CHAPTER VIII

CONCLUSION AND SCOPE OF FURTHER WORK

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The present work is a report of our experiments with the application of different methods of applied cybernetics in electrical power industry.

In chapter III we have developed the hourly flow simulation technique with the cybernetical method of recursive least square instrument variable algorithm with on-line parameter tracking adaptiveness. The effectiveness of the developed technique has been demonstrated with the field data observed at the different gauging stations of the hilly river Teesta in North Bengal.

The seemingly complex algorithms and high performance computational requirements have in the past limited the application of estimation techniques to aerospace technology and missile guidance system where there are high cost performance tradeoffs. Recently, LSI microprocessors have had a dramatic impact in the control of data processing area. LSI and VLSI technology have advanced so rapidly that the current high performance microprocessors have the computational capabilities to implement estimation and control algorithms. In this part sufficient details of the recursive least square instrument variable algorithms are given with associated

parameter tracking adaptiveness in the instrument variables including real time experiments to allow one to assess the requirements and capabilities of microprocessor based estimation algorithms for real time monitoring of hourly river flows and for on-line controlling of the hydraulic structures of the large size run-of-the river hydroelectric plant. The ability of the algorithm has not yet been tested on real world problem.

In chapter IV a mathematical description of annual electrical energy consumption in India has been developed with population, gross national product, gross domestic saving and gross domestic capital formation as exogenous variables in the form of a polynomial of optimum complexity with the help of a learning identification technique known as the multilayer group method of data handling algorithm. The model is found to simulate adequately the effects of interactions of different techno-economic parameters on annual electrical energy consumption.

The modelled data are found to be in close agreement with the observed ones. From the results of the illustration it is observed that multilayer group method of data handling technique is capable of ascribing structure on processed data by providing missing information to systems with uncertainties operating in a complex behavioural environment. Other techno-economic and socio-economic parameters e.g. national

productivity index and indices showing the quality of life of the people can be incorporated in the developed model.

In chapter V the model of annual installed plant capacity of electrical energy of India has been obtained in the form of polynomial of optimum complexity by computer aided self-organisation of mathematical models. Desired rate of growth of annual installed plant capacity and annual energy consumption have been assumed. On the basis of the growth rates the polynomial models of optimum complexity have been obtained for annual installed plant capacity and energy consumption. A model for plant annual load factor has also been obtained. The models can be used as handy tools for planners of power industry.

The polynomial models presented in this work are found to simulate adequately the variations in the observed data. The models are handy tools for planners of power industry. A close look into the model for plant annual load factor will bring out many important features of Indian power industry. This discussion has been kept outside the purview of our present research interest.

In chapter VI we have developed State Estimation technique which provides a powerful tool to obtain a data base for on-line supervision and control of power system. In this work recursive type least square technique with parameter

tracking algorithm has been used to obtain the estimation of the power system state variables. Incorporation of the parameter tracking algorithm makes the states estimator amenable to on-line operation. The estimates of the states will help in selecting on-line contingency plan. An illustration is given to show the application of methods and the software developed.

The tracking state estimator developed above has been illustrated using only one snapshot of measurements. It can handle the slowly varying characteristics of the power system and thus is capable of functioning properly under discretetive on-line operating conditions.

This part presented a new type of state estimation algorithm. This algorithm is suitable for both estimating on real time basis the static states and quasi-dynamic states for on-line operation. The algorithm has fast converging characteristic since it does not involve matrix inversion. The approximations used in this method were shown not to have any negative impact on the discriminatory ability of the data detection and identification process. Since the sequence of operations, during iterations for static states as well as for recursive estimation of quasi-dynamic states for on-line operation, is identical for both $e(.)$ and $f(.)$ systems, the modularization of the algorithm and the use of structured

programming are possible. However, it is believed that much effort is still needed for real life application of the developed algorithm.

In chapter VII Gauss-Seidel load flow with optimally ordered nodes by dynamic programming algorithm of applied cybernetics has been described. Algorithm has been illustrated on IEEE 14 Bus System. It has been observed that the computational efficiency is improved with optimal ordering by dynamic programming algorithm.

The Gauss-Seidel load flow with dynamic programming algorithms have improved the computational efficiency of the load flow analysis. The convergence of load flow calculation is quick. SPECTRUM/ -3 microprocessor of DCM data products was used for calculation. Because of the memory limitations higher order bus system could not be tested. It is hoped that number of iterations will be drastically reduced if other fast converging load flow methods are used.

Investigation, carried out in this work, has helped in developing necessary softwares for off line planning and on-line control of electrical power industry. It also shows that cybernetical methods are powerful tools for analysis the different aspects of electrical power systems.