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Petar Kokotovic

An interview conducted by
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with
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Q: Why don't we just start by having you tell us where you were born and where you grew up and went to school?

Petar Kokotovic: Well, that sounds very boring. Yeah, born in the unfortunate city of Belgrade. I went to school there. That was disrupted by World War II. The city burned including a bomb that fell on our house. And then there was a glorious time of four years without school that for some kids was disastrous, for some kids was fun but it was war time. After that, it was scrambled to have three or four shifts in a school building, many buildings were missing, destroyed. Then things regularized and I think Belgrade provided excellent education, in fact. And the university I remember it as the top quality. While the textbooks are missing and so on you would find enough of English language books were being received by hundreds and hundreds of aid organizations. Then we were reading from Russian books and so on. So I think the education was very good. The labs were maybe somewhat obsolete but fundamental education was quite good. Mathematics was particularly good.

Q: What did you study there?

Petar Kokotovic: Electrical engineering. Yeah, this was at the time the hardest to get into and some kids like when it's hard. There was this qualifying exam I don't know how many hundreds apply and as I recall only 100 get in. They give you tough questions to write about and so on. Then another point of selection was after two years you have to pass with whatever score to continue the study or else you can be eliminated. And there was some remarkable professors that influenced us. I mentioned to you Mitrović. This was the beginning of automatic control in most countries and this was certainly in Belgrade the first time that so called server systems course was presented. And you know, server system meant, for example, in the artillery arrangement, you may call it robotics, if you wish, but basically the antiaircraft artillery has to follow an airplane. So this was a development of World War II, you know Wiener, Norbert Wiener participated and mostly MIT Labs were developing things. So the radar became available. The radar's antenna would follow the plane. There would be an image of the plane and the server system would have to adjust the radar in at least two dimensions. And then the radar was to be followed by the alignment of the antiaircraft artillery. So that was one of the earliest products of World War II that was fully automated. So we studied that and then I went to the nuclear science institute near Belgrade. Many of us were recruited for that kind of work.

The first project was on this experimental nuclear reactor, the bigger one, the safe one just to try the level of the heavy water inside the reactor, also to adjust the odds. And then we had lots of industrial projects so that control systems group or automation group or a process control group. And there was quite a bit of cooperation Belgrade, Szeged, Sarajevo mostly this triangle. So pretty much people of the same generation. Some of us were in the same train, not only in the same train, but in the same sleeping car as we went to the congress in Moscow in 1960 all by

train, you know, two-and-a-half days or so; plenty of time to discuss. So you had guys from Szeged, Sarajevo, Belgrade, some other cities. So we almost created a committee so that when we returned back to Yugoslavia from the congress we'll start some joint working and indeed we did. So that was the beginning, if you wish, for me, certainly but for the field it wasn't much before. The field, in a sense, the modern version of that field started in World War II. But if you want to take history, of course, the old Greeks or old Mesopotamians, they were controlling damns. They were controlling irrigation systems and so on. So that concept of regulation control is very old.

Q: Was there anything called robotics or what you would call robotics going on <inaudible>?

Petar Kokotovic: Yeah, this was the first major project was the – there were many amputees, you know, former parties and resistance fighters and many amputees also from bombings just the war victims. So there was a big need especially for artificial arms and legs. And the artificial arms were a big challenge not only in Yugoslavia but people were trying in Germany and other places to develop with the growth of electronics. I have to tell you that transistors just appeared and some miniaturization was possible. Several motors became sufficiently small for the war time applications. And the idea that maybe artificial arms could be created motivated many people. So Belgrade had this project later called Belgrade Arm organized by Professor Rajko Tomović. A group of us started. I didn't continue for very long. Others continued. This developed into bigger robotics project, bigger robotics operation. There was a section in the Pupin Institute for a while supervised by Tomović and then taken over, continued by Vukobratović. But my information about that period is already too vague. I was in this country. I wasn't there. So I know only these three or four years and they were sort of an enthusiastic start maybe not always realistic. You know, fantasy and dreams very often propel you especially if you are in a less than super developed country. The development also when a country is developed, it sobers you. It shows also what is impossible. When you are not so developed when you are young you have all sorts of heroic ideas that transfer into technology. Some of them sometimes succeed.

Q: So they were looking at a cable control system for that hand?

Petar Kokotovic: There were several designs. The first one was with the single motor and some sort of a switch mechanical coupling that would pull the cables. That was the most primitive original thing. Then the idea was that maybe there would be ways of doing it with some rotating axels and pulling the fingers individually. The hope was that the motors would be so miniaturized. Then there were even as I recall ideas of the pneumatic and it was not pursued in Belgrade but elsewhere to have pneumatic pipes as little pistons to pull the fingers up and down. So the mechanics of it were extremely difficult, especially if you wanted to have fully anthropomorphic human hand. If you were satisfied with the three fingers only or with a claw or

something then it was easier. It happened that years after I believe a French product succeeded. I remember maybe in the seventies staying in a hotel, a bed and breakfast place and I saw a youngish man taking the coffee cup and drinking. And I realized it was pretty much that same idea that worked. Plus, apparently, in his case he didn't have to use motion. Apparently, he was able to control it by his own nerves that means that already then. As I mentioned the first IFAC Congress if you take a look in the proceedings of that first IFAC Congress where the Belgrade Hand or just the skeleton controlled by cables, wires was described. There was also a presentation and I remember the name of the Russian author was Kobrinsky. I attended the demonstration. The demonstration was with a patient who was trained enough to concentrate so that he would create strong enough electric signal in the ending of his amputated arm so that he could do two basic operations closed and opened and that was demonstrated already then. The electronics for the time it was very clumsy obviously, a big apparatus, not portable and so on but it worked.

So that was – that line was a fascination that the robotics should serve the industrial needs, of course, that was well known. First, was positioning as you would say pick and place operations. That I connected with the early isotope manipulators that were not automated initially that included a system of mechanical transmissions so that you could control an artificial hand by basically squeezing and opening with your own hand. So that existed in industry for all sorts of hazardous materials, for handling of the hazardous materials. And that helped the mechanics of these types of hands. But, you know, industrial robotics as I worked in industrial control they would appear, they would go to first move some heavy objects then as we know painting was one of the early applications that succeeded. And I pretty much only occasionally then would follow what happened in robotics. You know, working in our conference isn't just some robot sessions or talking to a colleague who was working on it. By the way, I think, my young colleague Mark Spong then came and joined Illinois and he wrote one of the first textbooks. I don't know if you know Spong with the Vidyasagar textbook. He's now dean at Dallas, University of Texas at Dallas. So he being an early textbook writer in that area can tell you more about it. There was a lot also of as I recall he was – there is even a name for it help me now, to transfer the feeling of the touch. I forgot this.

Q: Tactile.

Petar Kokotovic: Yeah, tactile but there is...

Q: Haptics.

Petar Kokotovic: Yes, haptics. Yeah. The development of haptics started and he had quite a bit to do with it. He got me interested in just a mathematical subject of if you design a robotic control, say robot arm control. Assuming that the material is completely rigid how can you do

correction for actual flexibility? So that fit some of theories we were developing separate from this issue namely the inclusion of additional tolerances and compliances that while assuming that something rigid in your design, it is rigid, then you can redesign it without repeating everything but just adding a corrective term for flexibility. So that was well received. Yeah, there was a significant – oh, now, I remember. There was a significant robotic center at Georgia Tech, Atlanta, Georgia. This was a nationally financed pretty big operation. The names now escape me but one was our former student from Illinois who I don't think worked in robotics when he went to Atlanta but David Taylor. He's a wonderful researcher. He may give you some information about that center there. I'm not sure what it's called now. I think it's called manufacturing or something or other. It started as robotics, I believe, but it became manufacturing. So that's another aspect.

Many of these robotics centers may be understanding that robotics is somewhat undefined and if defined then maybe unnecessarily narrow. They brought that into the concept of manufacturing because pick and place was one thing, right but more complex automation required understanding the whole factory floor and passage of the material, all sorts of things of this kind. So the complex automation absorbed, subsumed the robotic elements as just individual actuators if you wish. You know, you have this body of a car to be painted. You see this thing the car comes, it's slightly rotated this and that way the painting goes. And the paint, I think, goes through the drying machine and then to something. The new body comes to be painted and so clearly there is robotics but there are many other things along. So now the robotics proper as I recall in Belgrade, the major activity was Vukobratović and then I remember visiting there. He was talking about exoskeletons. Obviously, he was similarly connected with the rehabilitation organizations and this was a good application to use robotics not to provide the whole motion but to assist in the disabled person's motion or in the recovering person's motion. So rehabilitation centers used it. And then when I came here through the work of this former graduate here and my colleague professor Buttner I learned about their surgery machines so much so that I was very happy to see how they operated and even took my wife, she had her knee operated by one of those – yeah, they are quite widely used. You must know about these orthoscopic and very fine surgeries that can be done now. Computer Motion, a local company was very much in the forefront of these and they patented many things and I think were financially successful. As we said they were sold to Intuit and I haven't...

Q: In Belgrade who funded these kinds of initiatives?

Petar Kokotovic: Yeah, well, the Pupin Institute was state funded. And also industry. We were getting some grants from industry. You would have to show the interest of industry in order to also get some state funding. There were commissions, I forgot, Zamtek or something Zavoz for technical development and so on. Then you would try some international aid. But as I say Tomović was particularly successful with a U.S. Veteran Administration. So for a while Belgrade Hand was financed by the U.S. Veteran Administration. I noticed maybe five or six

years ago that actually U.S. Veteran's Administration is continuing to finance more advanced models. And there was this report, I don't know, I've seen I think even on the television program of one of these amputees that is so successful, a military person that is so successful with this more advanced, with very advanced versions. Still the training and improvements are needed but I remember seeing this and reading. So that line I don't think has ever been abandoned and every new development was cultivated through that. Then, as I said the rest is probably described in the Belgrade publications which I haven't followed from the group of Vukobratović.

Q: What years were you a student?

Petar Kokotovic: What years was I a student? I was at the university from '52 until '57 probably. What happened is I went to France first during my studies. Then, again, to Germany so I sort of delayed getting my diploma because it was easier to travel before you get your diploma. The moment you get your diploma you have to go to the military service, right. So most of us, this was in the early time, the Yugoslavs got the opportunity to travel, students and positions were open for us industry. So I was in France. It was a good automated power station where I worked. And in Germany I worked in a factory. And they were cooperative and nice and showing us some advanced projects and so on these post organizations. So it was good. I still have friendly relations with Stuttgart. Some young people when I told them I worked in Stuttgart they realized, they're around 50, they weren't born quite. <laughs> But yes, I will send you an email this little autobiographical sketch which I wrote for IEEE. What happened they sent a guy to interview me and it was a long interview. The transcription of it, you know, he wanted me to tell him more about the Soviet science at the time but the transcription of it even though I was remembering what I was talking I couldn't reconstruct even my own thoughts. So I begged him to remove it and then I said I'll write it for you on my own. So rather than having an interviewer because that particular person might have been too tired to or I don't know. Anyhow, maybe my English was too bad. But in this I refer to in the state of the sixties, you have to understand the post-Sputnik era. Sputnik shook the West. They just couldn't believe it. I was in Germany and the dog was sent to space. Remember, there was a little dog in the satellite and then, of course, when the man went to space et cetera. So then the idea was that the Russian mathematics and especially Russian applied mathematics and control theory were responsible for these successes. Cold War. So I am a victim of World War II somewhat and beneficiary of the Cold War because even before I got my Russian degree some American colleagues met me and said as soon as you finish we will arrange for you to come to the United States. So I was really repackaged slightly when I came back to Belgrade and literally a couple of months later, three or four months later I went to the U.S. and that was it.

Q: Where did you study in Russia?

Petar Kokotovic: At their Academy of Sciences Institute called Institute for Automation and Telemechanics. At that time it was IAT. Then when they became too big and got a new big building prospered beyond their dreams they became Institute of Control Sciences, Institute of Control Problems, rather. But just about everybody who was known in the field was either a member of that institute or was somehow associated. Very often, they were just the front sometimes for some classified organizations. So if you were to – if you were declassified then you were to present some results, then you present them as the member of that institute, even though you might be a member of something else. And this was one of the firsts that started a professional journal in that area. And now we celebrated the 80th anniversary of my colleague David Mayne in London. So he remembers how they in London were grabbing every bit of the translation or finding people who would translate this from the Russian magazines. This is how far advanced at that moment or at least was believed to be so far advanced. You know, there were mathematical breakthroughs there that were of immediate help to engineers and that was appreciated.

Q: How did you decide to go to Russia?

Petar Kokotovic: Well, that is a touchy subject. That is a touchy subject. I applied for a Fulbright fellowship. And the Fulbright commission at least at a time I don't know now was composed 50 percent of the local members, 50 percent of the U.S. members, right. And there were situations in Yugoslavia happening, people were getting unhappy with what was then called the bureaucratization and misbehavior of the leaders mostly on the level of misusing the public property. You know, government cars were present in various resort areas, various restaurants and so on. It's pretty obvious they were not there for official purpose or so on; many such things. So there were basically criticisms and so on. And as a typical thing for this was to immediately start diffusing the pressure. So the leaders, for example, Belgrade leaders would go to various organizations, especially where the younger intellectuals were working and say, okay, comrades tell us what's wrong, let's discuss it, so on. We were also tired of this kind of sort of a farce.

So this comrade came and he was saying, okay, tell us – there was no way that anybody could misuse any government property in our institute. We had none basically. But I was sitting next to the window which was overlooking at the parking lot. So I said comrade, I don't know see one of these cars is an expensive Mercedes. This is the only candidate that could be misused, is this by any chance your car? I was making what I thought was a good joke but it exploded. They attacked me. They said I was agitating against Tito or something or other. And it just happened that the professor from the university liked me a lot and he was a member of the Fulbright commission. So I get a call from him and he says, "Idiot, what have you done?" And I said well nothing serious. He said, "What do you mean it's not serious? We were already told to remove you from the list of candidates for Fulbright and to send a letter that you haven't satisfied on the English test," which probably was also true. But I would have probably received Fulbright other – I don't know. Anyhow, and then moreover, he said, "You know what, the things are so

serious from what I hear you better leave the country for a while. Invent some business trip or something or other.” He said, “Better yet I am also on the commission for some Soviet fellowships and we have ten of those. Nobody wants them; only two ballerinas and one violin player. No engineer wants them.” But interestingly I was reading some of this Russian literature and I very much wanted – of course I preferred Fulbright but I very much wanted to see Professor Feldbaum.

So I thought okay I will go there. I will get one year fellowship and I will go there and stay a month or two until the dust settles and then come back. But it turned out it was a very good opportunity that they gave me. Again, they would not put me in that institute. It was closed to the foreigners. That’s another interesting story of the time. But when I somehow tried to get in touch with Feldbaum the secretary would always say he’s out of town. And then I read popular science page in the Moscow newspaper once a week it comes and in the palace of popular science Professor Feldbaum is giving a popular lecture. So I rushed there, introduced myself to him after the lecture. And he says come to the institute. I says how can I come this is closed? “I will take you in.” So he waited for me at the door. Amazing, I’m a kid there and he’s a famous, world famous guy. One day, the next day he waits for me and passes. And so I finally get embarrassed that this guy would have to come down from the third floor to take me up. So I tell him I am unable to come, I have something else to do next day. But then I come the next day and I just walk in and the guards salute. They saw me with an important person three times in a row and then I started coming every day normally passing through, not showing anything, just passing through like everybody else. I made sure I bought some Russian shoes and Russian pants. And I had to change my glasses because western glasses were recognizable as opposed to, et cetera.

So to make the long story short the secretary of the institute somebody introduced me to her. I already had chocolates and other things ready for the purpose. It was well known. So finally she came once and said “Give me your pass so I can extend it.” And I said, Marsha, what pass? And she really got white. She says, “What do you mean, you don’t have a pass?” I said, no. I didn’t even know that there was a need for a pass. And poor woman, she rushed and did something she said when was the first time you walked in? She gave me an old pass and she gave me a new pass. And I managed to stay there. And I told this story to Sveto Zimonjić but I told him make sure you get guarantee. Don’t play the tricks. Now, the second time the trick will not work. So by then we organized things so they were allowed to go and he went to work with Yemeljanov and Utkin, that was interesting. Yeah, these were the times, the funny times that you had to – as much as they were claiming KGB’s this and that, basically they were stupid. You could play tricks. I was able to get rid of my tail as a joke, you know. You read Agatha Christie and there it is he is behind you reading back there and you just wait in the subway, wait when the door starts closing. And just about halfway the door you jump out, right. And these tricks were common for us to joke with them.

Q: So you were there for two years?

Petar Kokotovic: No, one year only.

Q: Then did you go to the States?

Petar Kokotovic: Yeah. Back to Yugoslavia for a few months only. But from there I was on an organizing committee. Although I was in Russia, I was on the organizing committee of a Dubrovnik symposium. And then I became well connected with the top of the Russian of that Institute, which was also top of the Russian establishment in this area of science. For example, Alexandar Lyotov was the president of IFAC. He was a remarkable man. He was fluent in English. He had an international passport. He was one of the Soviets that could travel anywhere. So much so we became friendly and now that I asked him, recommend some theater shows here in Moscow to me. He said, “Oh, no, there are no theaters in Moscow. There are only theater museums. If you want to see some new plays, you better go to Broadway. Wait until you get to Broadway.” No Soviet would dare say this unless he was well – yeah, there were all of these remarkable people. So seven of them came to Dubrovnik as a package. So they called themselves, the movie was very famous then, “The Magnificent Seven”, remember that movie?

Q: Yeah.

Petar Kokotovic: So they called themselves the magnificent seven.

Q: Who else was in the magnificent seven?

Petar Kokotovic: The Russians. This was quite a representative group. Mark Aizerman. Yakov Tsypkin. Slava Emelyanov. Vadim Utkin was the youngest. Tolya Butkovski. Meerov. Rosenberg, maybe. Did I get to seven? Yeah. They were quite advanced. They stayed in Lapad, in a hotel there. And apparently that was a hotel where they would put the Soviets. At the same time, there was a delegation or a group of the Russian writers including their leading woman poet Bella Akhmadulina. And I remember it was a rainy afternoon. Nobody was swimming in Lapad Beach and I went swimming and whoop, a face appears from the water like one of those she was a bit of a Kalmik beauty; yellow porcelain or pink porcelain and so on. So we became friends and her husband was also a major writer, Nagibin. So we then organized that I was taking the tour of Russians by bus. And the Soviet writers union by two busses were returning together from Dubrovnik to Mostar; Mostar Beach to Sarajevo and so on. I have another Mostar Beach story but that's separate that we can do off because this says fantastic things about Mostar people. I will say it. In Mostar an elderly man was sitting, you know, with a fez and I was walking with Bella she was a true beauty, a striking beauty and showing her this and that. He

stands up comes and kisses her from one side, from the other side and Yuri was behind, her husband, he just got panicky. What's going on? The old man wasn't disturbed at all. The husband runs and he says in our language, "Are you the husband of this indescribable beauty?" And he congratulates him. This guy he just looks like – I was the translator. So then he, of course, wrote a story about it. Yuri Nagibin in his collection of stories because that describes Mostar in my terminology maximally. This was fantastic.

Q: So what were some other interactions between Eastern and Western scientists in this time?

Petar Kokotovic: Yeah, there was quite a bit. That was the time when I was even encouraged to invite Soviet colleagues. So we brought Emelyanov was invited to Urbana. Utkin stayed for a year as my guest in Urbana. Then Aizerman we got Emelyanov and Aizerman once together to – I have these pictures, it's funny them playing with my kids and so on. And for example Pontryagin and the group they came to MIT. The came to – oh yeah, about these connections you want to contact Professor Balakrishnan at UCLA. He has a movie of Pontryagin giving a lecture in 1969, '70 to I forgot when at UCLA. He would be more than happy to share this with you. Professor Balakrishnan. Speaking of which, have you heard of Boris Kogan? Yeah, this was one of the seven. Boris Kogan who is now probably 95 I think he still has an office at UCLA. He came to UCLA in his late seventies; a remarkable character. He was one of the lab directors in that institute. So he's a walking history. Last time I talked to him two years ago he was perfectly lucid. So I haven't been in touch lately but it's not hard to find him. Everybody at UCLA – he's kind of a legend. Everybody will know him. By the way he was in contact with Bekey. Maybe Bekey will know closer contact. There was another important name that I should mention who is among us Walter Karplus. So he did a lot for interactions. So he interacted with Yugoslavia and was a frequent visitor and then with Soviet counterparts with Boris, for example. He even arranged for Boris to come. I wasn't quite in the loop. Boris Kogan. And then there were official contacts as well. Apollo Soyuz was a major one. We had a joint meeting. This was only my second visit into Russia – well the first visit after I left. There were all sorts of also unpleasant things with visiting Russia especially if you were there before and then settled in the U.S. That was not in that way convenient.

But anyway in either '73 or '74 there was the Apollo Soyuz recapitulation reporting meeting that was held in a sports training center, near Yerevan in Armenia. This is where their Olympic team was practicing because that was the same elevation I believe as Mexico City. This was just before the Mexico City Olympics. And we were attached to that group, Apollo Soyuz. And there was just too much of intelligence supervision. I mean the spies all over so much so that when I came to my hotel room a ravishing blonde was sitting on my bed and saying can I do something to help you. I immediately walked out and went to the room of my colleague who was the director of the institute in Germany, Jurgen Ackerman, a very good friend. I said Jurgen come to my room and then both of us come to the room. And I said look this lady wanted to help me but what do I do now, I don't need any help? So she escaped, of course. But I saw her

around. She was part of the official group. But it was clear. So they wanted to trap you into some inconveniences and it was standard and take a picture or two and then blackmail you into cooperating. By the way, whenever you went to a trip a CIA person or FBI person would come and tell you that such things might happen. So to be very careful and avoid such traps because there would be cameras and so on that would embarrass you. Yeah, but this was a good meeting. Apollo Soyuz was a good progress and things, contacts went up and down depending on – the major change was, of course, with Khrushchev when he came to power.

Q: How did you wind up at the University of Illinois? And what kind of work was going on there in control?

Petar Kokotovic: Yeah, this was all due, as I describe this little autobiographic document, this was all due to Mac Van Valkenburg. So you will see the details there. He organized not for me to come to Illinois but he organized a series of lectures for me. So I gave lectures at about 20-30 institutions, universities but also research institutions in this country, which took about three or four months. In some places it would take two weeks, like a short course, which was in Urbana, Illinois and maybe at Berkeley and a couple of other places like this. At that occasion I made contacts with all sorts of American colleagues. And I did get several offers then. But Mac he really acted as my mentor so he was a very significant person, wonderful. So he says, why don't you stay in Illinois? I felt the atmosphere was so friendly, I don't know if you share my impressions, people were really fantastic. So I felt totally at home there. Here is the Illinois trio. These are the guys. Bill Perkins, Joe Cruz and myself.

Q: So which department?

Petar Kokotovic: Electrical engineering. But mostly coordinated science lab. This itself was a product of Cold War. It was first called control systems lab and was doing things for the Korean War, during the Korean War and then evolved to a multi-disciplinary lab. It's still there very successful multidisciplinary organization. And it was very enjoyable. You were with colleagues, 50 percent there, 50 percent in the department, electrical engineering department. So these were a wonderful 25 years. And if it weren't for Anna my wife who then belatedly, you know, went back – Reagan abolished her organization in helping the inner city kids – I mean abolished the grants for this, you know, like Head Start and these things lost under a very generous president. So she went back to get her Ph.D. and then in Urbana you don't get a job if you have a Ph.D. from that place. So then she got an appointment here and I said okay, time to change. Every 25 years I make this change a few more times.

Q: So you had encounters with Heinz Foerster and <inaudible>.

Petar Kokotovic: Yes. These were fascinating people when I first came to Urbana. And Heinz was easy to talk to. He was gregarious. And you would see him everywhere. You'd just ask one question you get a whole little story behind it and he would take you to whatever lab. It wasn't always clear what was in it but Heinz would always give very imaginative explanations. And it was very different with Ross fortunately. Through friends I had a very direct connection. So we would have almost weekly dinners at the friends' home because she cultivated this connection and she was not really in any technical field. So I got to know and basically to listen to him. I couldn't possibly follow any of those suggestions. I had too busy a career to basically maintain my own position and to develop the field in a different direction. But if I were in some area closer to where his ideas could be implemented this would have been fascinating but soon after he left. I met him '65, '66 and maybe '67. I don't whether he left in '67 or '68.

About Yugoslavia I want to say another thing. You know, that the father of cybernetics is Norbert Wiener, right? Well, he was also one of the early visitors because there was a conference on cybernetics in Opatija as early as 1960 or so. So Wiener came and then had a tour of Yugoslavia. I was assigned for a couple of days to take him around Belgrade. I still have some pictures. Some journalist wanted to have an interview like this so I arranged for this and we were sitting somewhere in Kalamegdan or somewhere they interviewed Wiener. The only thing that bothered me was his holding his cigar. I could smell that his fingers were burning and it didn't bother him at all. They were burnt for years probably. You know, you sit with somebody you smell the flesh burning. It's quite...

Q: So would you say there was a strong influence of cybernetics on early robotics?

Petar Kokotovic: Yes. This whole business if you read – I will have to leave now. If you read Wiener you will see that he already was enchanted by some pathological oscillations of human hand and so on. So that was definitely very influential. The whole cybernetics at that time was more of a – he coined a term that was more like a dreamland. And his book is called “Cybernetics: Human Use of Human Being”. So it's an interesting thing to read about John Von Neumann on one hand and Wiener on the other. One was hawkish militarized person. And Wiener, although he worked for military projects during the war, he on the other hand was human use of human beings. It was a very different person, different nature. I will tell you one vignette which was fascinating. This conversation goes at the lunch table. And I thought we were talking about this arm section from his book and all of a sudden he's talking about some irregular verbs in the Macedonian language. I was shaken. And I said finally it was clarified his father was some world linguist and as a kid – he was losing track obviously I said because of old age. And when I talked to people who took courses from him said no, no, that was always the case. But anyways he knew irregular Macedonian verbs and so on which somehow jumped into a conversation about cybernetics.

Q: Was there anything robotics going on in Illinois while you were there?

Petar Kokotovic: As I say, Robert Chen, Professor Chen had a robotics lab and this is when Scheinman hand was bought. So one of my students worked on Scheinman Hand. There were other things there not just the Scheinman Hand, but there were more on the software side. Chen was more of a software person. And then I should say later on Mark Spong came so that period was then characterized by the work of Mark Spong who wrote a book about, a textbook for it. And he also made small robots for laboratory experiments. One was called Pendubot. One was called Acrobot, little acrobats they were something or other. So he didn't go into sophisticated things but sort of elementary operations.