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Masaru Uchiyama

An interview conducted by
Peter Asaro

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Peter Asaro: If you could just start be introducing yourself and telling us where you were born and where you grew up and went to school.

Masaru Uchiyama: Born, yeah. Are you asking? So, now I can answer?

Peter Asaro: Yes.

Masaru Uchiyama: I was born Fukuoka prefecture in Japan. And I was growing up in that prefecture, hometown. Until at the age of eighteen I entered university, the University of Tokyo, and started my study in Tokyo. So, I moved – I was born in Fukuoka, small village. And I was growing up in that area. And I go to elementary school from my home. And I go to junior high school in Kurume city. You can find that. And senior high school, I also go to a school in Kurume City. From my hometown to Kurume City, it would take around forty, thirty to forty minutes by using bus and train, electric train. It is called Densha in this country. But the – it's different from U.S. or European electric train. So, each digesting to topic – changing topic. Each train has motor inside. In U.S. or in Europe that is an engine, engine train. And customer train has no power and no driving unit. So, the engine pull whole train. But in Japan, like shinkansen each train has each motor for its own. So, the European/American system heavy engine, railway infrastructure has to support heavy engine. But in Japanese system, infrastructure or bridge or tunnel can be prepare for low load.

Peter Asaro: So, when did you realize you were going to be an engineer?

Masaru Uchiyama: The reason I chose engineering school was very simple. When I was in junior high or senior high, I was interested in making – for how do you call that? Making model airplane or –

Peter Asaro: Aeronautics.

Masaru Uchiyama: Aeronautics or just sort of making things – I was interested in or attracted by that sort of model making. So, I thought engineering is proper for my interest and career. English – okay.

Peter Asaro: That's good. And what was the first robot that you worked on?

Masaru Uchiyama: The first robot – yes, when I was junior high or senior high, I was interested in kind of making things. But I never thought of a robot. At the time, I only used

electric motor or motor engine, that sort of things. And when I start robotics, I think it's when I become a master student at the University of Tokyo. At the University of Tokyo, my major was mechanical engineering. And I studied mechanical engineering very hard and mechanics, fluid mechanics, thermodynamics, and so on, that kind of thing. And but in those subject, I was particularly interested in automatic control. So, I chose – and of course, at the time, there is no robotics lab in the University of Tokyo. So, the automatic control lab is the only one I could choose for study, study robotics like subject. At the time, we don't call – the robotics is not regarded in the academic world. Robotics is science fiction world. So, the – when I entered graduate school at the University of Tokyo as a master's student, I said to my supervisor, "I am interested in computer controlled mechanical arm." And I started my study of robotics. It was 1972 and 1973. So, my supervisor suggested to make a robot which can hammer nail. It was a very difficult problem to solve. So, I designed a three degrees of freedom robot. And I showed it – hammering nail is the right expression? Hammering nail, hammering nail – okay. And hammering nail was my subject. So, I tried to solve. First of all, I needed robot itself, mechanical arm. So, I designed. Of course, I studied mechanical engineering at the graduate level. I could write the drawing. So, I made a drawing of the three degrees of freedom mechanical arm. And I connected – that's a robotics like subject, connected the robot with computer. So, I learned a lot of electric circuit, A to D converter, D to A converter, and counter, and so on. And anyway, I designed the interface between the robot and computer and made software. And I realized the robot hammering nail. So, I could successfully pass the exam, graduation exam.

Peter Asaro: What kind of computer would you have been using in '73?

Masaru Uchiyama: Ohh. It's a long history, long tale. The computer I used was Stachi made made computer, not PDP level. At the time, the PDP level was very popular also in Japan. But it was expensive. So, the lab bought a Stachi mini-computer. Memory is made of magnetic core or something. It's not flash memory. It's – TTL memory. So, but and software was very poor for the computer. The minicomputer has main language to develop software was that one, assembly language. So, and the memory size was very small. The memory size was about four kilowatt, four to eight kilowatt. So, that means eight to sixteen kilobyte, very small. That's it. And I made software on the computer. And you know I sometimes write modify to adjust software. Sometimes I used machine language. Anyway, I wrote software. And the computer and the robot was connected. And the computer software is developed, now ready to go. So, I realized successfully the robot hammering nails. That master course – that for master degree. And but after master degree, I was very much impressed. But I become very much like that kind of robotics. At that moment, we didn't say robotics. But from the point of view, current point of view, it's robotics. It's robotics research. So, I was very much – I become very much like that kind of – attracted to robotics research. It's a combination of mechanical engineering and computer science, or mechanical engineering, electronics engineering and so on. It's a kind of interdisciplinary field. So, fortunately, I did like computer software or electric circuit. Of course, mechanical engineer – I also liked mechanical engineering subject. So, the hammering

nail action can be achieved from the mechanical point of view after knowing the detail of the mechanics, classical mechanics of course, not quantum mechanics, classical mechanics. So, I learned mechanics. And to learn mechanics, of course you need kinematics. So, kinematics and mechanics – so that sort – I was very much interested in that sort of become to be interested in that sort of subject. So, I decided to go ahead with the Ph.D. course. At that time, Ph.D. student was not paid by government. But fortunately, I could afford to support my life. So, I enter the Ph.D. course. And during the three years Ph.D. course, three years Ph.D. study, I enjoyed mechanical, kinematics, and dynamics, and more defined software, and more defined programming system. And so on. At that time, my target was dynamic control. Today's Marc Raibert was dynamic control. But at the time, but his dynamic control is very much advanced. But twenty year – thirty years ago, it was around seventy, fifty – seventy, fifty to seventy – I graduated graduate school, I got Ph.D. '77. So, at the time, dynamic control was very primitive. But I was interested in dynamic control. And also, supervisor suggested that one is a very promising –

Peter Asaro: Who was your supervisor?

Masaru Uchiyama: Supervisor was Professor Fujii, Sumiji Fujii. He's an expert in mechanical vibration. And after doing research on mechanical vibration, he moved to automatic control. And he studied man-machine system in car driving. And finally, before – during ten years just before retirement, he was involved – he was very much interested in robot – mechanic – not robotics, at that time, we called it mechanical arm control. So, he suggested me to do dynamic control mechanical arm. And so, I tried to find example and solution and so on. So, after my kinematic analysis, I found kinematic singularity of mechanical arm. Nobody, at that time, very few papers exist for the analysis of mechanical arm. So, mechanical arm is a very special machine. So, if you study automobile, or if you study airplane, you can find many different papers or different textbooks and so on. But at that time, very few textbooks or papers existed in the field of kinematics, or dynamics, or mechanical arm. So, I enjoyed. And as soon as get Ph.D. in 1977, next program is my job.

Peter Asaro: And where was that?

Masaru Uchiyama: I tried to find a place to use my skills or ability. But it was very difficult to find. But my supervisor helped. And the supervisor contacted Tohoku University because my supervisor used to be a professor at Tohoku University as well. Being a professor at the University of Tokyo, he had the position of professor of Tohoku University, procedural engineering. His appointment was – appointment at Tohoku University was professor of automatic control in the department of procedural engineering, not mechanical engineering. And the successor – his successor at Tohoku University was Professor Hakomori. Professor Hakomori was the successor Tohoku University of professor Fujii Sumiji. And I started to work

under his laboratory, Professor Hakomori's laboratory. And he's a very good guy. So, I was expected to be a researcher or a teacher, a professor. And I was expected to be a professor in the subject of automatic control. So, the people said – some people said that robotics – robotics kind of research is a part of automatic control, or a part of procedural engineering, or a part of mechanical engineering. So, it's a kind of small area, people say. So, you had better – they suggested me to expand my expertise by doing different research, different from mechanical control. So, I believed. I followed the tradition. I started – I stopped my research. Of course I was interested in – very much interested in robotics research. But I stopped. And I worked on the flow measurement, unsteady flow measurement. You know, flow is very important in fluid power actuator. Today's labored printer talk – the wildcat – wildcat running very fast was not driven by electric motor but driven by hydraulic motor. So, that sort of hydraulic power – to experience this sort of tidal of power, I started to research flow measurement in dynamic situation. My expert is dynamics – dynamic situation.

So, I applied the flow measurement. I applied the Kalman Filter automatic control technique, control technique called – very famous signal processing technique is Kalman Filter. So, I applied Kalman Filter to the flow measurement. And I successfully measured the dynamic, transient flow. And I heard it is still – that kind of flow measurement is very useful in diesel engine or fuel injection engine. So, right now I understand why I was suggested to do such kind of research work. Professor Hakomori, his Ph.D. thesis is on flow measurement. Why? Because his supervisor was an expert in engine, automobile engine, or airplane engines, and so on. And Toyota – Dr. Toyota, current president of Toyota, his father got Ph.D. from Tohoku University. And professor Hakomori's supervisor supervised Mr. Toyota. And so, the lab was a kind of center of engine research. So, I was – what I did was application of control theory to engine research. And so, I was confident; I become big. And I wrote some papers. But it was around 1980, I was promoted to associate professor. Before I was assistant professor, but at the Japanese system it is called research associate. So, then 1980, I was promoted to associate professor. Associate professor can take student – a graduate student. So, I discussed with my graduate student what kind of research. When people – 1980 at that time, the robotics attracted many people – began to attract many people. And probably you have heard from other interviewee, 1980 is the starting year of robotics in Japan.

Peter Asaro: Why is that? How did it emerge? In your experience, why did that happen in 1980?

Masaru Uchiyama: Why? Yes, robotics – apart from myself, I remember that robotics become popular – unpopular. It's a kind of cycle. Robotics took cycle, popular, unpopular**,** and popular. The early peak of popular phase was when I was a master graduate student. So, at that time, why robotics was popular? It probably is because industrial robot was introduced to Japanese manufacturing company. Of course industrial robot was invented in the United States of course. Engelberger and so on, they developed industrial robot. And it was – at that time Japanese

industrial scene was like this. Friends of – always looking for the U.S. situation, U.S. market. And attractive technology appeared in the United States. They picked up and import or copy – no, not copy. Don't – erase that – learn – learn from the U.S. new technology. So, that around when I was a graduate student like early '70s, industrial robot came in to Japanese industry. So, that's why I was attracted by the industrial robotics research. But at that time, the University of Tokyo had other – I repeat again. University of Tokyo didn't have any robotics lab. So, I entered automatic control lab.

Peter Asaro: Were there other robotics labs in Japan at that time?

Masaru Uchiyama: Yeah, at that time, there are several robotics labs. So, most influential, most strong lab, was Professor Kato at Waseda University. Professor Kato's lab, they said exact not the robotics they use. And they started the mechanical, artificial arm study committee or something. They organized that kind of artificial arm study committee or something. And I was once when I was a graduate student, I was invited to his committee meeting. And I gave a talk of my master's degree, result of my master's degree. I remember when I was a Ph.D. student, I was invited by Professor Kato to give a talk on my master's study. So, that robotics committee was very small. So, separate in the community, less than ten Ph.D. student, or less than five professors a lab. Kato's lab is very big. And at the University of Tokyo, this industrial research, industrial science research or something, there is a Research Institute of Industrial Science. I don't remember the exact name. And in the lab, in the institute, there is a lab involved in robotics. And the professor's name is Professor Mori, M-O-R-I. You can find the program, digest of program, you can find Professor Mori. He's going – I didn't know – today I learned he's coming to the conference and give a talk. Professor Mori and Professor Kato was two of most influential. And Professor Umetani is a little younger than Professor Mori. Professor Umetani used to be a Professor Mori's associate professor, Mori's lab. And around 1970, that Professor Kato and Professor Mori is the – I don't know any other. And around when I was – I become a research associate at Tohoku University, some other professor become – professor started robotics research like Professor Hanabusa. He's a big name – another big name. Professor Hanahusa started his research around when I was a Ph.D. student. And from his lab, there is many young – right now they are not young, but at the time young professors born. Professor Asada at MIT and Professor Nakamura at the University of Tokyo, both graduated from – both were born in – academically born in Professor Hanahusa's lab.

And Professor Fuji, before five – several years before his retirement he said that he did some research on, he said he did some research on robotics. But he said that he, I have almost all done <laughs> in the program of robotics and it's a good time to retire <laughs>, that he retired. That—our interpretation is that he did what he sought of as a research target and he did all of the, all what he sought of; that's our interpretation. And Professor Fuji's lab very strong student graduated. Professor Inoue is seven years older than me so when I was a student Professor Fuji's lab, Professor Inoue was researcher at the Electro Technical Laboratory. When we talk about the

robotics and when I, around 1970 I said that there are two or three influential university professor but at that time the more active, was active group, was Electro Technical Lab or mechanical engineering lab researcher. Mechanical engineering lab and electric technical lab is now unified into AIST. You, how you have the word? A-I-S-T. And traditionally they are the strong group in mechanical engineering and electro technical laboratory. Both group are separated. But the two, those two laboratory belong to MITI; Ministry of Industrial Trade and something. I thought that was called MITI. Right now it is called METI. <laughs> Industrial trade, a long time, around 70, industrial trade, trade was very important for Japanese economy so the ministry was trade; ministry of trade existed. But government encouraging trade is not, caused trade friction and some countries say that it's not fair because the government is supporting industry to make trade; make export. So the Japanese government moved trade from the Ministry of Economy. So before Ministry of Economy is called Ministry of Economy and Industrial Trade; METI. But now it is called, they call Ministry of Economy just, Ministry of Economy; METI. But that different from robotics. <laughs>

Peter Asaro: Yeah. Why was that significant in the rebirth of robotics in 1980?

Masaru Uchiyama: Sorry?

Peter Asaro: So the reemergence…

Masaru Uchiyama: Reemergence, okay.

Peter Asaro: …in 1980.

Masaru Uchiyama: Yeah, that I wanted to talk about. Yes, at that time key word in the reborn of 80 was mechatronics. Mechatronics was, the one mechatronics was field of fused field of mechanical engineering, electrical engineering. Attracted many people, particularly many control people in mechanical engineering. So the, why mechatronics made impact to robotics is that at that time the microchip; emergence of microchip. In 1970 we would use many computer but in 1980 we don't need to use many computer; many computer huge box. <laughs> So you cannot use for walking machine or you cannot use for satellite, manipulate or equip satellite or something. <laughs> So the, everybody, it's innovation. <laughs> Emergence of microchip is a strong innovation. So Microsoft born from that circumstances and many high tech company born during that circumstances and robotics reborn. And robotics enjoyed a cheap and small computing part. But at the time another peak, '80s peak is mechatronics progress mechatronics is a key concept which accelerated innovation in the robotics field. Recently in 2010, around 2010, I feel… 2010 between, I'm not sure but two, 1990 to 2000, 2010, 20 years; around 20 years also innovation progressed. I think innovation progressed and in my opinion I feel that the

sense of technology advanced very much. I think that a kind of fusion of robotics and MEMS due to, thanks to MEMS technology, thanks to MEMS technology we could obtain accelerometer in aerospace field it is called inertial measurement, IMU or something. I don't remember, IMU. So the sense of which can measure, which can detect three axis accelerometer, acceleration, three axis acceleration plus three axis and angular velocity; XYZ force and XYZ velocity, rotational velocity. So the six axis, six instant – small, very, very tiny, very small chip can, very small chip can measure six component of auxillary motion; rigid body motion. Very, very surprising, that's surprising. That make, that have made machine change, make machine change -– wait a minute, I'm tired. <laughs>

Peter Asaro: Well it certainly changed how they think about things. So what were some of the robots that you worked on in the 1980's?

Masaru Uchiyama: What sort of robot?

Peter Asaro: Yeah.

Masaru Uchiyama: I couldn't follow your question.

Peter Asaro: Yeah, what robots did you work on in the 1980's and how did you get into aerospace robotics?

Masaru Uchiyama: Oh, I see. Okay. That the long… <laughs>

Peter Asaro: <laughs>

Masaru Uchiyama: So I restarted the research on robotics. So the tools for robotics at that time was same as my, as, same as I used, tools as I used in Ph.D. study so I used microcomputer. No, no I didn't use microcomputer. First I used minicomputer; same computer as I used in the University of Tokyo, Hitachi minicomputer. And motor was not change very much at the time so, but I was interested in first, you know I said I worked on transient flow measurement. Transient flow measurement is a kind of Karma Futa program applied to distributed parts of the system. And I was very interested, after the research work I have become, I have become expert in probabilistic technique and also modeling of distributed parameter system. So I was interested, I was, I tried to apply those knowledge into robotics so that's why I started research on flexible robot system. The dynamic robot controlled the robot due to, dynamic controlled the robot; begun to move very fast but other robot become faster and faster. The robot structure cannot support itself so that means the robot, when the robot moves the robot structure…

Peter Asaro: Deforms?

Masaru Uchiyama: Deform. Okay. <laughs> Deform, deforms. So how to suppress the deformation of vibration was a very, very popular issue in robotics field. So I worked on robotics, that kind of robot and also I have sufficient knowledge of Karma Futa. So I try to apply the Karma Futa to sensing measurement; measurement of force in manipulator arm. So we call the dynamic sensing, dynamic. So I, so after '80s I think no new, I didn't work the creation of no, I didn't do work, creation of new robot; new system. The system, the target system, the target system of research, research target system was the same as my Ph.D. study; manipulator and how to control, define the controls, manipulation, manipulators, define mainly targeted the, topic mainly targeted was refinement of sophistication <laughs> Sort of modification that target. So it continued around 10 or 15 years. And the research, when the research direction changed after 1980's was shift to introduce of research of humanoid, also the aerospace. That why I started the aerospace was support by, support of professor at Tokyo Institute of Technology; Professor Umetani. Professor Umetani he's a good idea man or he's a man who can find cutting edge research work in robotics. So he produced. <laughs> He produced a very good, many good professors. Professor Hiroshi is, used to be a student of Professor Umetani. And Professor Yoshida, Yoshida is professor at our university, Tohoku University, who is working in space robotics. He also graduate, he also graduate student from Professor Umetani's lab. So Professor Umetani <speaks Japanese>… <laughs> Professor Umetani suggested, no, suggested to join his research group funded by Japanese national space development agency or something. Before JAXA is called NASDA. NASDA supported the research committee on space robotics. The possibility of application of robotics technology to space was a very much interested, interesting topic for NASDA people. So they support, they funded the research group and Professor Umetani was the head of that research group and he asked me, he suggested me or he asked me to join that research group.

So I thought it was very interesting because at that time, so far at that time I had experience, I had the experience with industrial robot. Four stroke, I studied four stroke sensor and force control or trajectory control and so on; all singularity analysis. All, you use, all those topic are used for industrial robot. But one day I met a professor, a MIT professor. He's a Korean, Korean-American, Korean, Korean-American <laughs>. He said that he visited my, not my lab, I was a visitor at Santa Barbara, California, Santa Barbara, UC Santa Barbara Research Institute. They had the research institute on robotics so I was invited to work at that institute. So during my stay at Santa Barbara a MIT professor, Korean professor, came to the lab and he said this, he make this kind of comment: "Why don't you do research on robotics to automate in the production line? If you need automation you can go, you can get factory with cheap labor if you go outside," <laughs>. "If you go outside the United States or outside Japan you can find many people who want to work in the production line. So why do you need robotics? Robotics has to compete with those people so robotics will fail." <laughs> Cannot get wrong, win. So the reason is labor cost and robotics cost, industrial robot cost almost compatible or labor cost is cheaper. If the labor cost, the robot has to compete with cheap labor. That was 1980's, around 1980's I met

a professor from MIT. So I thought that the labor cost, so the robot can compete with human beings whose cost for labor is very expensive; that astronaut. <laughs> So the good application, so I thought that space robot, application of robotics to space is a very good field of robotics application at this moment. Of course the robot become, you can make robot cheaper and cheaper than you can replace whole labor, human labor, by robot. But it's, it would take time; long time. So that 1980's moment the good target is replace astronaut by robot. So that one reason why I started. <laughs> That one reason why I started my research in space. And there was another interesting story exist. <laughs> I was a professor, I, no I was associate professor at Precision Engineering, in Precision Engineering. Precision Engineering…

<off-topic conversation in background>

Masaru Uchiyama: Precision Engineering was the engineering, the department used to be a aeronautics engineering department before the war. Before the war Japan needed many engineers in aerospace and, not space, aeronautical engineering; aeronautics engineer. So they, major university started aeronautic department so before 1945 and Tohoku University started aeronautic department in 1940-something. But, so the engine professor, they needed engine professor. The engine professor supervised the Toyota auto-bots sync. So the, but it was forced to close the department. Of course the aeronautics department is very much related to Air Force Technology. Probably you heard about after the war the kind of military engineering research was stopped by general headquarter; general headquarter means MacArthur <laughs> They stopped. So the, but they wanted, they needed to survive so they changed the name aeronautics to Precision Engineering. <laughs> So they, all professor wanted to reborn, wanted to restart the aeronautical, aeronautics research. So they proposed Aerospace Engineering to Minister of Education and it was accepted. So that kind of train, I was expected to do aerospace research in robotics. <laughs> So I start lot and lot of motivation.

Peter Asaro: So what was one of the projects that you did for that?

Masaru Uchiyama: One of…?

Peter Asaro: One of the robots or projects.

Masaru Uchiyama: Yeah. So I did tele-operation; so I started the tele-operation research. So I, JPL Tele Robotics, very, very strong, we, again by using the robotics experience, exploiting the robotics experience I started the Tele operation robotics. And successfully we could, tele-operate real robot via satellite. I said to NASDA to support it robotics application study group headed by Professor Umetani. Umetani, that was around 1980, late 1980's, late 1980's. So late 1980's Umetani started the research meeting, research committee and I was asked to join the

research committee and I worked very happily <laughs>. I was very happy to work on the aerospace, space engineering application; robotics space engineering. But stimulated by the result by the committee NASDA started to launch robot satellite and on the background I had there is a political, political aspect. What is political was that NASDA tried to, wanted to launch a satellite for communication with something; a kind of commercial use. So the US didn't like that one because to fair, for fair trade and government should not support political satellite; the government should support not political but long-term, long-term research satellite. So I think that kind of political aspect pressure from US, NASDA changed the design, start change, start change the design of satellite, commercial satellite and they needed to change the commercial satellite to long-term research satellite. So long-term research satellite is ETS7. ETS7 is mission, two, the satellite had two mission; one mission is rendezvous docking. Rendezvous docking, Japan didn't have rendezvous docking technology. US and Russia had rendezvous docking technology and they demonstrated long time ago. But we didn't have the rendezvous docking technology. So to test, to obtain or test the technology NASDA said that we build, we design and launch this satellite so nobody can complain. <laughs> And another another interesting mission is robot mission. So the robot mission used to be very ambitious. But not every mission cannot, could not achieved. But anyway, the satellite lived longer than expected.

The NASDA NASDA invited some university research group to do research experiment using that ETS7 satellite. We proposed to tele-operate, tele-operate space robot, space manipulator. So we did, we did research; we researched on using the ETS7 and the tele-operate the robot from scuba space center using my, our haptic devices. We did develop, of course we are expert in mechanical arm <laughs> design so we develop mechanical arm haptic master arm and by using the master arm we tele-operated the, manipulated the satellite. That one peek of our research work and after that expo AICHI Nagoya, Japan held the Nagoya Exposition, International Exposition in several years ago. I don't… <laughs> several years ago. And NADO, NADO is a research funding agency belonging to METI, they they organized the robot exposition. We proposed impact, impact motion of humanoid robot. So impact, because my lab was traditional thinking from this dynamics stand <laughs> point of view. So dynamic robot demonstration impact robot. At the beginning we proposed to make Karate <laughs> Karate by robot, impact but the METI group METI officials said that <laughs> since we are showing the robot demonstration Karate robots to elementary school children, young children, so in Karate if something happens, Karate is very dangerous for young children. Why don't you change? So we changed. <laughs> according to following his advice we changed to demonstrate by using the drum. The drum beating robot. That was very popular, that exposition. Young children voting for most attractive robot. We won. It is the number one in the voting.

Peter Asaro: What year was that?

Masaru Uchiyama: What year … <pause> 2000 zero, 2005 or around 2005. 2005.

Peter Asaro: Was that your first humanoid other than the arms?

Masaru Uchiyama: Yeah, sorry?

Peter Asaro: Was that your first humanoid?

Masaru Uchiyama: Yes, Yes. Humanoid robot. We introduce HRP2. KAWADA and AIST designed and built manufactured robot. It is called HRP2. We used HRP2. And Associate Professor Konno He is now professor at Hokkaido University. He used to be associate professor in my lab. He has good connections with Professor Inoue's group. And through the connections through Professor Inoue's lab and KAWADA's research group and engineers group we could successfully use the KAWADA HRP2. So we developed only software for that. You know hardware… To develop humanoid hardware is a very very tough job. Without developing hardware of robot, we used… we just used the robot itself. Robot hardware by KAWADA and AIST. But what we did what we contributed is the development of software. That humanoid research. And after the expo, Konno keep the cross contact with KAWADA and Inoue's lab and he is now he is just before moving to Hokkaido he had several humanoid robot. And he achieved core cooperation between two humanoid robot. But technology itself cooperation of humanoid robot, technology of humanoid robot cooperation is very difficult. But financially also very difficult for university research. <laughs> And quite recent research is UAV – Unmanned Aerial Vehicle. There is … yeah not reason – how it can be possible? Is that innovation of sensor and chip microchip. And mechatronics age still microchip is kind of like board. But right now is a computer like a –

Peter Asaro: So ahh… Can you tell me about some of your students who have gone on to do a robotics professors or researchers in industry?

Masaru Uchiyama: Sorry?

Peter Asaro: Your students –

Masaru Uchiyama: My students?

Peter Asaro: – who have gone on to become professors –?

Masaru Uchiyama: So I have I have had too many masters students. Mainly master students go to industry. Several masters go, I counted how many student I supervised. I found that

around 100 master students. I supervised around 100 master students. Most of master student go to industry and manufacturing, mainly manufacturing industry. I don't think they use robotics directly. But robotics related technology like mechatronics or mechanical engineering of course that sort of thing. They work in the field of that kind of things. And as to Ph.D. students, I counted around more than 30. And most – very strange. Usually the Tohoku University or many other major university, Ph.D. student do not get academic position. They work in industry. Most most and we are encouraging Ph.D. students to work in industry. But as to my student, more than half of 30 get job in academic position. And I have former student working in Hokkaido, Professor Konno, he is now professor at Hokkaido University. And Iwate there is a Ph.D. former Ph.D. student working in Iwate University. And Yamagata University we have 2 Ph.D. student – 1 Ph.D. student 2 Ph.D. student <laughs> And in Tokyo area. 1, 2, 1 Ph.D. student working in university near Tokyo. And technical college, polytechnic college in Japan there is a polytechnic college for short course engineering kind of short course engineering school. So 1 associate professor working in that Polytechnic Institute in Tokyo area. 1, of course, 1 former Ph.D. student. And in Shikoku there is 1 Ph.D. student, former Ph.D. student. In Kyushu there are 2 or 3 Ph.D. student so altogether more than around half <laughs> and of course some student working in industry. But one, two of those working in industry getting Ph.D. from my lab is return from company. 2 was sent from company to my lab as a Ph.D. student and getting Ph.D. he go back to his own company. That kind of … we have that kind of skill. So being a company worker you can be a Ph.D. student.

So using the system scheme, using the scheme, 1 from Toyota, 1 from Hitachi become a Ph.D. student in my lab. And they did very well. And they get Ph.D. and they are now working in their home company. And so one strange guy <laughs> one little different guy hoped wanted to have job in industry. So I suggested Aerospace National Aerospace laboratory, but he said he wanted to work in institute which is cross related to real machine. So he moved to Toyota Institute … Toyota … Toyota Research Institute. Several … few months ago … about a year ago I met him and he was quite happy. <laughs> And also the 2, 3 … 2 or 3 work in AIST. AIST is popular for Ph.D. student. Encouraging student Ph.D. student to work find job in industry. My student find job in academic area. I think to have job in academic area student will be more happy happier than to find job in industry. Because robotics robotics is still economically still small area. Automobile, if you got Ph.D. in automobile engineering, the automobile is a very big industry. So you can find job in with that job you can be happy. But robotics you cannot find, even if you find job in major company, you cannot find job in robotics. It is very very much similar to aeronautics. We started aeronautical engineering but about one-third of student get job in aeronautical industry. Some others, the rest find job in mechatronics or magnetic disks <laughs>. So the robotics is very similar and very popular for student. Like aeronautics is very popular for student. So very smart guys, student are … most student are very smart guys. But getting job in industry. Yes, you can find job in Mitsubishi Power Plant or Hitachi or Toshiba may be they work in atomic power plant <laughs>. But they they find so that is reality.

Peter Asaro: Do you see that there are more robotics lab in universities now?

Masaru Uchiyama: Yeah. Universities Robotics lab at university expanding. In some 1970 robotics there are only several robotics lab in university. But now particularly private university want to have robotics lab because it is very attractive for student. So they student number is decreasing. So university want to have to attract decreasing student as many as possible. So the robotics. So the private university major attraction attractive object is uhh subject <laughs> attractive subject is robotics. That's why my student find academic area. Most of my student more than half of my student could successfully find academic area because university who want to have robotics lab increasing. So demand for robotics teacher increasing. So we could supply more robotics teacher than any other field. It is my observation, my interpretation <laughs>.

Peter Asaro: Ok. I wonder if you could just say a little about how the IEEE Robotics and Automation Society and the Japanese Robotic Society help shape and create robotics community in Japan?

Masaru Uchiyama: Right now the robotics community in Japan inside robotics community we have robotics society. And as to international, we attend to many international conferences. But right now the IEEE is major partner for Japanese Robotics society. Before we used to have a International Symposium of Industrial Robot, International Conference on Advanced Robot, and so on <laughs>. But and IFTOMM, IFTOMM Conference. Do you know IFTOMM? IFTOMM: International Federation of Theory of Machine and Mechanisms <laughs>. That sort of thing, but right now the IEEE is very strong and very attractive probably every in many respects IEEE is attractive for Japanese researcher. So the international partner IEEE is very strong as international partner for Japanese robotics community. And this IROS is co-sponsored by IEEE plus Japan… Japanese Society of robotics … Robotics Society of Japan <laughs> and SICE, Society of Instrument and Control Engineers. So the Japanese academic society collaborate with IEEE. What I say? I say that IEEE has more attractive aspect as a partner is that IEEE has very good paper database. Explore and it can be international global global citation it has implanted <laughs> implanted very global citation system.

Peter Asaro: And historically have you seen a shift from Japanese scientist and engineers publishing in Japanese to publishing in English for international audience?

Masaru Uchiyama: Yes. When I was student young researcher to write paper. Most people it is very natural very strange not strange to write papers in Japanese language. So the first paper I wrote was in Japanese of course. And to be international people say that translate translate Japanese papers into of course some modifying but to translate Japanese paper to English is necessary. That level long time ago. But now the global competition to write Japanese university or research community is pressed to be global. Because because to contribute

something to global community, our community itself has to be global. So that means one solution one point of globalization is publish in international language, i.e., English. So the recently I feel recently in recent ten years in recent ten years more student or more researcher writing English paper. That true. May be to extend this trend we will English is a top priority language. And Japanese is, of course Japanese is necessary for communicating inside. But powerless in international community so that we have to we have to fortunately <laughs> use English language as a global language. IEEE is becoming I think from my point of view it's a <inaudible> <laughs>. Probably the – I'm stuck <laughs>.

Peter Asaro: <laughs> Ok. Aaa. So the question we have is like to wind up with is: What's your advice to young people who would be interested in career in robotics?

Masaru Uchiyama: <long pause> What… yeah. At this age, <laughs> I have many things to ask to ask to young children, not children, young researcher. But one thing is what I thought of immediately is that make industry, growing industry based on robotics is what I expect most probably. Without industry strong industry robotics will not progress. May be afraid it disappear. Because if industry strong industry exist, the technology will be advanced. Like if you look at electronics or automobile or aerospace. Of course aerospace very small industry in Japan. Aerospace industry, but globally global point of view there is a strong industry in aerospace. Airbus or Boeing is strong industry. So what I want to ask … what I want to expect young people is to make industry in robotics based on robotics. So I expect it very much <laughs>.

Peter Asaro: What do you think of the big challenges or opportunities in making robotics into that kind of industry?

Masaru Uchiyama: <ponders> May be it is a small point. But right now I am already enthusiastic is that fusion of automotive industry and robotics industry or any other world electronics industry. Robotics robotics is based on electronics. So robotics and electronics and kind of mechatronics things. And automotive industry automobile automobile industry, automotive automotive technology, I am sure can be fused to create innovation <laughs>.

Peter Asaro: <hints> self-driving cars?

Masaru Uchiyama: Yeah

Peter Asaro: Ok Is there anything that we have missed that you would like to talk about?

Masaru Uchiyama: Yeah Yeah I have not prepared. So my talk in this interview is not very well organized. I hope that you organize very well edit. <laughs>

Peter Asaro: Oh It is great. Yeah

Peter Asaro: Alright. Well thank you very much.

Masaru Uchiyama: Yeah sure.