

# Modelling and Simulation of Mechatronic Systems Project

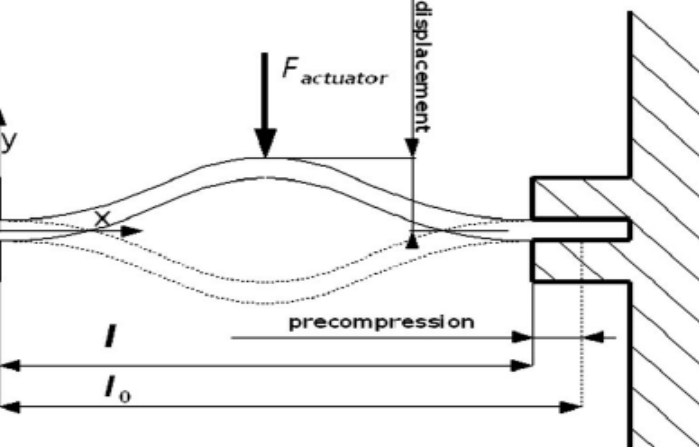
## Optical MEMS BiStable Switch

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## Introduction

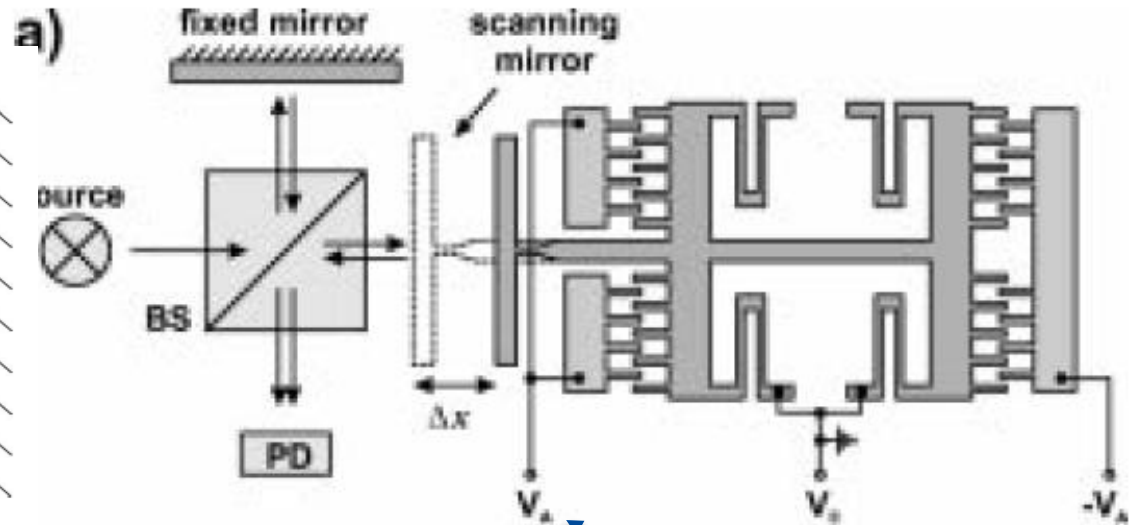
### WHAT IS DISTANCE MEMS?



Precompressed bistable mechanism. A force allows it to snap from one stable position to the other one.

### WHY IS THIS DEVICE IMPORTANT?

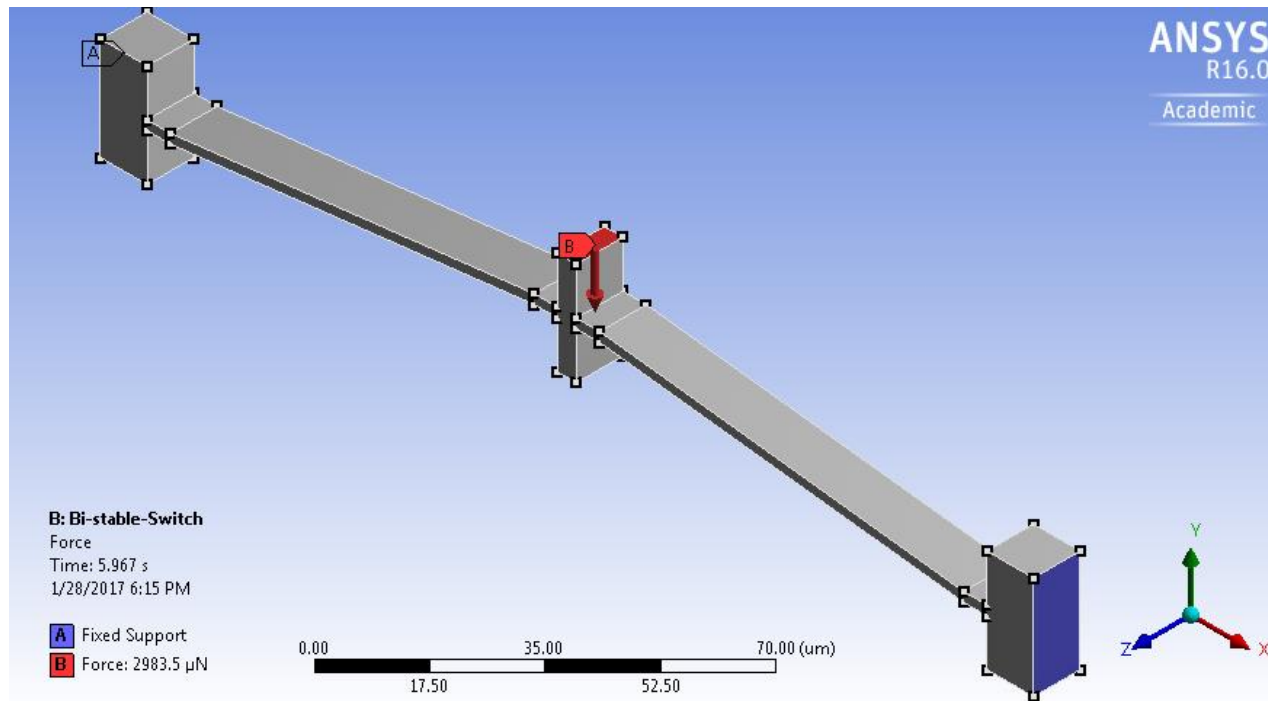
- 1) Telecommunications Industry
- 2) Photometers (Spectroscopy)
- 3) Accelerometers
- 4) Optical Sensor Technology



Voltage  
difference across  
central probe

## Task

Find the BiStable actuation force



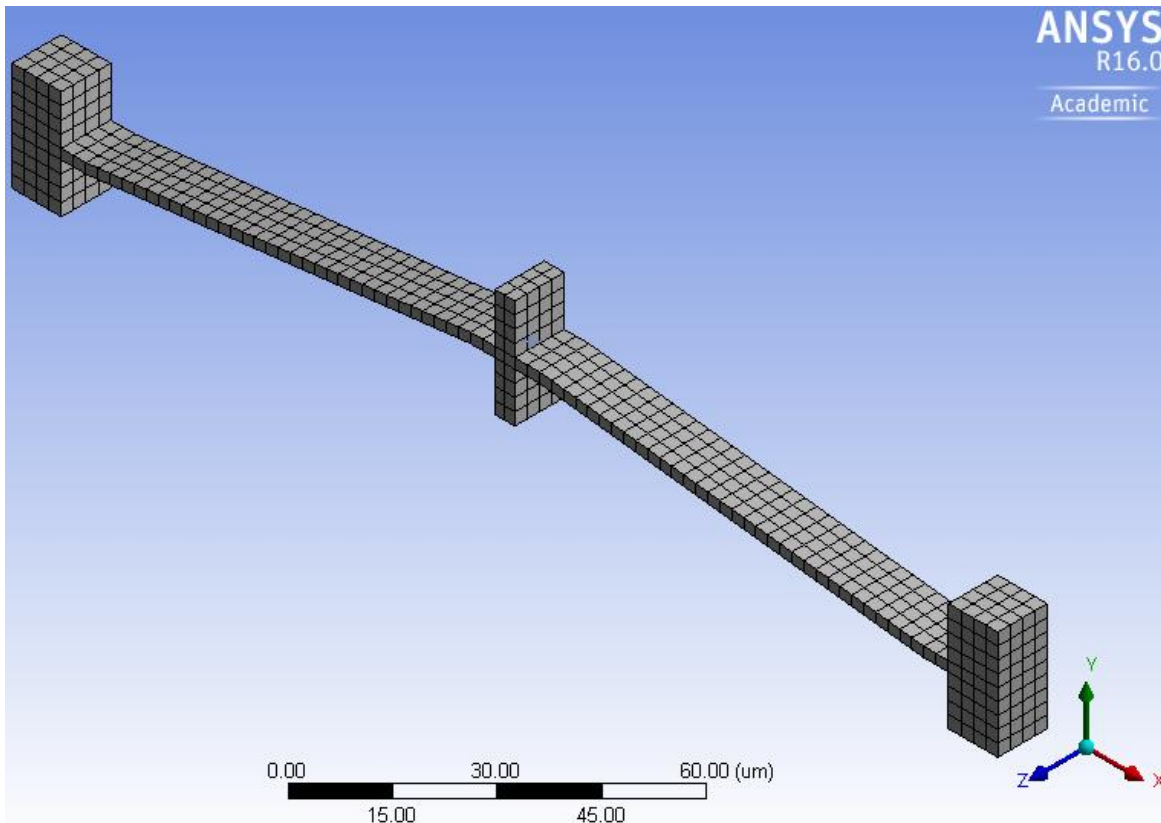
### Setup Properties

- 1) Silicon (as material)
- 2) Young's Modulus: 169 Gpa
- 3) Poissin ratio :- 0.3

### Boundry Conditions

- 1) Fixed Supports at the end surfaces
- 2) Force acting in -Y direction

## Case Setup



In Static Structural  
Standalone

Material :- Silicon

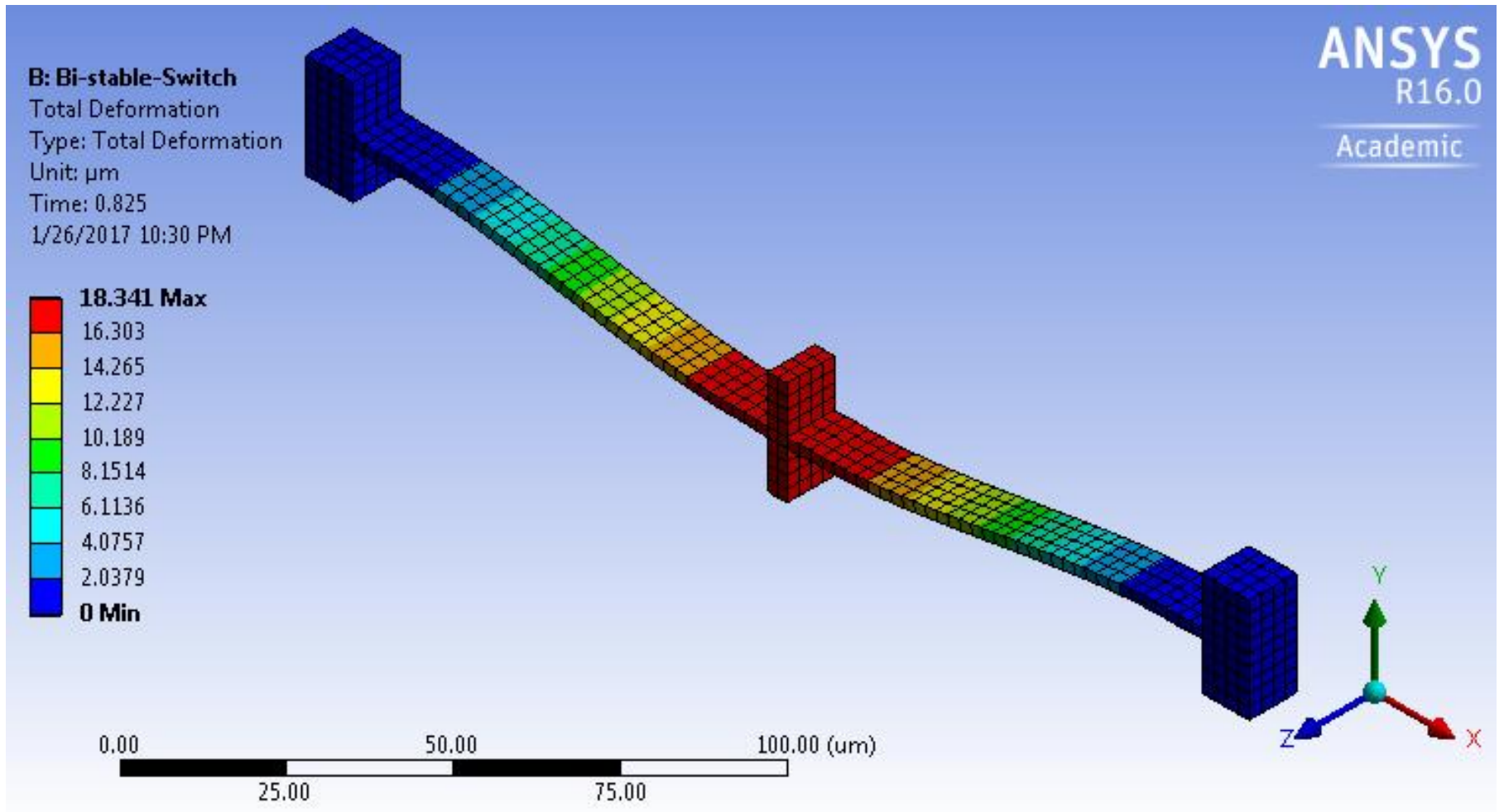
Sizing –Element size 2.5  $\mu\text{m}$

Steps :- 6  
(Force added in various  
steps)

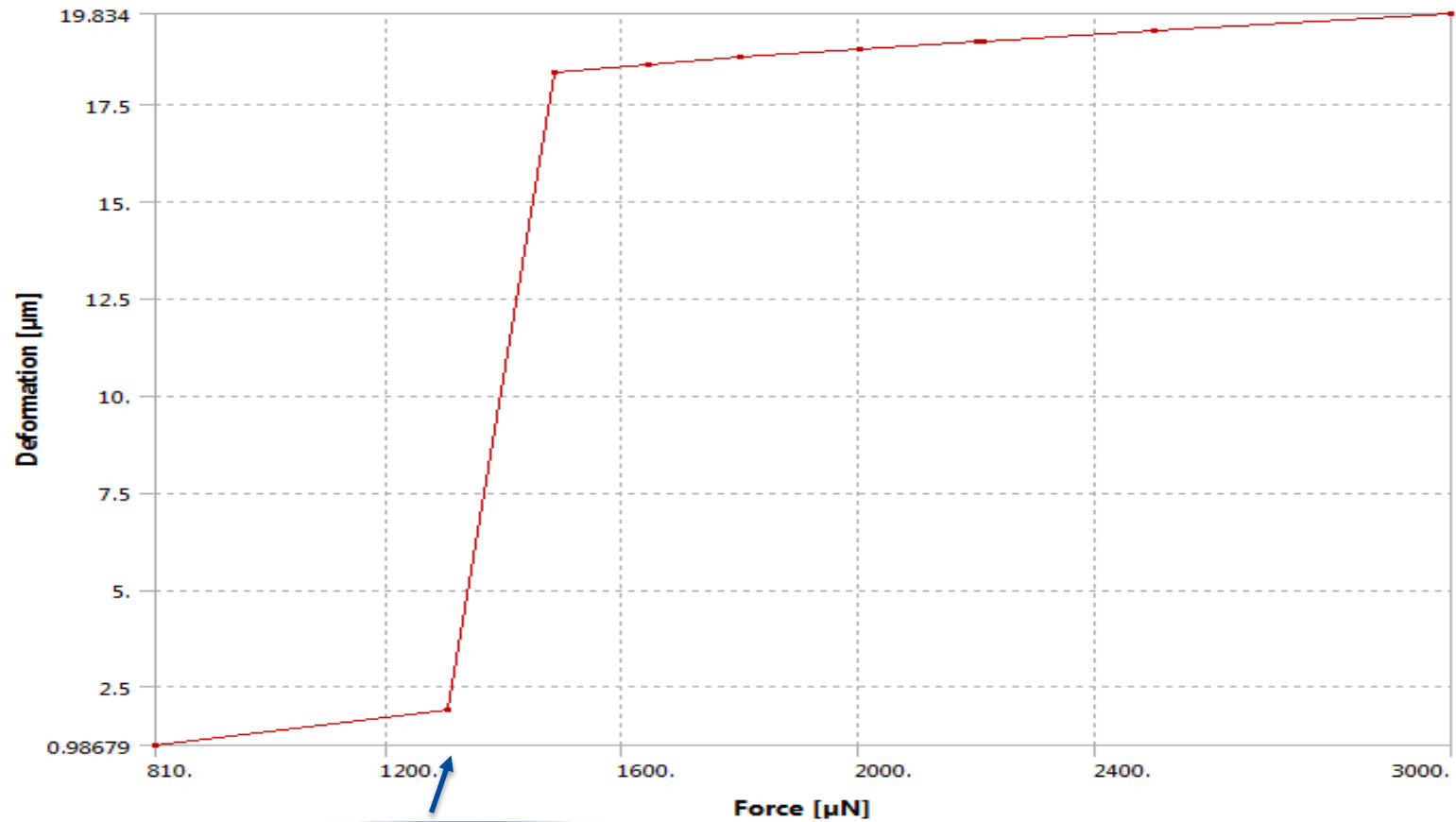
Large Deflection :- On  
(For non-linear analysis)



## Results



## Result



Threshold Transverse Force  $\approx 1300 \mu\text{N}$

## Conclusion

- 1) For a Silicon mem device with geometry of length  $200\text{ }\mu\text{m}$ , clamped at both ends with a central probe , having  $169\text{ GPa}$  Young's Modulus and  $0.3$  Poisson Ratio, the bistable actuation force obtained is in the range of  $1300\text{ }\mu\text{N}$  to  $1500\text{ }\mu\text{N}$ , deflecting the geometry to nearly  $18\text{-}19\text{ }\mu\text{m}$ .
- 2) A force above this range causes a negligible deflection.

## References

- [1] <http://mechanicaldesign.asmedigitalcollection.asme.org/article.aspx?articleid=1472577>
- [2] Marc Sulfridge, Taher Saif, Norman Miller, and Keith O'Hara, Optical Actuation of a Bistable MEMS
- [3] Ansys Troubleshooter