

Performance Analysis of Digital Micro Mirror

Laxmi¹, Nisha Raheja²

P.G. Student, Department of Electronics and Communication Engineering, OM Institute of Engineering and Technology, Hisar, Haryana, India¹

Assistant Professor, Department of Electronics and Communication Engineering, OM Institute of Engineering and Technology, Hisar, Haryana, India²

ABSTRACT: This research work starts with a brief introduction to the DMD device, which is the heart of DLPTM technology. In optical and point-to-point communication, various micro mirror devices have been used to reshape the wavefront of a propagating beam to recompense for aberration in the beam path. To improve the stress in the mirror geometry new mirror geometry is proposed in this thesis to reduce stress in the mirror. The main objective of the thesis is to design an advanced digital micro mirror Experiments has been performed. To achieve the best results, experiments are carried out on length, thickness.

KEYWORDS: Aaberration, intrinsic, compression, recompense, counterparts.

I. INTRODUCTION

One method of creating DMD spring -like structures or inducing twist in plated structures is to plate materials onto a substrate such that the layer has a remaining stress after the plating process. The plating process can control this stress, which can be compressive or tensile, even for similar materials. The automotive industry has studied this phenomenon at length because highly stressed chrome is considerably shinier than nonstressed chrome. This section shows the fundamentals of how to set up and solve lift-off of a prestressed plated device.

II. MODEL DESIGN

1. GEOMETRY DESIGNING FOR FOUR*TWO LEG MIRROR

In the first step we will design five squares according to the dimensions given in the table (1).

NAME	SIZE	BASE	POSITION	
			X	Y
SQ1	1	CORNER	0	0
SQ2	0.2	CORNER	0	1
SQ3	0.2	CORNER	1	0.8
SQ4	0.2	CORNER	0.8	-0.2
SQ5	0.2	CORNER	-0.2	0

The initial geometry after creating squares is looks as given below in the figure (1.1):

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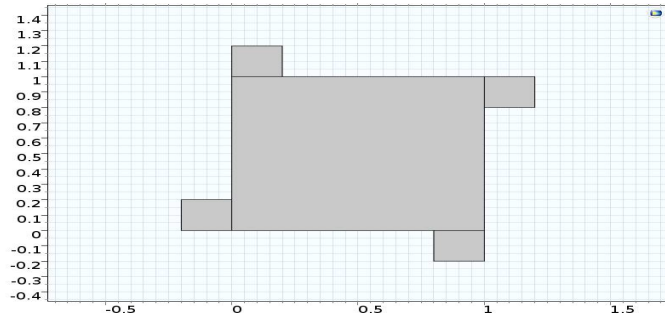


Fig 1.1: The geometry with the five squares.

Next chamfering of each of the corners are done .The figure obtained after chamfering is shown below in Fig (1.2).

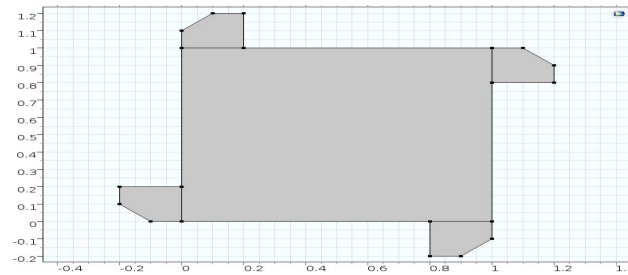


Fig1.2: The mirror geometry after chamfering.

Next we will design four*two springs around micro mirror.

Table 2: Table showing measurements of all rectangles.

Rectangle name	Width	Height	Position	
			X	Y
R1	0.025	0.9	1.125	-0.1
R2	0.9	0.05	0.2	1.15
R3	0.9	0.05	-0.1	-0.2
R4	0.025	0.9	-0.2	0.2

Geometry of mirror after designing eight rectangles around it looks like in the figure (1.3)

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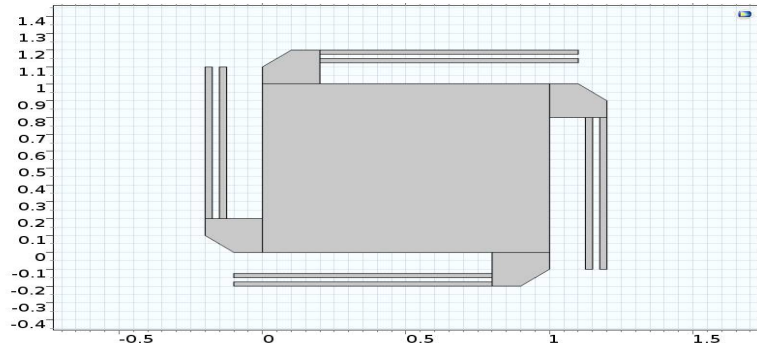


Fig 1.3: The geometry with the springs added.

1.1 MESHING

In this step we will create a mesh structure. In meshing we divide the whole geometry into smaller elements then extrude it into 3D to produce a mesh with hexahedral (brick) elements. This way you can have the mesh create structured elements with a high aspect ratio.

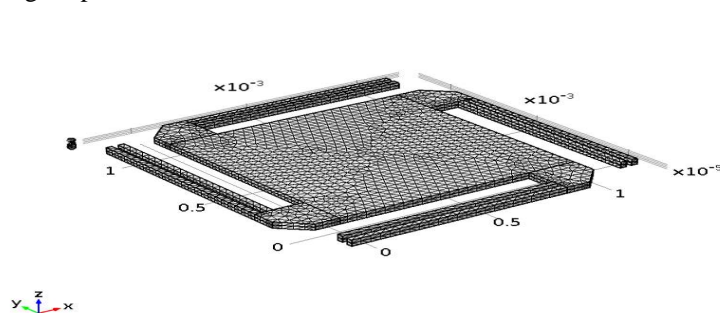


Fig 1.4: The geometry after extruding the mesh into 3D.

1.2 APPLYING MATERIAL

For applying material, on the **Home** toolbar, click **Add Material** to open the **Add Material** window, in the tree, select **Built-In>Aluminum**. Click **Add to Component** in the window toolbar. By default the first material you add applies to all domains, so you do not need to change the settings in the **Geometric Entity Selection**.

1.3 APPLYING BOUNDARY CONDITION

The next step initial stress and strain is applied to different domains. For initial stress “+Stress” is applied to sub domains 4, 6, 8, 10, 18, 24, 26 and 18 (fig1.5a) and “-Stress” is applied to sub domains 3, 5, 7, 9, 15, 17, 23 and 25 (fig1.5b).

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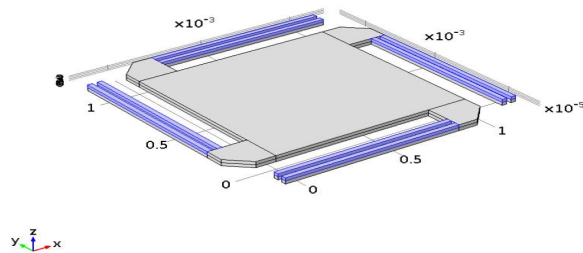


Figure 1.5(a): Applying (+Stress)

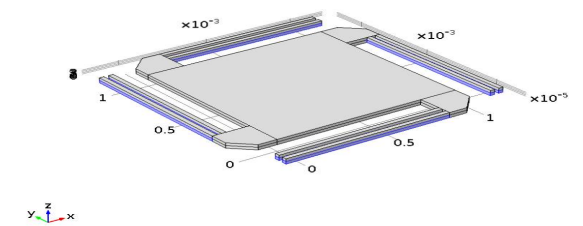


Figure 1.5(b): Applying (-Stress)

1.4 GEOMETRY DESIGNING FOR FOLDED LEG MIRROR

Initial geometry is same as four*two leg mirror.

The geometry with four added springs around micro mirror is same as previous mirror

Table 3: Table showing measurements of all rectangles.

Rectangle name	Width	Height	Position	
			X	Y
R1	0.9	0.1	0.2	1.1
R2	0.1	0.9	1.1	-0.1
R3	0.9	0.1	-0.1	-0.2
R4	0.1	0.9	-0.2	0.2

:

These springs create a folded geometry as shown in the figure (1.6).

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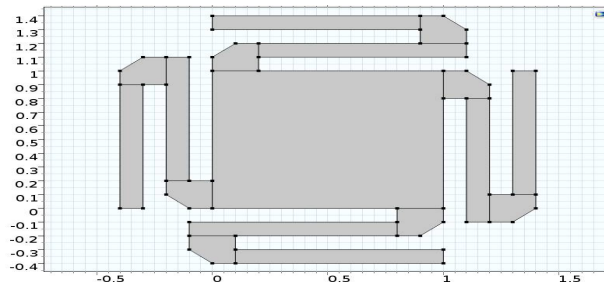


Fig 1.6: The folded geometry with the springs added.

1.5 MESHING

In this step we will create a mesh structure. In meshing we divide the whole geometry into smaller elements.

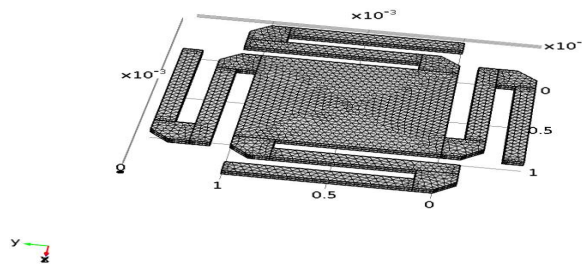


Fig 1.7: The geometry after extruding the mesh into 3D.

1.6 APPLYING BOUNDARY CONDITION

The next step initial stress and strain is applied to different domains. For initial stress “+Stress” is applied to subdomains 2, 4, 8, 10, 12, 18, 20, 22, 26, 30 and 32 and “-Stress” is applied to subdomains 1, 3, 5, 7, 9, 11, 17, 19, 21, 25, 29, 31, and 33.

III. RESULTS AND ANALYSIS

One of the key process parameters we wish to determine in this class of problem is generally what prestress level is necessary to result in a desired lift-off. To analyze these parameters we have designed and analyzed basic four leg mirror and new proposed four*two legs mirror, folded leg mirror. For study and results following steps are performed:

Figure (1.8) shows deformation in the mirror at 4 GPa. Mirror is deformed 154 um at the center of the mirror.

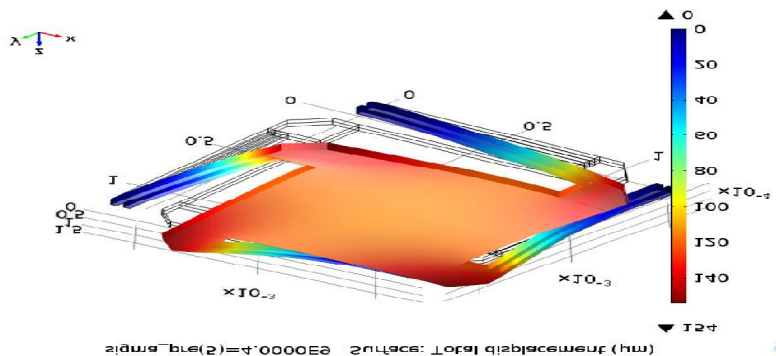


Figure 1.8: Displacement in Four*Two Leg Mirror

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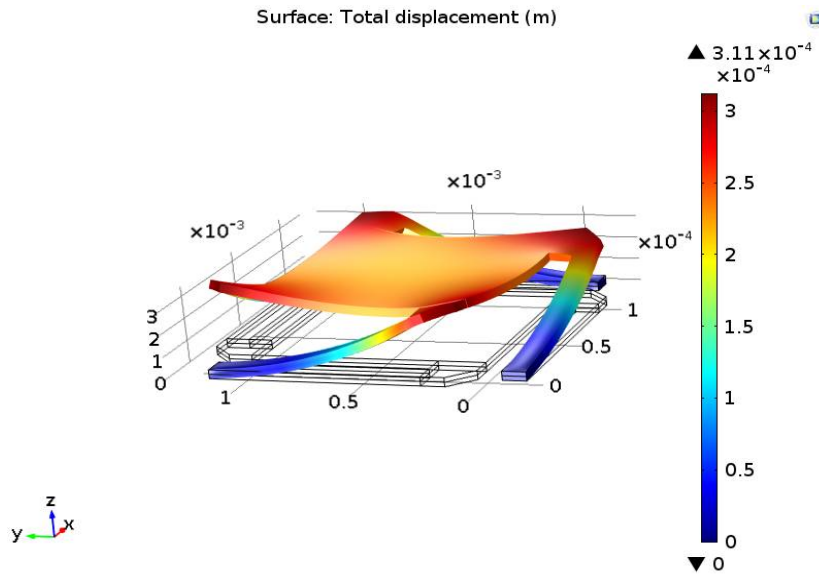


Figure (1.11): Displacement in Four*Two (folded Leg) Mirror

Figure (1.12) shows the stress in the mirror is 3.5 Gpa.

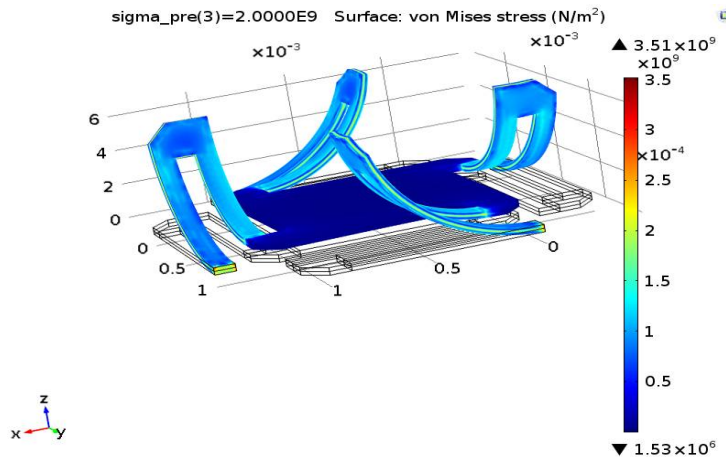


Figure (1.12): Stress in Four*Two (folded) Leg Mirror.

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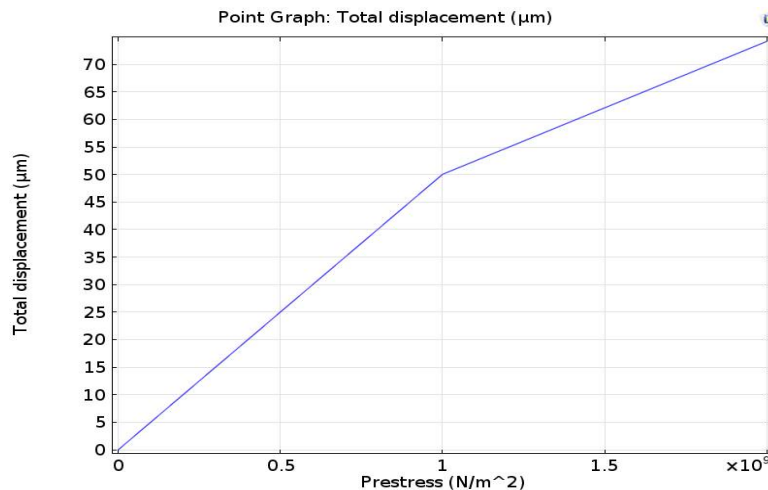


Figure (1.13): Lift-off in Four*Two Leg Mirror.

Figure (1.13) shows the center point deflection is almost linearly dependent of the prestress.

IV. CONCLUSION

The results of the proposed micro mirror are analyzed in terms of less induced stress along edges of micro mirror due to lift off, least surface deformation during lift off and maximum displacement of the micro mirror. The maximum displacement of proposed four*two leg mirror is $154 \mu\text{m}$. The maximum stress is given by 5.58 GPa. The stress is higher in the legs and lower on the mirror surface. At 2 GPa prestress the new proposed folded leg mirror is lifted $75 \mu\text{m}$ at the center of the mirror and stress is 5.58 Gpa. So by using this new proposed mirror in automotive industries we obtain better results

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