CHAPTER I

I N T R O D U C T I O N

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The present investigation is an account of our experiments with the applications of different cybernetical tools to the real world problems of electrical power industry. The investigation deals with the five broad aspects of electrical power industry namely,

(i) On-line simulation of hourly river flows for run-of -the river hydroelectric plant ;

(ii) Electrical energy consumption model with interacting parameters by a learning identification algorithm ;

(iii) Medium-term and long-term prediction models of annual installed capacity and consumption of electrical energy by computer-aided self-organisation of mathematical models ;

(iv) States estimation of electrical power systems by a tracking algorithm ; and

(v) Gauss-seidel load flow with optimally ordered nodes by dynamic programming algorithm.

The practical implementability of different methods of applied cybernetics and pattern recognition such as recursive least square instrument variable algorithm with on-line adaptiveness in parameter variations, multilayer and combinatorial group method of data handling algorithms of computer-aided self-organised learning identification technique, least square recursive states tracking algorithm and dynamic programming algorithm of optimum nodes ordering technique for power networks have been demonstrated. Wherever necessary modification and improvement of the existing analytical techniques have been suggested for practical implementations. The computational procedures have been developed in well organised programme packages in high level software.

The report contains eight chapters. The contents and the scope of the individual chapter are briefly described below :

1.1 Scope of the Work

1.1.1 Chapter I

The chapter I deals with the introduction and the problem of investigation. It contains the scope of the work and the sources of data.

1.1.2 Chapter II

The chapter II deals extensively with the survey of the existing literature and the state of-the-art. It discusses the effectiveness and the shortcomings of the previous works. It exposes gradually the harmonious evolution of the scientific thoughts pertaining to the present investigation.

1.1.3 Chapter III

The chapter III deals with the on-line simulation of the hourly river flows for run-of-the river hydro-electric plant. It develops 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 field data observed at the different gauging stations of the hilly river Teesta in North Bengal.

1.1.4 Chapter IV

The chapter IV develops a mathematical description of annual energy consumption in India 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 multilayer group method of data handling algorithm. The developed model is found to simulate adequately the effects of interactions of different technoeconomic parameters on annual electrical energy consumption.

1.1.5 Chapter V

In chapter V a 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 rates 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 in the form of a polynomial with harmonic terms. The developed models can be used as handy tools for planners of power industry.

1.1.6 Chapter VI

It is observed that the state estimation technique provides a powerful tool to obtain a data base for on-line supervision and control of power system. In this chapter 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 state 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 the method.

1.1.7 Chapter VII

This chapter deals with the Gauss-Seidel load flow technique of electrical power networks with optimally ordered nodes by dynamic programming algorithm of applied cybernetics. The algorithm has been illustrated with IEEE 14 Bus System. It has been observed that the computational efficiency is improved with optimal ordering by dynamic programming algorithm.

1.1.8 Chapter VIII

This chapter concludes the report. The specific areas of further research are suggested. At the end a list of referenced bibliography is enclosed.

1.2 Sources of Data

Data pertaining to the Teesta river system have been obtained from Jalpaiguri Field Division of the Central Water Commission, Government of India.

Data relating to the electrical energy consumption models with interacting parameters have been obtained from the Economic Survey, 1981 - 82, Government of India.

Data pertaining to medium term and long term prediction models of installed plant capacity and electrical energy consumption have been obtained from the Sixth Five Year Plan, 1980 - 81, Government of India.

Data relating to the state estimation of electrical power system have been obtained from the 5 - Bus network given in Computer Methods in Power System Analysis - G.W. Stagg and A. H El- Abiad, McGraw Hill, 1968.

Data for illustration of dynamic programming algorithm for optimum ordering of nodes have been obtained from IEEE 14 Bus system.