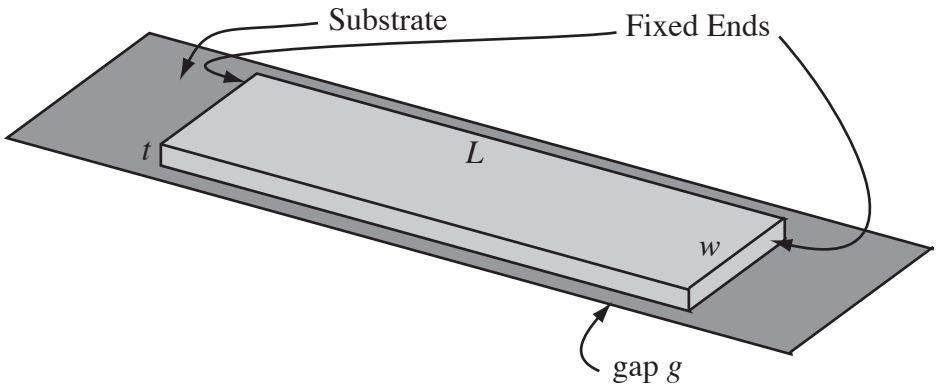
ECCE 550/ME595R-006 Simulation Lab 4: ANSYS Simulation of an Electrostatic Switch

1 Introduction

For this lab, we will use the multi-physics modeling capabilities of ANSYS to model the pull-in behavior of an electrostatic switch. The switch is also being fabricated in labs 5 and 6 in the clean room.

The figure below shows the basic geometry to be modeled. A metal fixed-fixed beam of length L, width w, and thickness t is suspended above the substrate with a gap g. Electrostatic force is applied to the beam using a voltage difference between the beam and the substrate. The goal for this lab is to develop a finite element model in ANSYS that will allow prediction of the pull-in voltage and distance for this beam.



2 Procedure

You will model the beam using the `SOLID45` element, which is an 8-node brick element in ANSYS. The electrostatic force will be modeled using the `TRANS126` element. To understand these elements better, you should read the ANSYS help information for each element. You should create a parametric batch file for your model (just as you did for the bistable mechanism). Of course, you are welcome to try things out in the GUI, as well as using it

to study your results. Below is a list of commands that you may need to create your batch file. You should study the ANSYS help files for these commands as well.

- `CM`
- `EMTGEN`
- `BLOCK`
- `MSHAPE`
- `MSHKEY`
- `VMESH`

In addition, the TA will help you to understand these commands and use them to write your batch file simulation. Table 1 gives sample dimensions for the parts you will make in the clean room.

3 Deliverables

Write a lab report describing the device and how it was modeled. First, compare your predictions from last time using a finite difference model to the predictions from ANSYS. Compare the devices with no residual stress. Can you explain any discrepancy between the two simulations? Where might any errors have come from? What further model refinements would you suggest to improve your results?

Table 1: Switch Parameters.

Parameter	*Value*
L	200 μm
w	40 μm
t	0.5 μm
g	2 μm
E	69 GPa
v	0.33