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Minoru Asada

An interview conducted by
Selma Šabanović
with
Peter Asaro

May 17 2012

Q1: Can we start with just having you state your name and where and when you were born?

Minoru Asada: Okay. I am Minoru Asada. I have to see here, or –?

Q1: No, no, no. You can look at us.

Minoru Asada: I am Minoru Asada, and I was born in the Shiga Prefecture in Japan, October 1, 1953. Therefore now I am 58. Almost 60. Yeah, okay.

Q1: And can you tell us a little bit about your early education and how you got to undergraduate – how you decided what to study.

Minoru Asada: So, a typical story about my education is just, I was born in Shiga Prefecture. More correctly, it's Nagahama City. And I went to the elementary school six years there, and junior high school just one year, because my father was employee of the JR. Well, at that time – JNR, Japan National Railroad – and his area was from a little bit <inaudible> of Nagahama City to the north part of Japan. And he got – he moved – okay, our family moved to Toyama Prefecture. There I spent two years junior high school there. And when I entered high school, again, my father moved to another place. But at that time my brother – older brother, senior brother – had three years difference. And when I entered high school, also he entered university. And at that time in Japan, it's a very famous one, it is examination of University of Tokyo, was cancelled due to a student movement against the university. This affect everything, many, many student. So my brother entered Toyama University, the local university, so he stayed in still Toyama. I was very near, and then I proposed to stay with him, because I entered the very famous high school for the very, very high rank to go to the very famous university in Japan. Then I decided to stay with him, apart from my father and my family, and spent three year there. So when I was a high school student, I just imagined, "Okay, maybe I work as engineer or scientific – or engineering science," not researcher. And I spent three years, and my high school decided the direction which university you can go or something, something. And I decided to enter the Osaka University when I was 18, and control engineering.

At that time, I just hesitated to the control engineering or information engineering. The control engineering just mainly control the object or something, including robots. So information engineering is a computer science and so on and so on. So I entered control engineering and spent four years as undergraduate. And then I choose which laboratory. So usually our department consists of at that time maybe five or six laboratories. So each laboratory consist of full professor, the associate professor, and at that time a research assistant – two research assistants. And one more thing I have to say, that I got married when I was undergraduate, somehow. And – or, more correctly, in Japan many high school students spend

much time to training, of enter the university. Therefore once I entered the university, that's all my freedom or something. So I spent – I didn't go to the university. I didn't attend classes, but maybe – something. So I spent one more year in undergraduate. So I spent five years, when I got married. So, okay, I suppose then I should to go to the industry, because I got married, and also the baby, and so on. But my wife told me that, "Okay, if you go to the industry, not for yourself but me" – that is, my wife and my baby – "please do not do that. Please choose your way as you like. Otherwise," my wife says, "I don't like to be" – how do you say? Or if I enter the industry without my – with not my will, so maybe I regret myself or something. So she doesn't like such a situation. Therefore, "Please choose your way." And then I decided, "Okay, I go to the laboratory, and I like to be the researcher, to do something."

And when I decided the laboratory, I just decided the laboratory of computer vision. At that time, pattern recognition. So the rough idea of my work, of course, I like – maybe my way is just engineering or science and something. And not simply engineering, but more deeply, I like to know what humans are. Therefore, I am just very interested in the pattern recognition. How does the machine recognize the object, or something? And then I enter the laboratory. The professor, Saburo Tsuji, he was famous in Japan in the computer vision, or the pattern recognition area. And I spent totally five years in the vision, computer vision, robot division. And my work, my PhD thesis, is how to reconstruct 3D structure from the image sequence – to the image sequence. And at that time some guy proposed some very simple idea of the 3D reconstruction from 2D image. I just followed, and my main focus, or thesis, was how to represent the 3D movement of the object, mainly maybe the robots and so on. That was my PhD thesis. And at that time – so, I spent five years – the master course two years, and doctor course, the PhD course, three years.

That first two years, just mainly focusing on this image processing – so, image tracking of the fish, fish swimming, and then tracking the object, and so on. And then the three years in the PhD course, I shifted more robotics, so the mobile robot, so the captured image of a sequence of the indoor and so on, and then we reconstruct the map of the structure of something, something. And that's related to the robot vision and the computer vision, and so on. After I finished the PhD course, I continued my work with my students and my professor. The professor, the supervisor – I was student. So we have, between the studies of mobile robots with vision, and so on. And when I was – I forget exactly, maybe 33 – yes – 1986. I was born in 1953 – yeah, so 32 or 33 or something. Okay. When I was 32, I was asked to going abroad, because at that time it's kind of sabbatical, maybe one year or something. And I tried to visit the States, the United States, somewhere, MIT or Stanford or CMU, and so on. And finally I decided to visit University of Maryland, Washington, D.C., and stay one year, two months, ten days. That's the early days of my research work.

Q1: Could you tell us – you mentioned that somebody was already doing – when you just started doing your computer vision work, you mentioned that a guy – do you remember who the guy was?

Minoru Asada: Simon – I forget – yeah. Ooh, ooh, ooh, ooh. Very famous guy. He published a book.

Q2: David Marr?

Minoru Asada: No, no, David Marr is so famous. Of course I did speak to him. And after him, Simon – sorry, I can't tell you.

Q1: We can –

Minoru Asada: Sorry, I forget the title, exact title, but I just say the 3D structure for motion. Structure for motion, or something like that. That's a very simple idea of how many points <inaudible> to reconstruct – how many points and how many images are necessary to reconstruct a 3D structure of the three points or four points, and so on.

Q1: And you mentioned then you started working with the mobile robots. What were some of the reasons that people were using mobile robots in your lab?

Minoru Asada: So the idea at that time – so they were of course very poor about the memory and the CPU and everything. So just – image processing for the still image is one of the big topics, and image sequence is another one. For example, at that time, I suppose maybe the image consist of 128x120 or something. Every – 30 frames per second, something like that. So it's kind of a challenge. So when I was the master course student, I just fish tracking. That's very, very simple image processing, the tracking of something. So the more challenge is analyze some image sequence, like humans working, and so on. Therefore the movement purpose is another big challenge at that time. And then, okay, so take a picture of the first, and then analyze the image, or the image sequence. That's kind of a big challenge at that time. Still very poor memory, poor processing power, and so on.

Q1: So the robot would basically take a sequence of pictures that you would be –?

Minoru Asada: Yeah. Yeah. So there are separate ways to analyze the image sequence, and our case is just the camera is moving along, like this, therefore pick up some image features,

vertical lines, how these lines are moving and the image, and then reconstruct the 3D points or the structure of the corridor, and so on. Did I answer to the questions?

Q1: Yes, yes, yes. He was going to ask something though.

Q2: So, who were you working with in Maryland and what kind of research were you doing there?

Minoru Asada: Azriel Rosenfeld and – oh, I forget. I remember his face, but I forgot his name. Rosenfeld and another very famous guy of image processing. Rosenfeld, Azriel Rosenfeld, is very famous as god of image processing. He published the image processing book, the book and so on. Sorry, I'll tell you later.

Q1: No problem.

Q2: What kind of research were you doing?

Minoru Asada: Oh yeah. At that time – so before I was there, I did some work with the mobile robots. So in the United States and the University of Maryland, <inaudible> Center for Automation Research got some funding from DARPA. So, ALV project, autonomous land vehicle, that is automatically controlled by the computer, and so on. So I continued the image processing, and other outdoor and also the large image. So at that time, also University of Maryland and also CMU, the Carnegie Mellon, and some very famous university or institute, they have started the similar work, ALV. And also one of the laser scanner – range finder – started to be used. So we suppose then we get some range image, and video image together and analyze the structure of environment. So that's the main topic of I worked on in the University of Maryland.

Q1: And what was some of the other work that people were doing there?

Minoru Asada: Oh, it's mainly the image processing. There are many, many, many image processing issues. For example, some image resolution, the database, or 3D structure or motion. One was a guy, at that time very young researcher, was Yiannis Aloimonos. He's a Greek guy. He was also at the same conference. He proposed active vision. Yeah. And he has published many papers about active vision, mainly from the theoretical viewpoint, reconstructions or other things or something, something. Anyhow, the point is active – that is, the observer – moving intentionally. I suppose maybe that idea is very close to the robotics – the robots. It actively captures image, and if the robot has some disambiguity, so the robot try to observe more, or

different viewpoint, well, maybe we can touch or something. Therefore the concept of active vision, or active perception, is a very close idea of robotics itself.

Q1: Did that have any influence on your work?

Minoru Asada: Yiannis's work?

Q1: Mm-hmm.

Minoru Asada: Yeah, yeah. Yes. I think so, yeah. Yeah, we have discussed many times, and his starting point is – he's a kind of a theoreticist. So all the time he claims theory, theory, theory. My position is much more – not solely practical, but real sensors, image, and so on. So what we discussed and we – actually, we didn't have any papers we've coauthored, but discussed all the time. Therefore maybe I acknowledged his name in acknowledgement of my paper.

Q1: Were there some other people that you spoke to often there, or had an influence on the way you thought about vision problems for robotics?

Minoru Asada: I just remembered – Larry Davis. Azriel Rosenfeld, the head, and the subhead is Larry Davis. So, of course we discussed – or, at that time, my English skill was poor. Therefore all the time they checked the English. And Yiannis Aloimonos, all the time we discussed. Any other guys? Yeah, there are many, many researcher from around the world, and we discussed many, many issues. But mainly I think I thought by myself and then exchanged the opinions and so on. So, yeah. Azriel Rosenfeld is a god of image processing. Larry Davis all the time check my English. Yiannis Aloimonos, all the time discussions, and so on. Yeah. When I was in the United States, these three guys made an impression for my work.

Q1: And was Rosenfeld basically the reason that you decided to go to Maryland rather than some of these other places you visited?

Minoru Asada: At that time, one of my friends in Kyoto University – he was at Kyoto University – he visited there two years before my visit, and he recommend the apartment – <laughs> – and any kind of thing. So for me, it's much easier to move. And so, more correctly, Takashi Matsuyama, the professor at Kyoto University, he stayed one year before me, two years ago. When he go, just the professor Kanatani at the Gunma University, he also successor of this guy. So the furniture or something, something – the same apartment. And then also I'm in the same apartment. So very smooth. Therefore when I visited the United States, he already set up my apartment. So my family – at that time I took my wife and two of my sons, for whole family.

It <inaudible>. Yeah, of course I traveled to MIT and stuff, maybe – I forgot the detail, but maybe I could not – I was not accepted by them.

Q1: Do you have anything you want to ask about Maryland?

Q2: Not about Maryland. I was just going to ask, what do you consider your first real robotic project to be?

Minoru Asada: It's difficult to define what robotics is. So when I was PhD course student, I already started some kind of image processing of the robot vision system. So this is part of the robotics. But much more robotics for me is much, much later. So when I was in the United States, my wife and two of my kids really enjoyed the U.S. life. So they ask me is there a possibility to continue more or to stay in the United States. So at that time I got a job interview inside the University of Maryland in the electrical engineering department, before I leave. So it was very, very close. So I got the interview with three or four professors, and after I left, I got some message of the interview. But when I returned to Osaka University, my supervisor when I was student, he decided my position to move, promote. Same university, but different campus and different department – more correctly, mechanical engineering. So I hesitated. Go to the United States, or stay, or something? And my intention was that, okay, if I have a chance in the United States – okay, I will have more times to go to the United States – okay, then I stay one or two years here first, and then decide. But actually I couldn't do that.

Anyhow, so when I returned to United States, I was the research assistant, and I was promoted to the lecturer first, and then one year later the associate professor, with professor Shirai – Yoshiaki Shirai. He's a very, very famous guy of the computer vision too. So I started continuing the vision work with him – '88, '89, '91 – yes, I think so. Three years. And I was telling him that I like to be promoted to other places in five years, in five years. So after three years, I just started to my promotion, and I told him – okay, I tried to start. So something happened that – so the professors of the department of mechanical engineering, there are many professors, total of 18, actually the group of the three departments of the mechanical engineering. So these professors liked me to stay. That means there is one empty space, one professor to be filled. So these professors asked me to stay and then be the professor over here when I was, at that time, 38 or something. Is that correct? Okay. I think so. Eight-sex, thirty-four – '90 is 37. Yes. Yeah, that's right – 37 or 38 – the age 37 or 38 is too early in Japan to be professor. Therefore, still associate professor. But I have one space for the full professor, associate professor, and two research associates. So that's a new stage for me. So at that time I started to a new idea of the robotics. At that time I really was very, very confident about at that time. At that time myself to start in robotics. So that was 37 or 38, yes.

Q1: Who were the professors that wanted you to stay?

Minoru Asada: Professors?

Q1: The professors that – you said that there were a few professors that really wanted you to stay. Who were they?

Minoru Asada: Oh, the professors of the department of mechanical engineering. So not my own area, but the fluid dynamics, thermodynamics, the material science, and so on, so and so. Complete different, but somehow, very complicated reasons. At that time I didn't realize that my achievement is so excellent. I have no – actually I did not have any idea about my own, but just research, publish a paper, and so on. But these guys suppose that, "Okay, this guy is very excellent. So we decide to say, 'ask him to stay here,' or something." Another reason is I was – okay, I graduated Osaka University the master course and also PhD course. They liked – another reason is they like to be the professor of the – graduate the same university, because actually there's some five professors in one department that come from the other universities. So that's kind of all the politics of the university. But I didn't care anything of such things – nothing. I can be anywhere, if I can do my research. So I stayed at this same university, and one laboratory. I can control everything. That is the hardest time for me, because once you're promoted to full professor, so many meetings and other issues. So I could not spend – I can't spend much time for the research.

Q1: So you were mentioning in your new position you could really start focusing and working on robotics.

Q2: And what made you decide to turn to robotics at that time?

Minoru Asada: So that's a point. That's a point. So, Japan – we had many Japanese robotics researchers, and many of them were doing the very – in some sense – very classical, the standard, the very popular robotics researchers. One of the ideas, the machine learning. So let me start to try – okay. When I moved – but associate professor, but moved to the new laboratory, I'm thinking about new ideas. Therefore we had many, many meetings with not my own laboratory but also with other people. So at that time, Professor Saburo Tsuji, he was my supervisor. He collected many members of my own and others, and so on. And we started some kind of – how do you say? – introduction to machine learning, or robot learning, and so on. One topic is reinforcement learning, and especially focused on the many theoretical issues and so on. I got idea, "Okay, we should utilize this" – the reinforcement learning, and we studied about the reinforcement learning again, and again, and again.

Okay, so the new topic, or new idea, is – because before myself, many people study about, not so many, but some guys studied – all they studied about reinforcement learning, and

so on, but not so real application to the robots. Because reinforcement learning is very, very interactive, but so many trials, it's kind of almost exhaustive search. They are not suitable for the robots because many trials means not easy to program and something, something. So we study about what kind of area is suitable to the reinforcement learning. At that time, my students at the new laboratory, newcomers – I spent much time with them, and we discussed what – one of the guys, one of the students, proposed tennis robots, some kind of sports, or tennis – so difficult. Okay, okay, okay. Okay, please keep him in mind. So another guy says, "How about soccer? Soccer robot." Okay. Also soccer is very, very complicated; very, very hard. But very simple gesture, chasing the ball and shooting the ball to the goal. Even though just one mobile robot. That's kind of soccer.

So we started about applying the reinforcement learning to the soccer robot. And also this is a same period of starting the idea of the RoboCup. That's one of the biggest, my life work. So at that time, 1992 or – yeah, 1992 or 1993 – there are two things, two big things for me. We have already started the work of the reinforcement learning, applying to the soccer robots. Another thing that Hiroaki Kitano – Dr. Hiroaki Kitano – he is a guy, cofounder of the RoboCup – and at that time he collected the researchers to start a new project from Japan. Because he is a guy of AI, and in the AI field, there are many Japanese researchers just follow the AI work in the United States. So he likes to promote some original idea of AI or something. So he held some workshops, several workshops, about a new challenge, the grant challenge. So one of the grant challenge we discussed is idea of the RoboCup at that time. So that's the big idea, and he collected the young guys and discussed how to promote the RoboCup idea, and also he collected his connection of the people outside of Japan, and then we started something. So that's a big issue one. Another one is that 1993, ICRA conference. Twenty years ago? Almost.

Q1: Next year.

Minoru Asada: Yeah, yeah. We submit the first paper from my lab about the application of the reinforcement learning to the soccer robot. We submitted <inaudible>? Yes, we started research and finished in '93 and submit the paper for – yeah, sorry, '94 ICRA conference. Paper was rejected. So that's – so the reviewer says, "It's very interesting, but something, something, something." So my paper was rejected. So I was disappointed – so disappointed – because this is a very new area, it's a very nice one. So I was confident that this paper should be accepted and I have a chance to give my talk or something. But that's a big conference. Even at this time it was a big conference. And the conference is kind of a gamble. So it depends on the reviewer, so it's kind of gamble. So I decided – I was disappointed. This is kind of a huge conference, and then I sent the paper to a very small workshop.

So I sent the paper to the Machine Learning workshop where ICML the International Conference of Machine Learning there are a series of workshops the robot learning or

something. I submitted the paper, it accepted, I gave my talk. So to researchers of machine learning area or robotics area and they were so impressed by my work and also I was rated okay so my work was rated by many people. That's a very, very strong motivation, okay, I can do that thing, yeah. The next year I sent the same paper, exactly the same paper to the ICRA conference, next year, 1995. So my paper was elected one of the best papers. Unfortunately I could not get the best paper, just one but nomination is okay. So at that time almost 1,000 paper submissions. The finalists is ten papers, that's one percent so my paper was elected so that is another evidence of the gamble, exactly the same paper, nothing changed. The paper is here, rejected, next year the finalist, so big difference. So I said okay, that's confidence a gamble or something, so then I started the series of the reinforcement learning and also I started RoboCup activities. So we discussed started the RoboCup idea and we set up the first RoboCup in 1997. The IJCAI in conjunction with IJCAI Conference 1997 because it was held in Nagoya in Japan so we set up '97. And then at that time we have four years because we started decide to hold the first RoboCup in 1997 four years before 1993. And we started a discussion and so on. So Hiroaki Kitano mentioned that because 1993 is the first year in Japan professional soccer league. So we say "Jleague" Japanese league or something. So Hiroaki mentioned "Okay, Robot Jleague." That members outside Japan "Why J? Why J?" Okay I have idea RoboCup is Robot World Cup. It's the naming. Actually I forgot to say I invented this name or not but anyhow myself yeah. So I started RoboCup activities and there was reinforcement learning stuff and so on. So the early days my work of reinforcement learning is directly ready to bring the RoboCup so my students do some work on the research and then at the same time do the RoboCup and so on. At that time the middle-size league, the mobile robots, are going around something.

Q: Was Manuela involved then?

Minoru Asada: Yeah.

Q: Okay.

Minoru Asada: Yeah let me continue. So <clears throat> as I mentioned Hiroaki collected that outside Japan. One was a researcher is Manuela Veloso and I forgot exactly the other guys but most influential was Manuela Veloso. And there was Peter Stone, her student. So before the first RoboCup in 1997 we held Pre-RoboCup 1996 and 1996 I was the General Chair of the IROS not the ICRA but the IROS Conference. And I have any right to everything therefore I said that play RoboCup 1996 and at that time Manuela Veloso and maybe Peter Stone maybe came to us and they participated okay in the Pre-RoboCup we had some competition of the simulation league, just computer simulation and we have some demonstration of the middle-size league just demonstration of my team, my students I think. So there is Manuela Veloso came to us and then her team participated competition simulation game competition, yeah that and we

discussed then how to organize the next year and so on, so on. Therefore Manuela Veloso is one of the founders of RoboCup.

Q: Were there any other people that you worked with on the RoboCup?

Minoru Asada: At that time?

Q: Uh-huh.

Minoru Asada: So French guy, Dominique Duhaut and I forgot his name, University of Southern California there was another group of middle-size league robot team. Now he is doing configurable robotics, or modular robots.

Q: It's not Trisch or who was at U.S.C.?

Minoru Asada: U.S.C. I forgot his name.

Q: Schall… No.

Minoru Asada: He is a Chinese guy.

Q: At U.S.C.?

Minoru Asada: At University of Southern California.

Q: Well we will look for it and if I can't find it I'll just email you and we'll figure it out.

Minoru Asada: I forgot his name. So anyhow, and also U.S.C. there were two guys. One guy is in the middle-size league. Another guy is computer simulation. His name was <laughs> I forgot. Wow. I have so long memory.

Q: Who won the first competition?

Minoru Asada: In 1997? Yeah, that's a story I'd like to tell you. At the 1997 the first RoboCup with three leagues, one is computer simulation game so 11 versus 11 games. The second one is the small-size league. That is Manuela Veloso participated the small. And middle-size league, not life size yet, no humanoid yet. So the computer simulation is much, much easier than the real robot therefore we got almost 20 teams or something or more 25? And the small-size league just four teams. And the middle-size the five teams. Small size league I suppose Manuela's C.M.U. gotta be – if my memory was correct. And the middle-size league the five teams my team from Japan, another Japanese team from RIKEN. RIKEN and another University. Three more that one is from U.S.C. and one from I forgot the name but also United States, Australia the five teams. So Australia teams. Nothing. They brought their robots but almost random movement. U.S.C. and my team by accident the same big Japanese toy, it's a Japanese remote control car, yeah. So I forgot his name, anyhow so this surprised us because two teams the same vehicle and we put on the TV cameras and so on and so on. So sometimes difficult to discriminate the two teams together. Anyhow, so these two teams the final these two teams. In the first game they draw so we proposed the second game but somehow the U.S.C. teams ran out of the battery so no battery anymore but we had but okay so we don't have any game. Therefore the core champions first game.

At that time it's very, very <inaudible> nowadays very, very competitive the first year because we are shuffling, we are sharing some difficulty of the challenge of moving robots because you know it's very, very difficult to control your five robots at the same time. So some robots it just stay, some robots it's random movements and so on so that is very, very difficult like a big challenge. So anyhow so the two teams core champion and we started it was together to do some research on this one. Yes and that was the first one and not so many European things yet that the RoboCup was held in 1997 and other people from European team, European people, okay. So they observed the game and they decided okay we can do it because you know the performance is so poor so we are very ashamed that the audience or spectators the potential the teams "Okay we can do it." So the next year '98 in Paris in connection with the RoboCup okay so many European teams and also Iranina teams and so on many started, so that's the beginning of the RoboCup and at that time so Hiroaki is Sony therefore we got sponsors from Sony that the RoboCup is really in the early days and many professors not business guys so therefore the banner or some poster made by ourselves and also put everything by ourselves. So the very, very early days of the RoboCup, yeah.

Q: And did AIBOs become involved in the RoboCup because of Sony?

Minoru Asada: Sony, yes. <clears throat> So the idea was that was yes, in Paris, 1998 it's the demonstration exhibition, and start from 1999 in Stockholm the first official game in 1999 yeah. So the idea of course you know Hiroaki is in Sony therefore easy to discuss how to involve AIBO in the RoboCup so the idea was that okay so two ideas, why that? Okay we should have the league with a common platform. Nowadays it's just standard platform. The hardware is

fixed, and some competition of the software, that's one reason. Another reason is that because many people suffering from building the Robots because at that time since RoboCup started from the IJCAI conference, there are many computer scientists, not mechanical engineering. They are not so good at, therefore they like to have research platforms. Therefore we love to have the RoboCup AIBO.

So the backside reason from the company is that it's a big promotion, a big advertisement. On the other hand so the RoboCup teams they are very, very hard users so all the time using the AIBO. And then so we are also my team and other teams also it's easy to broken and then to the company that they fixed again and again and again many times. And then the company found one thing. One part systematically broken easily for many teams. They found some mistakes in the design of some parts. That is a good reason for the company side the user found something that something is wrong. That is the key idea of RoboCup. It's open to public, there are many people just try to use and then found some feedback. This is some origin though, origin idea of my proposal of the RoboCity CoRE. The RoboCity is a town but some experiment – all kinds of robotics experiment. And I proposed the city of Osaka ten years ago and we started to work almost ten years. But sad news that last year election of the new mayor and the new mayor changed everything. Because Japan as a nation huge amount of deficit all the time and also the local government similar situations so the city of Osaka spent much money to the not useful in the past, therefore the new mayor change everything so cut, cut, cut everything and the reviews all kind of events and everything. So one of the events is my proposal because actually is a new town we can next year 2013 March, and we try to set up the RoboCity CoRE to deploy the experiments but no way to <inaudible>. So now I'm thinking about different way to realize the RoboCity CoRE or something but first one was rejected.

Q: So you were never able to –

Minoru Asada: Never.

Q: But in Fukuoka, I think they have the free zone like there are some areas where you can do that right?

Minoru Asada: Yeah, yeah, yeah, you know every well yeah that's right, okay.

Q: What were some of the elements that you were going to incorporate into RoboCity? What sort of things did you want to incorporate into the RoboCity? Like self-driving cars or –

Minoru Asada: Okay so nowadays, Honda, ASIMO they are trying to utilize the ASIMO to serve tea or coffee or something so in the restaurant situations or ATR it's Hiroshi Ishiguro, he is

the researcher there and also ATR of Honda and Osaka University has an experiment of the robot experiment on the street. But still there are some fence, not entered among people. So the idea that the RoboCity CoRE some experiment with robots, the idea is not simply some individual robots but the environment itself a kind of robot, big robot, the town itself. So that is some people say it's invisible robots so there are many Sensors, actuators, and so on so watch the behavior of the humans and to have to provide information and so on. So there a strong connection with a kind of a cloud idea so therefore we say just cloud robotics.

So the environment is kind of the brain the information collection storage and then individual robots are kind of interface with people. So this is invisible. So the cooperation with between the visible robots and invisible robots so the invisible robots not only help the people, not only to help to support individual robots but also help the people like the case of the senior people and now Japan is super aging society right? In a couple of years maybe one-third of the population is over 65. So we are so serious so the robots should support the senior life of the people therefore <inaudible>. So the idea of the RoboCity CoRE is also involved in this kind of situation some experiments how the people accept the robots or some artifacts or something. So all the time I mentioned this idea as many people agree oh, that's a good idea nice idea or something. So therefore the Korean people they said RobotLand or something near to Incheon Airport. That guy came see me and then I had interview similar idea they try to realize. So and also Singapore, not exactly same but some similar idea I would say the corporation the business side companies and the university that kind of incubation centers and so on. So it's a pity to not to be in Osaka because actually I proposed that RoboCup in the next year that after the quake and also new mayor changes and Japanese big companies recession like this one we forgot, we throw out the proposal so next year it's not in Osaka.

Q: Maybe after the other this mayor changes again. <laughs>

Minoru Asada: <laughs> Yeah, yeah because previous mayors send a letter to hold a RoboCup night in 2013 but this is the previous mayor and this mayor was worst.

Q: The politics in robotics.

Minoru Asada: Yep. So I'm continuing the work of reinforcement learning and machine learning applying to RoboCup and so on so on. And also where the final goal of Cup of the RoboCup where is to build a team of 11 humanoids by 2050. Not my own statement but Hiroaki's statement. He got the interview with the Scientific Generalist commentators and they asked and this guy asked Hiroaki "How many years do you need to realize this kind of thing?" And this guy said that "Okay 100 years or something." This guy said that usually in general 50 years is kind of the time for example, gene, 1953 that when I was born it's again at the gene and then 2003 all human genomes are analyzed. Or airplane, Wright brothers I forget the exact date

and then 40 years later the jumbo airplane and rocket and so on. So with the things should they be achieved in 50 years, that's his comment. "Okay," Hiroaki mentioned "Okay, by 2050." That's his statement. But the statements as you know not the goal itself is a goal, but the process is much more important.

So just as we say the project like U.S. space project to send a man to the moon or something and during this process, Teflon fabrication or something the spinoff. So we set this goal and toward this process we have many spinoffs. For example if we can build that, then the challenge is a very recent one is a very closed one where the humanoids can do everything, humanoid can do everything. So if we have the humanoid that can play soccer with humans, that means they are very, very flexible and very dynamical movement and also the skin because if the human player damaged by the robot player many people claim <inaudible> or something. So the robot should be easily broken against the humans, the very soft skin and this kind of material should be applied to the house for the senior people to protect them or something. So that's the idea. So toward the humanoid. So Hiroaki mentions that we have a chance because robot does not the humanoid they do not feel any pressure. My statements are completely against. Without feeling the pressure we can't continue will to get a win or something. So the motivation, our consciousness, there are many cognitive issues I remembered when because I was graduate student I chose a laboratory of the pattern recognition because I am interested in what humans are. Therefore the idea of course you mention learning but much more interesting is motivations, emotion, consciousness, it's a very, very big issues. So of course I am joined I was keeping in order such as the RoboCup and the reinforcement learning but at the same time I started some kind of new research issues of the cognition of the emotion, intuition and so on and so on so that is much more human oriented research started. I said maybe yes around early 2000, 2001 or '02 or '03 so one side is RoboCup research. Another side is study to apply reinforcement learning but still another other research is the human itself.

Q: And so is that your JST ERATO project?

Minoru Asada: Yes, yes, yes, that's actually I started with Yasuo Kuniyoshi at University of Tokyo and also Hiroshi Ishiguro, these three guys because we had some research meeting in Keihanna near the A.T.R. and the young guys, myself and Yasuo Kuniyoshi and Hiroshi Ishiguro the key persons and Hideyuki Nakashima. He is a very famous guy in Japan, A.I. and he is now President of Hakodate University and with other guys and also one of the members is Kenichiro Mogi. He is a brain scientist that somehow he is a kind of generalist or the commentator and so on so also he published many books and so much media coverage therefore many other brain scientists they do not like evaluate his work. Because this guy Kenichiro Mogi, is so media coverage and not only the scientific program but also some other entertainment, make comments so this kind of behavior not so good for these other guys so many Japanese brain scientists they do not evaluate Kenichiro Mogi's work but for us sit's different field so we exchange, discuss also he gave out qualia, feeling the color or any kind of things so he cares about qualia and we

discuss how to realize qualia in the humanoid something, something. So anyhow this research meeting so stimulating and the first meeting I introduce my robots of reinforcement learning. And that is so stimulating.

So we discuss how to apply reinforcement learning to the other areas or other learning method of other like humans and so on. So it's one of the guests was Mitsuo Kawato or the other guys and also all the time we invited the researchers not robotics but a medical doctor or biologist or sometimes another brain scientist and so on. So it's very, very stimulating and we learned about what humans what the biology systems is or something, something. So we think about such kind of issue the 2003 or '04, something like that and 2005 the start the year of my project and also interview during the RoboCup in Osaka. That is so busy time so 2005 in the summer I have interview with a lot of project. The more correctly I have JST has ERAO it's a very top one, very famous one and much more funding. Other one the CREST that I have two interviews, CREST and ERATO at the same time of the same member. So a kind of backup, okay? The first one is CREST and the second one is ERATO and my ERATO project was elected and then I started from September and therefore the CREST project okay you're rejected, of course. So we started September, 2005 and 5.5 years project. That second time of my life was so motivated. First one was I mentioned my paper was rejected and so on. That is okay so the idea is okay we can start the research of the human-related robotic research so the group consist of Yasuo Kuniyoshi, Hiroshi Ishiguro, and another guy is he was my colleague Koh Hosoda. So his group is good at pneumatic actuator robots. So the baby robots of the newborn P.N.E.W.

Q: The crawling.

Minoru Asada: Yeah the crawling and the walking. Yeah, both. So his group is developing this in different kind of robots the baby robots and so on. And Hiroshi Ishiguro's group of course you know he started already the Android research so he asked – I asked him, "Okay the humanoid is okay, but don't make Android." The humanoid, but please humanoid, but very close with humans because at that time my impression Android is so impressed so much by us so it's sometimes difficult to focus on the research issues. Therefore I ask him to design not the Android type but somehow the humanoid but close to the humans. So his group they designed, discussed with companies and CB squared was the first robots we introduced from our project.

Q: So it's kind of like a newborn but it's much larger in a sense, CB squared.

Minoru Asada: Yeah.

Q: It has the bigger head. <laughs>

Minoru Asada: So at that time still it's very difficult downsize it. The size is 1.3 meters and the size is three kilograms but the proportion is a baby so the big head <laughs> yeah right.

Okay so anyhow CB squared at the time the Hiroshi named the robot M3 so manmade man. It's so <laughs> strong impression. So we changed the name CB squared, Child robot with biomimetic body and CB squared but Hiroshi liked to insist M3 so after the CB squared his group developed three kinds of robots, Neony, Synchy, and Kindy three types but all the time M3 Neony, M3 Synchy, M3 Kindy <laughs> yeah, he likes to put "M3".

Q: What other sorts of collaborations have you had over the years and who have you been collaborating with?

Minoru Asada: Collaborating with –

Q: Different researchers in the U.S.? Or around Japan?

Minoru Asada: Oh okay, okay after we started a lot of projects of my own, so yes, Hiroshi, and Hiroshi Shigiro, and the okay, I forgot, another guy is Toshio Inui. He is <clears throat> cognitive neuro scientist. So he has been doing some imaging study of the function MRI and also joined research with medical doctors who cares autistic children and Williams Syndrome. So the both A.D.S. and Williams Syndrome two extreme of the language development so one of the big challenges of my project was how the language capability emerge in early development. So therefore we focused on the very, very early days of the human that's infant or the baby so with the Yasuo Kuniyoshi's group they have already started about fetus simulation the very, very interesting one and that is a strong connection to the medical doctors who cares the babies and also were developmental psychologists and also they making studies brain scientists so at the beginning the brain scientist, the developmental psychologist, the cognitive scientist, the medical doctors and so on are not exactly in my project but there is a connection and discussion and so on so on.

So therefore my idea was each group focused on their own research issues but my idea is unified, integrate everything together after 5.5 years, but actually I could not do that because of course the integration itself is very difficult but in each group they once they started their own research they found a new one, new one, new one, new one that is more closely related to some biologists or the real one therefore I give up, okay, please do that. And then in my brain, tried to connect, and then, so the whole picture is everything, but the – just the part is realized, so we achieved this one. Someone, guys did, I think, this one. This is missing, okay, this is something. So in my brain, I have a whole picture but I cannot integrate everything together, but I just put something, something here, and something – so there are many simple research issues, as I

mentioned it's a strong connection with the brain. It's actually, Toshio Inui, he is a cognitive neuroscientist. Therefore is very close to the brain scientists, and also he has joint research with a brain scientist who cares monkey, monkey brain, so electrical probe, now of course it's very, very different, but has the monkey think about the maze or some predictions, or – so his group mainly focuses on the brain activities and that's the patient of the different disorders, so this is a very extended connection to the – it also involves many people, like this one. Did that answer the question, these kind of things, the more concretely some examples of research?

Q: Or just other people whose work has influenced you, and you've interacted with in terms of sharing robotic <inaudible?.

Minoru Asada: Yeah, yeah, yeah, so also I have to tell one other thing that, my background in the academic society. Not exactly the robotics itself, but in Japan, the baby science, it's –

Q: I was curious about that. I saw that on your CV, and I was curious. What is baby science?

Minoru Asada: Yeah, the baby science is, you know, once a year we have the meeting, just once a year. Therefore, because each people has their own background. So for me, it's the robotics society or something, so there are the medical doctors, the primate researchers, and the nurse and the care helpers, and also the engineers like us and so on, so on. So kind of different people gather, and so the – usually it's the Academic Society, says that it's open to public, everyone come, but actually not, only the expert attend this conference. But the baby science, it's really open to public. Therefore some forum so the ordinary people can – especially mothers, come and then discuss. So therefore, not really scientific discussion, but how to care the baby, or some social program how to care of the kids who are some kind of you know, they climb, and so on, so on, so – but the baby science is just focusing on the early days of the fetus and the infants and maybe before two or three years and so on.

Q: How did this start? I don't – do you know of this being in other countries, or is this just in Japan, this kind of baby science?

Minoru Asada: It's – next month I come again to Minneapolis. It's actually ICIS, International Conference of the Infant Study, but it's different atmosphere, and I see ICIS, the Society, the International Society of Infant Study, ISIS, it's almost all from the United States, almost. I suppose I maybe forgot, exactly number, but maybe 60 or 70 percent, almost the, you know, United States and developmental psychologist, almost. So in Japan, the baby science, so different, really interdisciplinary, but the infant study, Infant Society in the United States, mainly, mainly, the different psychologist, almost. So it's different, I think so, yeah. So mainly the observation, and analyze the data and so on. Yeah, it's that I mentioned about this ICS story,

that's, usually I attend the ICRA conference, or IROS, or some workshops. IS is many, many female researchers, quite different from us, so once I attend the one session with my friend at the University of Tokyo, this was a guy male guy, organizer female, all panelist female, I just – we look around, all female, no males. Oh, and that I realized, okay, the female student in my lab, same situation.

Q: It was – I was in the conference waiting to talk to someone, and a student came to me, he was like, are you a psychologist? It's like, why do you think so, because I'm a woman?

<Laughter>

Q: Now you know how the women feel in robotics.

Minoru Asada: But somehow, it depends on the time, but sometimes we have the female students. Actually, I have just now, I have one, but last year, four or five or something, and they had specialized in the learning, or the cognitive functions, and so on, not hardware itself.

Q: And I think sometimes with human robot interaction, or more social robotics.

Minoru Asada: Yeah, yeah, yeah.

Q: They're more female researchers.

Minoru Asada: That's right, yeah. More psychological issues and so on.

Q: So who are some of your students who are still working in robotics, or maybe have prominent positions that you've trained?

Minoru Asada: My group?

Q: Yeah, or former students.

Minoru Asada: Former students. Okay, one of the guys, when I started the RoboCup, one student Yasutake Takahashi, so just we say, Yasutake, or Yasu, Yasu. Okay, he entered my laboratory and from the beginning, he was involved in the RoboCup. So his life just RoboCup, so he has done the work of the reinforcement learning stuff based on the RoboCup, and middle

sized League, so that he promoted to the other university. I forgot the exact year. Maybe five or six years ago, and then, at that time, so that he took everything of the middle sized league to his university, and then at the time, I have a full, so medium size, the small size, Aibo League, the Human League, four leagues, the four teams in my lab, so many. The medium sized league left. Okay the AIBO League, when Sony retired, okay, gone. And small sized league, just for education also gone. Just only the humanoid. So anyway, Yasutake Takahashi, one of my students, now he's Associate Professor of the Fukui University, and then he continues in the work of the middle sized league, participation. That's the one guy.

Another guy is also he, doing the same research, the RoboCup and machine learning, and the same stuff, but he's more theoretical guy, and one or two years he spent post doc in my lab. After that, he moved to the ATR. At the end of the Kawato-san's Project, and next year, Doya'san's group at OIST now he's in Okinawa and he continues some running the research studies and so on. That's Eiji Uchibe, the guy. After that, oh, there are several – PhD students.

After two guys, yeah, okay, also were, we started, before ERATO project, we have already started some work of the joint attention, how to realize the joint attention something and Yukie Nagai, she got the PhD from my lab, and after that, she spent three years at NICT, near ATR, and NICT, just one or two years, I forgot, and then she moved to Germany and spent three years in the Bielefeld University, and the Bielefeld University is a very interesting, because it's just one building. All kinds of different faculties – department, together, and you know, the basement is a street, the shopping, like a town, and upstairs is just mechanical engineering or psychologist or sociologists and so on. So it's much easier for the staff, the faculty members to exchange, to discuss everything. That's kind of a – therefore it's very similar situation – similar research direction, the Bielefeld University and ours. So Yukie Nagai spent three years, and Hiroshi Ishiguro has the founding of the Global DCY project, and special appointment, associate professor Yukie Nagai came back to Osaka , and she is doing, not only research, but also many administration work of the project and so on.

This is Yukie Nagai, and other guy is Masaki Ogino, he got a PhD from my lab, but actually he graduated from a different department, the bioengineering. So that he is a little biased by the biotics world more. And his study was a kind of the walking, the human. He contributed to the Human League in my lab, starting to use, and also were not to adapt a humanoid, but also – but we bought the standard platform and modified something. So, and in this work, and also, he is personally interested in the human walking how to – or something, how to <inaudible> the walking and so on, was some more general research issues of the body image or the body representations, and also the attention and so on and so on. So now he is Associate Professor of the private university near Osaka University. Still he has one – two students in my lab. So all the time, the Skype connection, the discussion. But his department is not real robotics, but sociology or informatics or something. Therefore he gave up to continue the robot research. But some human related research issues, that's Masaki Ogino.

Or Hidenobu – I forgot his last name. Hide – Hide – he graduated – he got a PhD from my lab and his study was about the joint attention stuff, and also the body representation and so on. Oh, before that, Yuichiro Yoshikawa he got a PhD from my lab, and he spent one year in the post doc in ATR with Hiroshi because Hiroshi likes to employ him as a research member of his project at ATR. But when I started another project, I'd like him to be contribute to my project, and then he came back, and spent four years in my project, and now he's Associate Professor. It was at Hiroshi's laboratory in a different campus. Because okay, another story is, I asked Hiroshi to be the professor of my department six years ago, no, no, no, years ago, before the ERATO project, 2005? Four or five, something, yeah, and Hiroshi was with me six years. Therefore, yes, maybe 2001 or 2002, I asked him to be the professor in my department, and then he spent six years in my department and moved to the same university, but different campus, different faculties, engineering science. My own is engineering, but he, engineering science. But actually, I graduated engineering science and moved here. So Hiroshi's idea is, every three years, he'll exchange everything. Therefore, the one exception is my lab, my department. He spent three years, he has some movement to promotion, but some promotion was not successful and then he continued three years, but he changed something. After six years, moved back to – not back, but change. Yeah, so my Yuichiro Yoshikawa moved with him, okay.

That's Yuichiro Yoshikawa and I tried to remember his name, but – Hidenobu Sumioka, Hidenobu Sumioka. So he got the PhD from my lab, and he moved Rolf Pfeiffer's in Switzerland laboratory, and two years, three years, I forgot. So the Rolf Pfeiffer – another story is that when I set up my laboratory, that's 1992, I asked a very famous professor Yoshikawa, at the time, he was Kyoto University. He is very famous for the kinematics robotics and also there are very big classical one. I asked him and Koh Hosoda, he is one of the project leader of my project, was just graduated PhD from his lab. I asked him to – someone to help me, and he came in 1993, two or three, okay, anyhow, so that's Koh. And he spent many years in my lab as a research assistant and as also associate professors, and many people evaluated his talent, he is very smart, very, very smart, and he's good at hardware, so when we started my lab, and so he's a necessary person to teach the students the hardware, and everything, so the first robot of the RoboCup, was, of course it's the car itself is a radio controlled car, but we modified, changed everything. At that time, Koh was good at – could otherwise, everything in the hardware stuff. So where he spent many years, and he had a chance to going abroad, that's the similar situation as my own at the University of Maryland, so I recommend him to the Rolf Pfeiffer in Sqitzerland because of course, you know, as I mentioned, Professor Yoshikowa is very, very traditional controlling and generating the robotics, therefore the Koh was, at the beginning, very, very fixed idea, very rigid the control theory, like this – but his talent is not related to this one. But his idea is much more broad. Therefore I think it's a good chance for him to deploy his idea to the different environment and different situation. So the Rolf Pfeiffers, I guess you may know, the Rolf Pfeiffer is very famous for the very chip design, the hardware stuff and the physical environment idea and so he did, also was recommended by Koh, was to get there, and do some research, and he spent two or three years, and again, Hiroshi pick up him for ATR. Now, so Hiroshi all the time watched the people and pick up, pick up, pick up, but this is very, very good,

because he is so good at utilize the people. Yeah, pick up, pick up, pick up. Yeah, so another guy is Takashi Minato. He got the PhD at my lab, but also Hiroshi pick up him. Still, he's working with Hiroshi at ATR.

Q: You should just give them contracts as soon as they're done with their PhD with you, a contract with ATR.

<Laughter>

Minoru Asada: Yeah. Actually, Takashi Minato was, yeah, he got a PhD from my lab, and ATR first, and then research assistant in the Ishiguro's lab in the Osaka University and a post doc of my project, and again, he's returned to the ATR. So this guy is very nice guy, smart guy. Usually we have got many students. One of the biggest stream is just from undergraduate course, at Osaka University, and undergraduate course and to the graduate course, this is one pathway to become – the undergraduate course is another pathway that, not entering Osaka University as a freshman, but how to say, it's – in Japanese, kosen, it's a junior high school is just three years, but they have the five years, so – sorry, sorry, high school is three years, and university four years in Japan, but this school is three years like a high school, and two more years. So just we say kosen, I don't know the exact English term. Not private school, a kind of college.

Q: We call it community college.

Minoru Asada: Yeah, yeah, yeah, like this one. Okay, so five years means that in order – third year of the undergraduate course, some examination to enter the third year. So this guy, Takashi Minato, is graduated, is not entered university as a freshman, but this community college and then moved. So this another pathway is now very popular in my lab, or my staff, so some guys did this pathway. Two different result, pathway to enter the undergraduate course, or two more years spent there, and then enter the graduate course. Anyhow, some of this community college is not more popular. But Takashi Minato is first guy in my lab to graduate this course. So this guy is very smart and good at hardware and so on.

Q: I just wanted to ask you. You got two awards that I noticed, one from Japan Design Award?

Minoru Asada: Oh yeah, yeah, yeah.

Q: And then also a Ministry of Education Award. Would you tell us about them?

Minoru Asada: Yeah, yeah. The design award is in collaboration with Kazuo Kawasaki. He's a real professional designer. Yeah, because I – yes, another story is that he was professor of Nagoya Institute of Technologies, and when I was, before he came to Osaka University, I have appointment with him about the design of the Robot City, so I met him Kazuo Kawasaki, with some company guys, some developers at Takanaka Komuken general constructors of the company, so anyhow, I met him to help to organize the town as he's the professional designer, he's a designer, therefore we asked him to get some advice on how to organize how to design the town or something. That starting time, and before that, my friend in Osaka University, Satoshi Kawata, he is also famous guy in, not robotics, but photonics, it's very, very micro world, small world, the physics and photonics and so on. And now he's leader of the Photonics Center of the Osaka University, but he got the funding from the government of the FRC, the Frontier Research Center, and my project the RoboCup project was elected one of the FRC project and got money or something. And this guy is a very, very aggressive guy, and also he was thinking about the design is very important so especially, that he loved the idea of the Kazuo Kawasaki, so he likes to invite him to the Osaka University.

The other guy is also like for Kazuo Kawasaki to come to Osaka. So after he came to Osaka University, some big argument among the mechanical – the development and mechanical engineering, design of the study, anyhow, so since he came to Osaka University, we have a meeting again. Not so much, but again, again, and we discuss somehow, some day we have some joint research of the design of robots and so on. And he has shown the interest of our vocal robots. First vocal robot is just the silicon tube, and we deform the tube and make a sound something. He care about, because actually, his home is a passion the heart therefore some joint research with medical doctors, how to design the artificial heart of something, something, and therefore, also he, you know, very interesting to have the vocal tract and also artificial lung or something. So therefore, okay, we started some design of the vocal robot with him. So the – our rough sketch was designed by my students and then we show – we have shown the rough sketch to him, okay.

Okay, he had idea as this one, this one, this one, and then we submit this robot to the design competition, and we got some design something. But robot itself is not so good as we expected, that the design itself is sort of – the vocal robot, so his idea is, our robots, the vocal robot is that silicon chips are the throat, because the idea is curved, because our vocal tract is curved, and its nose is – needs some kind of curve and this product, so okay, so the main body structure is like this cone, right, this one, and to change, to deform the silicon tube, we need some kind of actuators. The previous version was just tendon type, and then the actuator itself was hidden. But his idea is just each segment, so the actuator is just like an Indian's hut, like this one, okay. So he likes this idea or something. From the viewpoint of robotics, it's not so good. But actually, oh, it's okay, it's okay, especially another idea is that, so by using this robot, how to vocalize, or how to change the – you know, deform the shape of the silicon is visible, therefore for the human subject can observe them, you know, how the robot tries to vocalize so one of the research issues, how this kind of decision affect the human subject to imagine communication or

something. Actually, such project was stopped, but anyway, that's the idea. Anyhow, that was elected as a good design.

Q: Do you think there's a lot of potential exchange between design and robotics?

Minoru Asada: I think so, yeah. After that, so his group, not this collaboration, but his group designed some mobile robots, very simple ones and so on, so yeah, as you mentioned, I believe that's where robot needs some design sense, because in a way, we expect that robots, you know, in daily in the future society. So in that case, robots should be accepted by the people. So therefore we should have the various kinds of design and that the human can choose which design. For example, I suppose maybe the Roomba, it's on a cycle, and now that you can pick out the YouTube cat on the Roomba – and then the different, like a pet, okay? So another issue is, of course we need some design to – as some commercially available product to be accepted by the ordinary people. But as the ordinary people change their way, we're thinking, therefore, often the public, it's very, very important to as a kind of feedback to change the product. So the Roomba now is like a pet, and a cat, yeah.

Q: What do you see as some of the future challenges for your work in robotics?

Minoru Asada: I guess still I'm continuing to work on the ERATO project, not the ERATO project, but such issues as the current project is that have the concept of the self and as has happened in the brain and also robots. So we're – especially the focus on the mirror neuron system. The mirror neuron system, in some sense, self same as a non-discrimination, the same, but other sense is a very good hint to discriminate among self and others, so now we are thinking about some very, very fundamental neuro-mechanisms to emerge such kind of interactions, so at the beginning, some learning, some behavior, and second stage is just imagination of – if observed others' movement, imagination of its own movement and the mirror neuron system. So that's some starting point of the concept of self and others and so on, so we are starting with this new project, so new staff is Hiroki Mori, he was a student of Yasuo Kuniyoshi at University of Tokyo, and he's the main contributor of the fetal simulation. And now he is a new staff of my lab, and we started some new project based on his study about fetal simulation, because you know, his study was based on the neural dynamic of the – still not so many, but some nueral dynamic of the neurons and the motor neurons, and occupations and so on. Therefore we started – we should – now, we are starting about the new project based on his idea of the neurodynamics and some social interaction and how this kind of situation change so some dynamic of neurosystems and how to develop this system to do something.

Q: And I guess we can do our final question. So our final question is, if you had some advice to give to young people who are interested in robotics, what would it be?

Minoru Asada: Okay, so generally I just say, not only the robotics, but for the young people, often I was asked to do this statement. Okay, please do what you like to do, that's the first thing. So because you know, in Japan, many students, okay, so I give my talks in front of the – not the high school – not the university students, the high school students, the junior high school students, sometimes elementary school students. The way to say is, of course different, but the content is the same all the time. So many students, and also their parents often asked me how my brother or my sons or daughters can be like you. Okay, okay, please, please. So one big point is that many students just in elementary school, okay, junior high school, it's okay, but high school students so pressed by the examination for the university, so kind of training and training and training, so that they give up doing what they like to do. So we're kind of the pressure. After they entering the university, they released the mind and then do something, but I suppose that all the time, please do – please challenge, please attack the new challenge if you like to do that. So if you can do that, or if you fail, whichever, you've got some information. And this is a very, very good basis, fundamental structure of, to start a new challenge. This is – so this is my experience all the time challenge, fail or success and again and again and again, so the failure is very, very good teacher for me, to think about what's next step. So on average, in my brain, I just counting ratio, fail and success. Maybe 10 percent success 90 percent failure, but failure is not failure. Ninety percent failure is supporting ten percent success, all the time, so in this sense, 100 success.

Q: Thank you.