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Traveling in Japan

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<i>Abstract</i> <p>This is the research report which was sent to the Japanese Society for the Promotion of Science, JSPS. It is a documentation of traveling as well as research activities, conferences, people I met, discussions, etc.. during my JSPS postdoctoral fellowship at Tokyo Institute of Technology.</p>			
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Research Report

Ulf Holmberg

April 22, 1993

1 Research subjects in Japan.

I have a broad interest in control theory and its various applications. During my time in Japan I have had the opportunity to discuss different areas of control. When I came to Japan the plan was to make research about ideas close to *sliding mode control* and *variable structure control systems*. The purpose was to investigate the properties of having a relay or similar switching device in the feedback loop. My host researcher, Prof. Furuta, has worked in this field for some time and a Master student of his, Mr. Shioda, had chosen this as a topic for his thesis. I helped Prof. Furuta with the supervision of Mr. Shioda. I had meetings with Mr. Shioda every week throughout the year for discussing a recent published book : "Sliding Modes in Control and Optimization". The final title of Mr. Shioda's work is: "Variable Structure Control Based on Frequency Domain Model". I also assisted with proof-reading a manuscript "VSS Type Self-Tuning Control" written by Prof. Furuta. The final paper was then published in IEEE Transactions on Industrial Electronics, Vol. 40, No. 1, February 1993. Prof. Furuta also let me take responsibility as referee for reviewing a couple of submitted papers in the field of variable structure systems and sliding mode systems. I have also been giving seminars on different topics. One of these were part of a new course in *International Engineering*. There have been many guest researchers at Prof. Furuta's Lab. while I have been here. There have been opportunity to talk to Prof. Aoki from U.S.A., Prof. Mansour from Switzerland and Prof. Tsypkin from Russia. All very famous and with interesting research topics. My many dis-

cussions with Prof. Tsyppin has led to a common paper: "Robust Stochastic Modal Control". We have not yet published this article but it will be submitted to the International Journal of Control. A reprint is attached.

2 Conferences

I have visit two international conferences, one in Korea and the other in Tsukuba.

- IFAC 2nd Workshop on Algorithms and Architectures for Real-Time Control (AARTC '92)
- Second International Symposium on Measurement and Control in Robotics (ISMCR '92)

3 Trips

I have made four trips. Two of these were connected to the conferences described above. The other two have been for visit different universities in Japan.

- After the conference AARTC '92 in Korea I took opportunity to visit some universities in Korea. At the National Fisheries University of Pusan I visited Dr. Kim, Dept. of Mechanical Engineering. He showed the laboratory and we discussed mostly engineer education. One of his students, Mr. Kim (they all seem to have that name!) I met later once again on my trip to Kumamoto university. He had started the doctor course there. In Pusan I also visited the Korea Maritime University. There I talked to Prof. Ha, Dr. Rhyu and Dr. Yung Ho. There applications on ship steering was interesting for me. In Lund, my home control department, we have had PhD and Master theses on ship steering, both super tankers and submarines. I later met Prof. Ha again in Furuta Lab. He is a former student of Prof. Furuta and they have still close contact.

- In connection with the Robot conference in Tsukuba I took part of the technical tour to Tsukuba University and the research center.
- I made a two day visit to Kyoto University. There I had discussions with Prof. Araki about frequency response for discrete systems and fuzzy control. I also met Dr. Hagiwara and talk with him about "zeros of sampled systems". He had made some generalizations based on work by Prof. Åström, my former supervisor in Lund. A student, Mr Furutani, also showed me some results on controlling blood pressure on a dog. In the end they want to control humans. In Sweden we cooperate with the medical department for identification of the balance system of humans. It was therefore interesting to hear about another application of control of biological systems.
- My last trip was to Kyushu where I visited two universities, Kumamoto University and Kyushu Institute of Technology. I first visited Prof. Kawaji's Laboratory; the department of electrical engineering and computer science. There I mostly talked to Dr. Shiotsuki what I had learned from Prof. Tsympkin about robust stability. The students showed me the Laboratory. They made some demonstrations of which one was with a walking robot. There was also an inverted pendulum control system. All control laboratories in Japan seem to have at least one inverted pendulum. I gave a seminar there about "Chaotic motion". I also visited the department of mechanical engineering where Prof. Kashiwagi showed me his laboratory. His research was in the area of signal processing. He is president of the information center which he also showed me. At Kyushu Institute of Technology I met Dr. Kajiwara and Prof. Fuji who is head of the computer-aided control system design laboratory. I talked to Dr. Kajiwara about relay feedback systems and we used his tools to simulate one of my examples. Prof. Fuji showed me a new multivariable lab-process using magnetic levitation. In Sweden we have something similar, but only one dimensional.

4 Seminars

I have been giving some seminars where I have presented my own research and others research. They are listed below:

- *Relay Feedback of Simple Systems*. In this seminar I introduced parts of my research from my PhD thesis. It was given in Furuta Lab.
- *Robust Start-up of an Adaptive Controller*. I presented here parts of a PhD thesis from Lund. The author's name is by the way also Lundh. This seminar was given in a smaller group for students with a special interest in adaptive control.
- *Controller Design using Convex Optimization/Sweden*. This seminar was part of a new course called *International Engineering*. The purpose was to let foreign researchers present their topics in general terms such that students get more use to listen to seminars given in English. Also, the foreign researcher should spend some part of the seminar talking about his home country, differences in education system, social behaviour, cultural differences, etc.. In the last part of this seminar I made a presentation of Sweden, the life style and differences from Japan. The students had different backgrounds, not everybody was interested in control. The talk about Sweden, though, seemed to be interesting for everybody.
- *Chaotic Motion in Relay Feedback Systems*. This seminar was given in Kumamoto University at the department of electrical engineering and computer science. Some of the students had also made some research about chaos.

5 Papers

I have written a paper together with Prof. Tsypkin. The title is *Robust Stochastic Modal Control* and it will appear probably in *International Journal of Control*. A reprint is attached to this research report. JSPS is acknowledge appropriately. I will discuss the material with Prof. Åström after returning to Sweden. If he finds it

more appropriate in *IEEE Transactions, Technical Notes* it might instead appear there. In such a case it will be a shorter version of what is attached here.

6 Comments

I appreciate very much the social trips organized by JSPS. It means a lot to meet other JSPS Fellows, who are in the same situation, and exchange experiences about Japan. I have joined two hiking trips to Mount Mitake and one ski trip to Nozawa Onsen.