experiment. But they gave us successful _____ where I'm seated then used as the scientist at that center. So we started 2001. In 1991 a more structured the project that led us to starting business with our robots and it was a success story until 2003. <laughs> Then it was a sad story because everything got stopped. Anyway, if you want I can show some video to you and perhaps to you I can give the videos if you want.

Q: Yeah. Yeah, I want to get those. Not right now but I want to get those. And pictures and all the videos, that would be great. So from Philippe, then your other big robot, that was Romeo?

Gianmarco Veruggio: Yes. The first one was called ROBY.

Q: ROBY.

Gianmarco Veruggio: And then we made an upgrade and we built ROBY 2. That was the first one used in Antarctica in 1993 and 1994. Then in 1996, we started the Romeo project and in 1997, 1998 we went to Antarctica with Romeo. And it was the first mission for Romeo. And then we worked on internet robotics. And in 1998, 1999, we started working on internet robots. I remember in 1999 we were able to control Romeo through the internet. And the first

experiments from Ken Goldberg were in 1996, perhaps, with the Telegarden and other projects. I was much impressed by this idea from Ken Goldberg. So when I designed Romeo I tried to create an open architecture and a fully networked architecture capable to be used from many labs, a sort of open prototype. And in 1999 we made a corporation with Lisbon with Antonio Paschal. In the architectural layers the Portuguese high level was able to control the exhibition leg in Italy. And Romeo worked in a pool automatically controlled by Lisbon. It was our first experiment in 1999. And in 2001, we went back into Antarctica with Romeo and we created the E-Robot project. So we were able to connect Romeo working in Antarctica through the internet in Italy and everywhere in the world of course through a satellite link. So substantially we brought internet on the pack with a satellite link. And the architecture for Romeo made it possible to control Romeo from Italy. And I think it is the first ever control of a mariner robot in operation through the internet from the general public. Because there were experiments of telecontrolled robots from Ames' lab but not through the internet because when we were working with NASA they had a dedicated channel. It was inspired by them, of course, but my idea was to broaden the possibility. I was much impressed by Bob Ballard's experiments also. He was able to bring students to his activity in his JASON program. I think it was very interesting. I think it was the first time everybody could control a robot simply connecting with a normal browser to our robot and just controlling the robot through a JAVA interface like a video game. It is probably linked with nefarious activity. We were able to make this robot available to many schools in Italy. We made an educational activity also and a prize. We made an award for the Italian school asking them to create an experiment to be installed on the robot and controlled by them in Italy. So the winner was a school in Austin. They built an underwater camera modified. They started from a commercial camera but they modified the forms. They put some infrared screens and a 232 interface. So we brought this camera to Antarctica. We started it on the robot. And then the students at school were able to take pictures with their camera in Antarctica in real time. It was amazing. I remember that when we at the ceremony for this award we had a team from the NASA space shuttle astronauts as special guests. Very interesting.

Q: So what were the scientific missions in Antarctica?

Gianmarco Veruggio: My first was to try to do something real, not just to go at sea to test the robot as if it was a toy just for my satisfaction. But it is to use it as a tool, a useful tool. So we made different experiments with different scientific projects. Because one of the criteria is this. After all it was to have an interchangeable payload. I spoke about the open architecture. So it was possible to change the payload simply connecting it to the power and to the network. So everybody was able to produce a payload with a very simple interface. We gave a relativity of internet connection and that's 232 connection and power. So the first mission was just below the sea, the surface of the sea covered by eyes to take samples of the sea life just below their eyes. Because there are very, very strange processes in the life cycle of the eyes. The second was – This was possible just with the robot because we were able to make a hole on the pack and to send the robot making long missions, for example, 300, 400 meters, because it was cable

controlled. So it was able to make these missions at different altitudes taking samples and measurements and so on. The second mission was to work on the bottom of the sea monitoring the life at the bottom for another team of biologists. The third mission was mainly technological. It was to test an equipment produced by ENA in Italy. It was a laser, a special laser device normally used in air. And they developed an underwater laser. And our mission was to test it underwater at sea in the real environment. The goal of the device was to characterize the dispersant in the water, the material dispersant in the water through the laser measuring the reflection at long range because the usual devices measure the quality of the water on a very short range. With this laser they wanted to measure for 100 meters. So it was a technological mission. But the whole mission was very important because of the publicity also of the capability or robotics to perform different activities, to be modular, to be flexible. The concept was to bring just one robot on board the ship and many different payloads just to be able to share the cost of a ship mission among different scientific projects. And this was a mission in 1997, 1998. In 2001, we tried a more difficult mission. The idea was to deploy a benthic station at the bottom leaving it in operation for some time and then go back to grab and recover it with samples and data and so on. We were able to do that. That project was called ABS, Antarctic Benthic Shuttle. Shuttle in the sense that it was just a shuttle to take an operation and instrumentation package and then get it back home after a certain time of operation. This was important because in this way benthic scientists were able to collect a long series of data in a certain place. And the difference of using a robot is that you can put the instruments very precisely where you want to put it without interfering with the environment. So instead of just dropping it with a rope and leaving it attached to a buoy – the traditional way to do that is just to drop with a rope leaving it connected to a buoy and go back – but this way you don't know exactly how it will make the robotic. With a robot you can make a survey, make an exploration, measure the parameter in real time. So if you are looking for a certain condition in temperature or of character or something else, you can look for what you are interested in too and then stop the deployed station very carefully and then leave it in operation. And also look at the station working before I leave it there. This is difficult. There are more difficulties to recover it because they need to find it and to make the docking. So it was a very complex mission but it worked.

Q: What were the biggest challenges for marine robotics during your career? What were the big problems that had to be tackled, not just by your group but everybody working in marine robotics?

Gianmarco Veruggio: I could cite Woody Allen, "Whatever works." The big difference is that underwater things have to work. So in a lab as you saw a few minutes ago, you can put things together in a very creative way. If something doesn't work you can simply repair it or change something. Underwater you have all the problems of hyperbaric technology. You have the water, you have corrosion, you have the pressure. And you can't control what is happening. The biggest problem is not to lose your equipment. This is the big difference between the sea and the land. On land things are much easier in a way. If you put something on the terrain it will stay there until you decide to start operations. If you put a robot in the water it will drift. It will not

be under your control. Nothing under water is totally under your control. So I think uncertainty. The key word is uncertainty. You don't know the environment. It is difficult to measure the environment. It is difficult to communicate with the robot. It is difficult to recover your robot after the mission. It's tough work. That's why it's a small group of people not totally integrated with the broader community of robotics in the world. Because usually marine robotics people are much more joined with marine scientists or marine operators, marine contractors. So the most important groups works, for instance Woods Hole in the States because Woods Hole is a big oceanographic institution. Or perhaps another very important example is in Monterey there is the Monterey Bay Research Aquarium Institute, MBARI, that has a technological branch developing marine robotics for the Aquarium Research Institute. So it is much more easy to find a marine roboticist near an aquarium than near an artificial intelligence group. So it's difficult to convince marine contractors that robotics is useful. That advanced robotics is. They want something that doesn't break. They want simple things, very tough things, very stupid, very rough. So when you speak about high level control intelligence, they show indifference. They think ah, this kind of stuff.

Q: They probably want sophisticated grasping?

Gianmarco Veruggio: Yeah, yeah. I think they are more and more understanding the importance of technology. But it is a slower process there. When I started I remember there were very few advanced robots in the world. Now for instance, Victor from ECA is a very good robot. And of course JASON from Woods Hole is perhaps the most famous. But anyway, going at sea it is always a risk. I remember that for instance ABE, the Autonomous Benthic Explorer from Woods Hole was lost a couple of years ago, not long. And also Kaiko, the Japanese robot. I think it was the most champion of depth, guided in 11,000 meters and Kaiko was lost. So we are speaking of the most important groups in the world and they lost important things. This is the big problem. So when you try to advise companies, underwater contractors or shore operators, in advanced technology you have to show that things work and don't break and don't cost too much. That's why I built Romeo, just to show that I was able to make research on control but in practice not just in theory. If you show a simulation or just a small test in a lab, they won't give any money to you. If you show you know their real problems, you are able to take the environment, they will increase their faith in technology. So actual robots have more capabilities than 10 years ago. But compared with the robot you can see on the land, there is still a slower pace. There is no ASIMO for underwater.

Q: That reminds me a lot of what is going on right now in the Gulf of Mexico with the oil spill and of course they're using these underwater robots to cut the pipes and assemble the stuff. Have you been following that? Do you know much about these robots?

Gianmarco Veruggio: I've been following it by press only. I know what you know. In a way that was an example of the huge work these robots can do underwater. It demonstrates also that they cannot do everything. I think the Gulf of Mexico they failed in prevention. When the risk is so big you should take more precautions. I think you should be more careful with your technology and not create these kinds of risks. The blow out, prevent this didn't work. Why? I have a friend working in the field and they told me that these kinds of valves that should stop the oil are not tested in any real conditions. Because it's not –

<Veruggio receives phone call>

Q: That's okay.

<brief interruption>

Q: So the testing of the valves in the prevention?

Gianmarco Veruggio: Yes, I don't know if it was official information but it was a friend speaking in a coffee bar. But he told me that these kinds of valves are not tested in real conditions. Actually it's not easy to test them at 5000 feet with that pressure. This should be a warning about the problems of our technology. In that condition they didn't work.

Q: You talked a little about your work in robot ethics and how you became interested in robot ethics.

Gianmarco Veruggio: As I told you, I started some of the popularization of my activity. I started in 1998 perhaps. I wrote a book. I made some conferences at schools. And then I founded an association that is called Scuola di Robotica, School of Robotics, to bring robotics to schools. And this made me interact more close with the general public, with the society, with the young people. And they started to make questions. And I started thinking on problems that before that were in the back of my mind. I remember I was a science fiction fan when I was young. I read all the books of Isaac Asimov. And I saw many movies on topics related with robotics and the future and the problems of robotics. So at a certain point thinking of these problems and also being aware of the debate on bioethics and all of the problems that are brought to the surface by genetic engineering and so on, and also the problems of the nuclear power and the problem of – Of these methods in my mind, I started thinking of robot ethics. I was surprised that many different ideas were not yet merged and coming forward to develop something useful for the society on one side but also for the robotics group of people on the other side. Because the affect of the society on our work could be huge. For instance in Italy the research activity on stem cells is very difficult due to the laws, due to the problems created by the Roman church.

And so in Italy the nuclear energy is not allowed because after Chernobyl there was a popular vote and Italian people decided not to use nuclear plants in Italy. I don't know if it is correct or not. But by sure the Italian research on nuclear power had stopped. This means that we as a robotics society should be very careful on the future of our work if we think that our work could raise problems for the society. And this is the case, you know that robotics has many possible points of crisis in medical robotics, in military robotics, also in robotics in the society. So I thought that it could be very dangerous going on and developing robots without taking care of the effects of our work. I said wait, it's a little childlike; I think we are adult people. And it's not correct to say I am scientist, this society should take care of the problems, because we are part of the society. And we are the part of the society that knows the problems better. So who else could take care of the problems if we are those who know the problems more than any others? So that's why I started working on robot ethics. And that's why I am working more and more in this field. Because after the first symposium in Sanremo in 2004 there were many other initiatives. There are more and more people interested in these topics. So perhaps I started because I made classical studies. I loved philosophy when I was young. I loved science fiction. I love robotics. Perhaps putting it all together the result was roboethics.

Q: And you also created the IEEE Robot Ethics Technical Committee or are involved in its creation?

Gianmarco Veruggio: Yeah. The Technical Committee was launched in Sanremo by Paolo Dario , Kazuo Tanie, Ron Arkin that were both in Sanremo. When I organized the meeting, I invited scientists from all over the world. And Paolo was President at the time of the Society. He was thinking on that problem also because he's another guy that's concerned about these aspects of robotics. So he was the President and started the technical meeting. So there is a turnover on the chairs of course. Now I am still co-chair of the committee but I probably next year I will do that and leave the task for another friend. Anyway, we organized this and workshops _____. And there is now an ongoing tech call for special issue on roboethics of the *Robotics and Information* Magazine. The deadline is in the fall this time I think. There are some books that are probably in press on the topic. So I am very happy because from the beginning I see that the field is increasing. There are more and more people. Also from outside our Society, that is starting to study the problems, there's people from the legal field that we started working with. It's getting more and more clear what roboethics is, which part of roboethics is starting to be developed in the world. Because for instance I see the raising of two branches that are roboethics – you can use words just to try to understand – and robot ethics. Because there are various levels of the problem. You have to build an artificial ethics inside the robot. And this is for instance what many people are starting to do now Ron Arkin. At the yes show its I see many that are starting to develop algorithms to implement socially acceptable behavior, to an ethically acceptable behavior. This means that we are trying to develop the tools to be able to give to the robot a behavior that can be autonomous but it could stay inside the boundaries of what we think acceptable. But above that level there is another level that should

define what is ethically acceptable from a robot. So I think that these two letters, one is more related to the society at large. This is what I call roboethics; there's similarity with bioethics. And the other is robot ethics. And this is much more inside our community. Because if someone would say well a robot should not do that. Well, we should be able to plant that command inside a robot. And if we develop a learning robot, an autonomous robot capable of change, of evolving its behavior, learning from experience, it's not very easy to guarantee that what is forbidden today to that robot will remain forbidden even when its learning capabilities will have changed his behavior. So this is a very important challenge for robotics. I think it's part of artificial intelligence, it's a branch of artificial intelligence. But still we are to define what is ethically acceptable. We have to define what society wanted that robot to be used for, in which way they should be used. And of course, the problem is not with the Roomba, but think of the future combat system from the DARPA. If you have someday a robot with little force capable to kill people, they have to promise our very ____. And also think of robots for surgery. And the robots for work. Robots are for prostheses, neuro transplants. I think there are so many problems that we should take care of that society would not fear our work. What I want to prevent is that someone at a certain point will start seeing robotics as an enemy, as a threat for humankind. Because at that point if you think of fanatic groups of people, we should face problems for our research. So what I say to my colleagues is robotics is for robotics, not against robotics. And if we find that some limit is necessary it is important that this limit is evaluated by experts, by robotic people, not just by religion or politics or philosophy, people that don't know anything about robotics. That's very easy because the robotics field is not very used to interact with the humanities. I think that the physicists are more keen to read books, to speak about philosophy. Their course of study is different. Also physicians in the medical field, very often they are capable to interact because they are in a tradition of problems with the medicine, medical ethics has a long history from _____. But engineers sometimes are very square people with no philosophical background. And very often I find colleagues that speak about philosophy of robotics from Asimov as if they were possible, as if they were something practical. I'm trying to wake up. I know you understand.

Q: Yeah. Well it's good to get it on tape.

Gianmarco Veruggio: Perhaps I'm not explaining the concept very well.

Q: No, no. That's very good, especially how it's sort of come together historically. And as a new field that's important to robotics too more generally. I think that situates it well. Can you talk a little also about education and robotics and how you see the importance of educating a new generation of people to become robotics engineers?

Gianmarco Veruggio: Yes. When we speak of the future or robotics usually we speak of what could be possible in some 20 years. It is probably 20 years that I hear people saying, "In 20 years we'll see…" And something happened of course. Sometimes we were too much optimistic perhaps. But I think that the future is very near now. I think that the robotics invasion will occur perhaps really in 20 years from now. And this means that I am perhaps too old to see all of these developments. And robotics will change the society but the society is the society that will be composed by people that today is a child. So I think it is important to bring to students, to young people, to children some knowledge about this. Because at school they usually see things that their teachers learned many years ago. So there is again between school and the real world they see video games or toys or computers. Some countries perhaps get this. It's smaller in the States, probably smaller. But in many countries they get this is huge. So if you want to prepare the society to the robotics invasion, we need to dedicate this younger generation to robotics. Not just as consumers but as capable to understand what they are using. Capable to understand the change that they will see during their life. When I was younger I had no TV set in my home and no telephone. So I saw in my life many things change. But I think that the next changes will be bigger. Because I think that the last century was the century of machines and the century of computers. Well robots are computers inside a machine. So I think that any machine will be a robotic from the biggest machines, ships, trains, factories to the smallest also, nano robots inside our bodies. Robots for surveillance. Robots for care to children, to elderly people. And interacting with these intelligent devices, I think will be different than just interacting with a TV set, dishwasher, a cellular phone. I think that there is a discontinuity in the technology due to robotics. And that's why I started an association to bring robotics to students. This opened my mind on many aspects of robotics. I think that both of the robotic toys that are coming from Japan are from the same principle. Because in my opinion they know they will have products in some time, 20 years, for the mind. And with these toys they are preparing the market. They are educating children to use these kinds of robots with the aim to make them acquainted with the robotics technology. So I think we have to do the same at school and we have to teach what aspects are involved within creating of a robot and the use of a robot. And what they will be able to do when they will be able, what role they will play. They will be just consumers or technicians or sellers of robots or scientists? In any case, they will have to live with this new population of aliens that have not come from outer space but from Chinese factories. Like my phone, my TV, my car, I don't know. And this introduces another problem related with roboethics. Because in the global market it is not possible to create our roboethics confined inside the borders of a country. Products are worldwide distributable. So the same barriers should be accepted in Italy, in Japan, in the States, in Columbia and so on. You have different religions, different social organization, different beliefs, different politics. For instance, the problem of privacy is not the same all over the world. The program of life or the program of right to life. So that is why we need to bring these questions to the society and mainly to young people. Because when these problems will become urgent probably I will be too old to tackle them. Probably they will be the player of the game. I think it is also stimulating, the current activity. I think all of the robotic labs should work with schools because working with children is very stimulating. Sometimes they make questions that are totally unexpected. And it is amazing to see a 3 year-old, a 4 year-old boy grab a small robot and push the right button to stop

it or to start it. The capability to learn, to sustain the concept is much more than you expect. It is much easier to explain a robot to a 3 year-old child than an 80 year-old grandmother or grandfather.

Q: Yeah. So who are the roboticists who inspired you, that taught you, who were the pioneers or robotics in Italy? Who do you think was influential on Italy and on you?

Gianmarco Veruggio: Actually I think I was influenced mainly, because when it started as I told you I started from marine robotics and there were no marine robotics groups in Italy. So my –

Q: Teacher? Mentor?

Gianmarco Veruggio: Yes. My mentors were all abroad. So that perhaps the first one was David Lane. He is in Edinburgh. He was much appreciated, his activity. David Lane. And after him I started to study. I remember a very amusing period in which I visited many labs and I was impressed by Dana Yoerger in Woods Hole. He is the father of JASON for instance. And he is a wonderful guy. And then let me see, Jim Bellingham at MIT. Jim Bellingham. Now he is the head at MBARI. So I was able to became friends. Also Sarigo_in France. It's a small community compared with the general robotics but very, very, very close in spite of the geographical distance. We used to meet in specialistic conferences; instead of a big conference with too many topics they are very specific.

Q: What's the big marine robotic conference?

Gianmarco Veruggio: I remember it was AV or ROV [ph?] or USD. They're not very big. It's difficult to see a very big conference in marine robotics.

Q: Well the important ones, I guess.

Gianmarco Veruggio: These I mentioned. Also there is a good space in Ocean that is a broad conference on the ocean but there is a technological part. It was very interesting for me to start from scratch and to be able to interact with the most important scientists in the world and find them very open, very keen to help me to grow. I was very happy in 2005 to organize a conference in Genoa and to invite all of them and have all of them here giving keynote speeches at my conference. It was a very good experience from my personal point of view to be able to put them at the Aquarium. After that when I started thinking of roboethics, I think I was influenced by the history of physics for instance. And it's not strange, when they organized the

first symposium; I organized it in Villa Nobel in Sanremo. Not everybody knows that Alfred Nobel lived in Sanremo and he died in Sanremo. He spent the last years of his life in Sanremo. And Villa Nobel, his house is a museum in Sanremo and there is still the lab. And Nobel is an example of a scientist that became famous and rich with a technology, dangerous. In Villa Nobel in Sanremo there is still a gun on the docks because it is in Sanremo. And he made experiments with bullet. He experimented with explosives. So he is not literally a pacifist. But at the end of his life he understood that the science and technology can have effects on the society that could be also dangerous. So his testament, he created the foundation and created the Nobel Prize and also the Peace Award. And that's why it is symbolic for me that our first conference was held there to make clear that we have to take care of the effect of our role. So I remember the work from Joseph Rotblat, the Nobel Prize for Pugwash Organization, the organization that took care of the physics. So this is the cultural background And in fact in Sanremo I invited a representative from Pugwash and also a representative from International Institute of Manteniendo that is an institute to take care of the training of peace keepers. It is working with military people.

Q: Who was that?

Gianmarco Veruggio: It's International Institute of Humanitarian Law. And they have quarters in Genoa. And the operation headquarters is in Sanremo. It's a coincidence perhaps but I don't know. If the fact that when I was a child I passed every day in front of the House of Nobel influenced me perhaps. <laughs>

Q: Maybe.

Gianmarco Veruggio: My analyst perhaps will discover it.

Q: Okay. Is there anything else you want to talk about?

Gianmarco Veruggio: I've spoken too much for today. If you have any other questions?

Q: Yeah. Okay.

Gianmarco Veruggio: I can say just one more? I hope you will cut it? Two hours of – I think that an important warning to my field is to be careful using words. Because in these years I spent a lot of time discussing about words. When we say that a robot has intelligence what do we mean? We use words that we already had. We had the word intelligence. We used intelligence for robots. But there is a psychological mechanism. When I say intelligence you think to your

intelligence, not my intelligence or the intelligence of your camera. So using this word could be very dangerous. So extending the concept to freedom, learning can very easily drive to discuss about the rights of robots or the consciousness of robots or about the possibility that a robot could feel pain or love. And this is in my opinion a very big danger. Because I don't say that I know the answer to any question on this problem. I don't know. I simply don't know if sometime in the future a robot will be able to feel like a human. But it is very dangerous to discuss these topics without making it very clear the meaning of the words. Today the intelligence of the robot is not the same intelligence of the biological creatures. Today. And I think also for many years from now. So in all of these workshops and many discussions at the end of many conferences starting from the question from the public, we always finish to discuss about what is the difference between a human and a machine. And I think that this could be interesting. It could be also amusing. But sometimes it is a waste of time. It is not very useful. Because the technology is around. The market is not waiting for us to decide what is the difference between a man and a monkey. So what we need is to develop useful tools for the society. Society needs robots that do something useful in the society, minimizing the dangers for society. And this is not done discussing about false problems created by their own use of words. So discussing with philosophers, I remember we proposed to make clear that when we speak of robots words have a different, there is an ontological difference. So we should perhaps say "intelligence star" instead of intelligence. In the same way as we say "x-tilde."

Q: You don't think the artificial in front is enough?

Gianmarco Veruggio: Yeah. Because otherwise we discuss in a big confusion of terms. And I think it is not very engineeristic. I think this could be good for people selling used cars or for politicians and so on. But not for engineers. We are engineers. We are used to using standards. When I make a project I define in the first page what is the meaning and the range of all of the variables I use in my formulas. So I think that building roboethics we should use the same care and the same seriousness, the same scientific method. So I fear colleagues that speak about consciousness because every time we spend hours discussing what consciousness is in humans. So if you wanted to make an interesting discussion, well, if you wanted build roboethics to perhaps be able to speak about self-knowledge or perhaps "consciousness star" but make very clear that robots are robots and humans are humans. I spent one hour just 15 days ago discussing about the connectionistic theory. So there is a scientist saying that in 2020 the number of connections in our computer will equal the number of neural connections in the brain. So his confusion is at that time the computer will develop a human intelligence. I think it's the most stupid <laughs> statement I ever heard. So I think it is unethical that a scientist comes out with these kinds of statements. So I recommend to my colleagues to be very, very careful spreading false ideas because this is much more related with superstition than with science.

Q: Okay. Good.

End of GianmarcoVeruggio.mp3