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Travel report from Australia,
Singapore and Korea.

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<i>Title and subtitle</i> Travel report from Australia, Singapore and Korea		
<i>Abstract</i> <p>This report gives a summary of Magnus Akke's visits to Australia, Singapore and Korea. An overview of the research is given together with a summary of impressions during visits at different universities.</p>		
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1. Introduction

During 5 months, from March 1989 to August 1989, I had the privilege to visit the Department of Electrical Engineering and Computer Science at University of Newcastle, N.S.W, Australia. In August I presented an article at IFAC-symposium in Seoul, Korea. I also visited

- Professor C.C. Hang, National University of Singapore.
- Professor Neville Rees, University of N.S.W, Sydney.
- Dr John Nichols, Sydney University of Technology, Sydney.
- Professor B.D.O Andersson, Australian National University, Canberra.

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- Statens Energiverk
- Magnussons fond (Australia)
- Sydkrafts Forskningsstiftelse (mainly to Seoul, Korea)

I want to express my sincere gratitude for this support and to thank the Department of Electrical Engineering and Computer Science in Newcastle for inviting me.

Section 2 contains a description of the research done during the time in Newcastle. The visit at University of Newcastle is summarized in Section 3 and visits to other universities in Section 4. Section 5 describes the IFAC symposium in Seoul. Section 6 contains the conclusions.

2. Research

During the stay in Australia my main duty was research in the area of power system stability. My work was supervised by Professor David Hill. I dealt with the three topics

- Matlab implementation of power system model with voltage dependent loads.
- Stable voltage control
- Power system stabilisation using tieline power.

Each of them are treated in separate subsections below.

Matlab implementation of power system model

A good model is the starting point for analysis and design. The importance of voltage dependent load models have been showed in Akke (1989a). The equations and ideas for a suitable model have been described in Bhatti and Hill (1987). To use this model for analysis and design it is necessary to implement it in a modern software package such as Matlab (Moler et al, 1987). All equations were rechecked (some errors corrected), rewritten in a form suitable for implementation, implemented

in Matlab and finally verified against Simpow (Lindqvist, 1985). The model has been used in the latter research.

Stable voltage control

This topic is described in detail in Akke (1989b) and the following is a brief summary. The motivation for this research are as follows. The main stream in power system stability research has been to apply additional signals, such as generator power or speed, to cure the stability problem caused by fast voltage control. The fundamental question, -how to make a fast voltage controller which does not cause instability ? has recieved very little attention and research on this is rare. A further motivation is that the analysis done in a leading textbook such as Bergen (1986) is erroneous.

The conclusions from the research are

- The relation of the complex poles and complex zeros of the open loop transferfunction are very critical for stability.
- By applying rules for drawing a root locus we can explain why the system can become unstable.
- A new second order voltage controller have been proposed. The new controller both gives fast voltage control and preserve the overall stability.

The new controller has succesfully been applied to a single generator infinite bus system, a two generator system and finally to a six generator design example.

Stabilisation by tieline power

The idea is to use tieline power as an additional signal to improve stability in power systems. Suitable references are Bolinger (1979); Parsa and Tayoda (1989). The approach aims to select low frequency modes between areas and increase the damping of those modes. More details can be found in Akke (1989b).

Both generators with proportional AVRs and the new AVRs proposed in the previous section have been investigated. The analysis method has been root locus. The results suggest that tieline power can successfully be used as a stabilising signal for modes where two areas are swinging against each other. It can both be used together with proportional AVRs as well as the new dynamic voltage controllers. It's most efficient to use feedback at both generators since this shifts the complex modes straight into the left halfplane.

3. University of Newcastle

I visited the Department of Electrical Engineering and Computer Science. The department also holds the Centre for Industrial Control Sci-

ence (CICS). The centre was established in 1989 by the Federal Government in an effort to concentrate academic effort on control problems of importance to industry. For more information about CICS, see the annual report (1989).

Staff

The staff at Electrical Engineering and Computer Science consists of two professors, two associate professors and a number of lecturers. The staff most closely associated with CICS are its directors, two administrative staff and six CICS-engineers. However, many of the staff members of the department have some involvement with CICS-projects. There are roughly 20 postgraduate students (Master and PhD) within the department and the CICS.

Research

The research interests at the department are,

Design of digital systems Dr R. Middleton.

Adaptive control Professor G. Goodwin.

Estimation theory Professor G. Goodwin, Dr C. DeSouza, Dr R. Middleton.

Robust control Professor G. Goodwin.

Industrial control Professor G. Goodwin, Dr R. Middleton.

Signal processing Professor R. Evans, Dr I. Webster.

Radar system Professor R. Evans.

Industrial electronics Professor R. Evans, Dr B. Cook.

Nonlinear system A/Professor D. Hill, Dr I. Mareels.

Stability theory A/Professor D. Hill, A/Professor P. Moyland.

Power system stability A/Professor D. Hill.

Power electronics Dr B. Cook, Dr B. Betz, Dr Sathiakumar.

Machine drive system Dr B. Cook, Dr Sathiakumar.

Electric machine theory Dr B. Betz.

Real time operating systems Dr B. Betz.

Application of AI to industrial control Dr B. Betz.

Teletraffic model estimation A/Professor P. Moyland.

The most interesting research projects are done by CICS and two examples are

Adaptive control project. The problem is to develop adaptive control methods to suit industrial control system. A prototype system with identification, robust design and controller implementation has been implemented on an IBM PC/AT with 386 processor. The system is believed to be the first adaptive controller to combine adaptation with robust design consideration.

Geosynchronous satellite tracking. To extend the life of geosynchronous satellites it is necessary that the ground based antenna system be capable of tracking them as they wobble in the sky. A full working system has been developed and tested in the field. The system is about to go into commercial production in Australia.

There are several more project in collaboration with Australian industry. My personal impression is that the CICS-engineers are highly qualified and professional. Furthermore the area for their work is very fruitful and fills a gap between academic theory and industrial applications.

4. Visits at other universities

National University of Singapore

During my travel to Australia, I made a stopover in Singapore and visited Professor C.C. Hang, University of Singapore. Professor Hang is working with adaptive control. I was showed the Department of Electrical Engineering and meet Dr Elangovan who is interested in power system stability. Hang also showed me a large research village next to the university. The research village is partly finished and partly under construction and aims to bring more industrial research to Singapore.

University of New South Wales, Sydney

I had the pleasure to visit Professor Neville Rees in the beginning of March. He showed me the various activities at their department. One successful project has been the simulator of Eraring power station.

Australian National University, Canberra

I had the pleasure to visit professor Brian Andersson's group in Canberra. I attended an informal conference between Department of Electrical Engineering from Newcastle and Andersson's group. The purpose of the conference was to meet informal and give the postgraduate students an opportunity to present their work.

Sydney University of Technology, Sydney

In July I visited Dr John Nichols who showed me a lot of interesting laboratory equipment. The department of Electrical Engineering had a variety of processes, mainly for educational purposes. Some of the processes where,

- Flying hoovercraft
- Ball-beam
- Steam engine
- Travers

5. IFAC Symposium in Korea

I attended and presented a paper at the International Symposium on Power System and Power Plant Control the 22-25 August in Seoul, Korea. The quality of the papers varied a lot, from excellent to less excellent. I meet Professor Malik from Canada, Dr Lim from Singapore, which I gave my licentiate thesis. I also saw a demonstration of a power system simulation program. The program was made by a Hong Kong chinese, previous working for DeMello at PTI. It was said that the program could do everything that PSSE could do and had some extra features. The user interface looked very nice.

6. Summary

The travels during 1989 have had a great influence on me both professionally and personally. The possibility to change enviroment and get inspiration through contacts with other people and groups has been very valuable for my research. Once agian I want to express my sincere gratitude to the funds and organisations that have made this trip possible. Finally I hope that this can inspire other to make the effort to do similar things.

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