SOME STUDIES ON HIGH GAIN FEEDBACK SYSTEM DESIGN

N. V. SURYANARAYANA

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INDIAN INSTITUTE OF TECHNOLOGY, DELHI

1989

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DEPARTMENT OF ELECTRICAL ENGINEERING

INDIAN INSTITUTE OF TECHNOLOGY, DELHI

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SOME STUDIES ON HIGH GAIN FEEDBACK SYSTEM DESIGN

by

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Thesis submitted in fulfilment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

To the

INDIAN INSTITUTE OF TECHNOLOGY, DELHI

JUNE, 1989

C E R T I F I C A T E

This is to certify that the thesis entitled "some studies on high gain feedback system design being submitted by NISHTALA VENKATA SURYANARAYANA for the award of the degree of Doctor of Philosophy to the Indian Institute of Technology, Delhi is a record of bonafide research work he has carried out under my supervision. The results contained in this thesis have not been submitted to any other university or institute for award of a degree or diploma.

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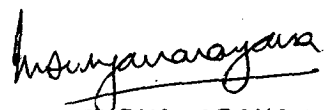
ACKNOWLEDGEMENTS

I express my deep sense of gratitude and appreciation to my supervisor Dr.M.Hanmandlu for his constant encouragement, in valuable guidance, useful discussions and critical suggestions during the course of this research work.

I thank the Director (Tech.Education) Delhi Administration,Delhi for having permitted me to undertake this research work. I am also thankful to my Principal Mr.K.Srinivasan formerly Principal Arya Bhat Polytechnic Delhi for his constant encouragement and support in carrying out this research work.

I am also very much indebted to Late Prof.A.K.Sinha, Department of Electrical Engg. for his initial encouragement and guidance, till his untimely sad demise in June 1985.

Finally I thank my wife and children who have put up with all the inconveniences during the duration of research work.



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Dated: 16.6.1989.

ABSTRACT

Singular perturbations occur in most of the physical systems by virtue of small time constants, masses etc. multiplying time derivatives or due to large feed back gains and weak coupling. Such systems suffer from ill conditioning which is due to the interaction of slow and fast modes present in them. These systems cannot be analysed by usual integration routines. The perturbation parameter underlying these systems is the ratio of speeds of slow and fast dynamics. When this tends to zero, the singularly perturbed system is seperated into slow and fast modes. The high gain feedback systems are a part of singularly perturbed system in that the gain is equal to the reciprocal of the perturbation parameter. The variable structure systems are similar to high gain systems.

The high gain system possesses certain properties like disturbance rejection, insensitivity to parameter variations. Another factor is that though considerable work in the practical use of singularly perturbed systems and variable structure systems is carried out, very little progress is made in new theoretical formulation and practical applications of high gain method. In this thesis this deficiency is met by developing two time scale and multitime scale decomposition and their application to practical systems such as power systems. The decomposition helps in the design of composite controllers and observers as shown in the thesis. The two time scale decomposition is also utilised in the development of

decentralised controller. A condition is derived to show the asymptotic interaction decoupling when the interactions are unknown. The multi time scale results developed in this thesis are spacific and simple. The general decomposition results are also available but are complicated due to involved procedure in seperating.

PUBLICATIONS

Papers Published

1. Multi time scale decomposition of a high gain feed back system - Int.J.Control 1986, Vol.44, No.1, 17-41, U.K.

2. High gain feed back design applied to AGC of an interconnected Power System - Electric Machines and Power System 13: 149-161, 1987. U.S.A.

3. Automatic Generation Control using singular perturbation approach - Electric machines and Power System, U.S.A. Vol.14/1, August 1988.

Papers communicated:

4. High gain stabilizer for a multi machine power system - IEEE Trans. on Power Apparatus and Systems, USA.

5. High gain Decentralised Control - International Journal of Systems Science, Taylor & Francis Ltd, London (U.K.)

6. High gain observer - Electric machines & Power Systems U.S.A.

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