SOME DETERMINISTIC AND STATISTICAL SENSITIVITY STUDIES IN NETWORK SYNTHESIS

MAHESH CHANDRA SRIVASTAVA

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ABSTRACT

This thesis deals mainly with certain deterministic and statistical sensitivity aspects of network synthesis.

In considering network sensitivity due to parameter variations, if the changes in the element values are small, a worst case design can be carried out within allowable tolerance by preadjusting the nominal element values resulting from a conventional design. In many instances, however, it is reasonable to view the output of a synthesis procedure as merely a starting point. Also, the practical requirements in such cases may be satisfied by seeking a suitable equivalent net-work, with minimum sensitivity to parameter variations, from among a class of continuously equivalent networks or equivalent minimal state-space realizations. In addition to sensitivity considerations in deterministic networks, appropriate statistical sensitivity measures may be used in case of networks having random distribution of their parameters. Finally computer aided design, which is assuming great significance in cases where exact synthesis procedures are not available, may be adopted for minimum sensitivity statistical design.

The thesis begins with a brief review of various filter realizations using DIOA, tolerance minded design of filters, deterministic and statistical sensitivity

minimization and computer aided probabilistic design of network in Chapter 1.

Recognizing that, in addition to sensitivity aspects, satisfactory distribution of element values and minimum number of elements required for realization are important from consideration of manufacturing cost, Chapter 2 of the thesis deals with the economic realizations of all the basic active RC filters (suitable for low Q specifications) using a single operational amplifier. Further it is shown that one circuit configuration can lead to several types of filter realizations having the same Q simply by short-circuiting or open-circuiting certain elements, thereby reducing the manufacturing cost.

Tolerance minded design of active band pass filter has been discussed in Chapter 3. It is shown that the design of the filter can be substantially improved by preadjusting, i.e., purposely changing the nominal element values resulting from a conventional design.

An algorithm for the deterministic sensitivity minimization of an impedance function using minimal state space algebraically equivalent realizations has been developed in Chapter 4.

The statistical sensitivity minimization for a network function having non-symmetric distribution of parameters with nonzero mean has been considered in Chapter 5.

A new sensitivity criterion is proposed for minimizing Q and ω_n sensitivities in filter design. It is equal to the weighted sum of Q and ω_n sensitivity functions developed in the Chapter.

In Chapter 6, the statistical sensitivity aspects have been considered from a different point of view. A computer-aided procedure for the estimation of 'Optimum' parameter moments for realizing the desired response moments has been discussed in this Chapter.

Concluding Chapter 7 summarizes the main results presented in the thesis and also contains a discussion on the scope of further work.

TABLE OF CONTENTS

TABLE OF CONTENTS (Contd.) Page No.

TABLE OF CONTENTS (Contd.) Page No.

TABLE OF CONTENTS (Contd.)