CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE THESIS

Customers today are demanding smaller, lighter and cheaper products with more features. Manufacturers are therefore being forced to develop technology that satisfies these demands. Smaller and lighter implies reduction in size of the systems without degrading the performance. A Micro Electro Mechanical System (MEMS) is the relevant technology to fulfill the desires of customers. MEMS with Opto electronics is called Micro Opto Electro Mechanical Systems (MOEMS) technology. It is also called as Optical MEMS. Optical MEMS devices currently find success in many established products. The development of Optical MEMS devices followed naturally from the development of Integrated Circuit (IC) fabrication technologies. The performance and cost gains achieved by miniaturizing the systems have led to an interest in this topic. Optical MEMS are extremely small and can therefore be capable of faster, more precise and more reliable operation than their larger mechanical counterparts. The areas where performance, size, cost benefits can be realized using Optical MEMS are almost unlimited. Optical MEMS offer consumer electronics industry, great hope for enhanced functionality. Optical MEMS is an enabling technology allowing the development of smart product, augmenting the computational ability of microelectronics with the perception and control capabilities of micro sensors, micro actuators and micro fluidic system and expanding the space of possible design for automotive applications. Integration across

several disciplines takes place in this field. In recent years, the projection display industry has undergone a period of explosive growth that drags the attention towards this area. Until several years ago, projection display systems were mainly based on either cathode ray tube or liquid crystal display technology. The Optical MEMS technology brings revolutionary changes in display technology. The invention of Grating Light Valve is a milestone in diffractive optical displays. The tremendous switching speed and very small size of this device turned the attention towards this direction.

1.2 OVERVIEW OF THE THESIS

Chapter 2 begins with an introductory section including an over view of Micro Electro Mechanical Systems. Starting with the introduction of MEMS technology it provides the literature review on Grating Light Valve. This topic presents the preview of the recent works carried out in Grating Light Valve by various scientists. MEMS with Opto electronics called Micro Opto Electro Mechanical systems (MOEMS) technology and their various systems are presented. Subsequently, it discusses the structure, functions and features of Grating Light Valve (GLV), a key component taken for discussion in this thesis. This chapter further describes the CoventorWare software used for analysis. It concludes with a theory of electrostatic actuation principle of micro components.

Chapter 3 presents the impact of fringing field in Grating Light Valve. Inception of this chapter explains the fringing field and its mathematical model in micro ribbons used in Grating Light Valve. Result obtained through mathematical model shows that there is an effect of fringing field in Grating Light Valve which deflect the biasing ribbons in GLV. The deflection of biasing ribbon shifts the reference plane and thereby reduces the intensity of output light signal obtained from the Grating Light Valve. The

result was compared with the CoventorWare result and it gives good matching. With the said theme and obtained result, a paper titled “Impact of Fringing field in Grating Light Valve” was sent for the publication in the Journal of Optics, an internationally referred journal from optical society of India and that was published in October- December 2006, volume 35, Number 4 issue.

Chapter 4 introduces a structure to improve the reflectivity of the Grating Light Valve thereby increasing the efficiency of GLV. Software model and mask layout of the improved structure is arrived using CoventorWare software. Moreover the reflectivity, deflection and capacitance of the ribbons of this new structure are measured. The reflection pattern shows that the reflectivity of the ribbon is increased. The paper titled “ High Reflectance Optical Thin film Grating Light Valve” was published in Journal of Optics, volume 36, No.3, July-September 2007 issue.

Chapter 5 explains a new application called edge detection using GLV. The inherent very small size of the Grating Light Valve pixel helps to improve the crispness of the edge detected image. A paper titled “Crisp Edge detection using Grating Light Valve” was presented in the International Conference organized by IEEE Madras chapter ADELCO 2007. This paper was published in the conference proceedings.

Chapter 6 explains the application of GLV as image filter. It is possible by changing the width and deflection depth of ribbons, which in turn tunes the pixel to deliver a single colour. Width and deflection depth of the GLV ribbons are different for R, G and B colours. Using this concept, with the inherent high switching speed of GLV, it is possible to design a wavelength image filter which split the R, G, B colours from the chromatic image in real time. The paper titled “Micro-machined Non-Linear Wave

length Filters for Image Acquisition" was published in the International Journal of Imagin Science and Engineering (IJISE), GA, USA, ISSN Vol. 1 No. 1, January. 2007. Technology Foundation for Research and Engineering in January 2007.

Finally, Chapter 7 gives the conclusion of this thesis and discusses possibilities for future scope of this work.