ABSTRACT

Micro-Electro-Mechanical-System (MEMS) is a new technology used to fabricate the components in miniature form in all engineering fields. The association of MEMS technology with Opto electronics has resulted in a new field called Micro-Opto-Electro-Mechanical-Systems (MOEMS). Micro–Electro-Mechanical-Systems (MEMS) devices have been increasing in popularity for display systems due to the ability of MOEMS devices to improve the performance of the system. The work described in this thesis is concerned with a MOEMS display device called Grating Light Valve (GLV). This thesis explains the fringing field effect in GLV, a method to improve the reflectivity of GLV and focuses on applications of Grating Light Valve in image processing systems.

This dissertation reports on the electrical coupling of micro ribbons in Grating Light Valve. Electric field coupling is due to the extension of electric field beyond the edges of micro ribbons in GLV. It is called fringing field. Considering the displacement of micro ribbons in GLV, the fringing field has significant impact in system efficiency. The fringing field is a source of error which mainly reduces the efficiency of electrically conducting microstructures. Due to this fringing field a small amount of voltage is induced in the nearby conductor and produces actuation in that conductor even when it is in biasing condition. Considering the size of the MOEMS component, a very small actuation or displacement produces a notable change

in the result. So finding the impact of the fringe field is an unavoidable part of any MOEMS design and particularly may have essential influence on micro beam dynamics because they appear in all orders of motion, including linear one. A mathematical model has been proposed here to investigate the fringing field effect in Grating Light Valve. The numerical results of fringing field induced voltage and the deflection of biasing ribbon due to fringing field has been identified and also its corresponding shift in ideal deflection of active ribbon are given in comparison with the software simulation using CoventorWare. The numerical result of deflection in biasing ribbon obtained through the mathematical analysis was compared with CoventorWare results with same parameters. The CoventorWare result matches with our Electrostatic solution. The reduction in the ideal deflection depth, in turn reduces the intensity of the output signal. The change in intensity of the output light signal is also identified. This report also explains a new structure to improve the reflectivity of GLV and thereby increasing the efficiency of the system. The new structure is obtained by adding a stack comprising of high and low refractive index materials on the top surface of the ribbon in existing GLV. This thesis also focuses on applications of Grating Light Valve in image processing systems. The crux of this thesis is to explain the fringing field effect in Grating Light Valve and to improve efficiency of Grating Light Valve so that light signal can be handled in a better way to bring out the special features of signals and images while processing.