

CHARACTERIZATION, MEASUREMENT AND COMPENSATION OF TRANSFER
INEFFICIENCY OF CHARGE TRANSFER DEVICES

A Thesis

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DOCTOR OF PHILOSOPHY

in Electrical Engineering

by

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CERTIFICATE

This is to certify that the thesis entitled, "Characterization, measurement and compensation of transfer inefficiency of charge transfer devices," being submitted by Mr. Vuppuluri Gurusaran Das to the Electrical Engineering Department, Indian Institute of Technology, Delhi, for the award of the Degree of Doctor of Philosophy, is a record of bonafide research work carried out by him under my supervision and guidance and in my opinion, it has reached the standard fulfilling the requirements of the regulation relating to the degree.

The results contained in this thesis have not been submitted to any other institute for the award of any degree or diploma.

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ABSTRACT

This thesis deals with the measurement and characterization of the inefficiency of the Charge Transfer Devices (CTD), and methods for compensating the same. A generalized model of the CTD is developed which takes into account the non-uniformity of the transfer inefficiency of the various stages. A new method, based on pre-distortion of the input signal, is developed for accurate measurement of the average and the standard deviation of the inefficiencies of various stages of the CTD. A detailed study of the exact compensation scheme of a CTD delay line using external feedbacks is made and a tuning algorithm for setting the feedback coefficients is developed. The effect of compensation on the signal dynamic range is studied. The sensitivities of the time delay and the magnitude response to the feedback coefficient settings and to the transfer inefficiency parameter are evaluated and it is conclusively established that the first few feedbacks are the dominant ones. The effect of limiting the feedbacks to the dominant stages on the performance of the CTD in time and frequency domains is studied. Conditions for stable operation of a CTD with truncated feedback compensation are established. Experimental evidence showing the practicability of the scheme is presented. Several FIR and IIR sampled data filters have been developed which, when connected externally in series with the CTD, compensate for the effect of its transfer inefficiency. Techniques for optimizing the filter coefficients so as to achieve equiripple magnitude response have been developed.

By means of a filter structure using both feedback and feed forward connections very low magnitude and phase deviations have been achieved even with CTD's having large transfer inefficiencies.

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