AN INVESTIGATION INTO SCATTERING OF SURFACE ACOUSTIC WAVES AT A GROOVE IN ACOUSTIC WAVE DEVICES

By

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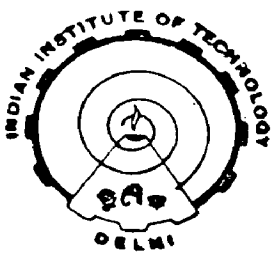

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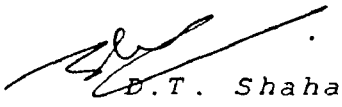
CERTIFICATE

This is to certify that the dissertation entitled, "An investigation into Scattering of Surface Acoustic Waves at Groove in Acoustic Wave Devices" which is being submitted by Mr Varun Jeoti to the Indian Institute of Technology, Delhi, is record of bonafide work carried out by him under my guidance an supervision.

In my opinion, this dissertation has reached the standar fulfilling the requirements of all the regulations relating, t the degree. The results contained in it have not been submitte in part or in full to any other university or any institute fo the award of any degree or diploma.



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(Varun Jeoti)

ABSTRACT

The motivation for the present work stems from the realization that the grooves form an alternate source of excitation (albeit secondary) of acoustic waves on elastic substrates. The objective of this thesis is, primarily, to analyze and understand the scattering of surface acoustic waves (SAW) at a rectangular groove and the properties of waves excited therefrom.

The problem of scattering of SAW is solved using the modes of the parallel acoustical plate waveguide. A half space is considered as the limiting case of such a plate when the thickness approaches infinity and detailed analysis is carried out to verify the scattering data available on the idealized half space. The use of the modes of parallel acoustical plate waveguide also allows extension to the analysis of thin plate devices such as planar bulk wave devices. However, in this case there is insufficient data for comparison.

It is assumed that when a groove perturbation exists along z-direction (the propagation direction) on the surface, the perturbed field can still be given by a superposition of all the modes of the plate waveguide, only that the modal coefficients now become a function of z. These coefficients are solved for by making use of known properties of the groove. Traditionally, the free surface boundary condition on the groove has been used to find the equivalent change in boundary condition over the region of groove on the unperturbed substrate. The method is generally called as boundary perturbation method or surface perturbation

method.

Alternatively, the groove can also be looked upon as an inhomogeneity near the surface where the mass density and the stiffness constants are zero. Such a method is called volume perturbation method. The problem of scattering is formulated using the volume perturbation method. It is shown that the two formulations are identical. The surface perturbation method is seen to be limited by the slope of the boundary shape. In fact, an ideal rectangular groove with vertical walls has posed considerable conceptual difficulty and, therefore, the solutions have so far been attempted only in a limiting sense. On the other hand the volume perturbation method which does not depend on the shape of the groove can always be applied.

Besides the formulation of scattering of SAW at a groove, efforts have also been made to analyze the response of a planar bulk acoustic wave device so as to be able to develop design criteria leading to an efficient device. The main motivation behind this work was an obvious lack of rigor in making these devices -- devices seem to have been made on whichever substrates were available. The result of this exercise is in form of a graph describing the range of angles over which a given material is more efficient than the others. These have been verified with the results of an independent optimization technique.

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