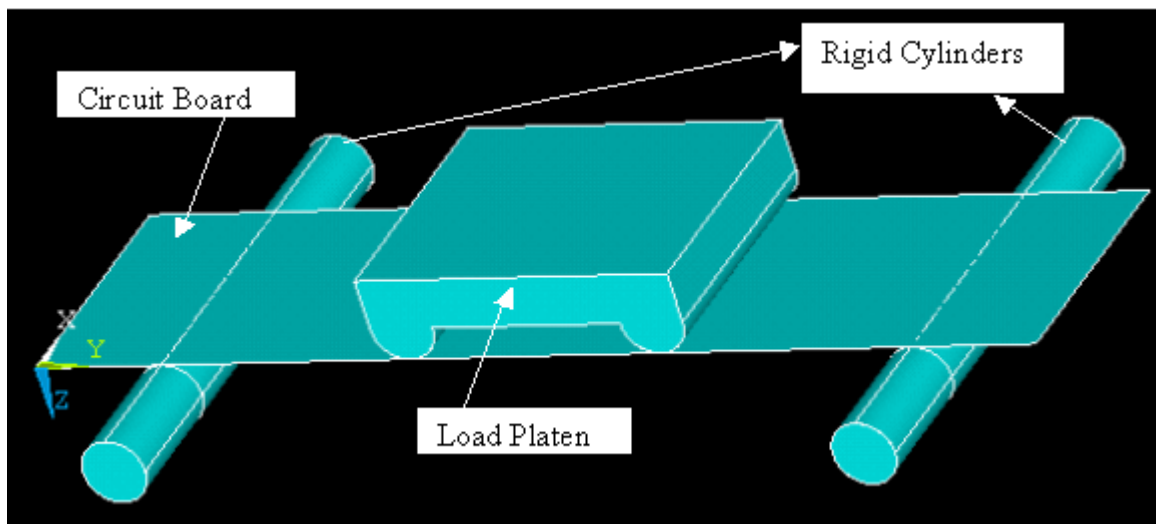
Modeling Methodology
and
Analysis of a Circuit Board

Outline

- Introduction
- Goal of the Project
- Modeling Procedure
- LSDYNA Input Cards
- Results
- Future Work

Introduction

- Army Research Laboratories
- FEA system to analyze before creating prototype



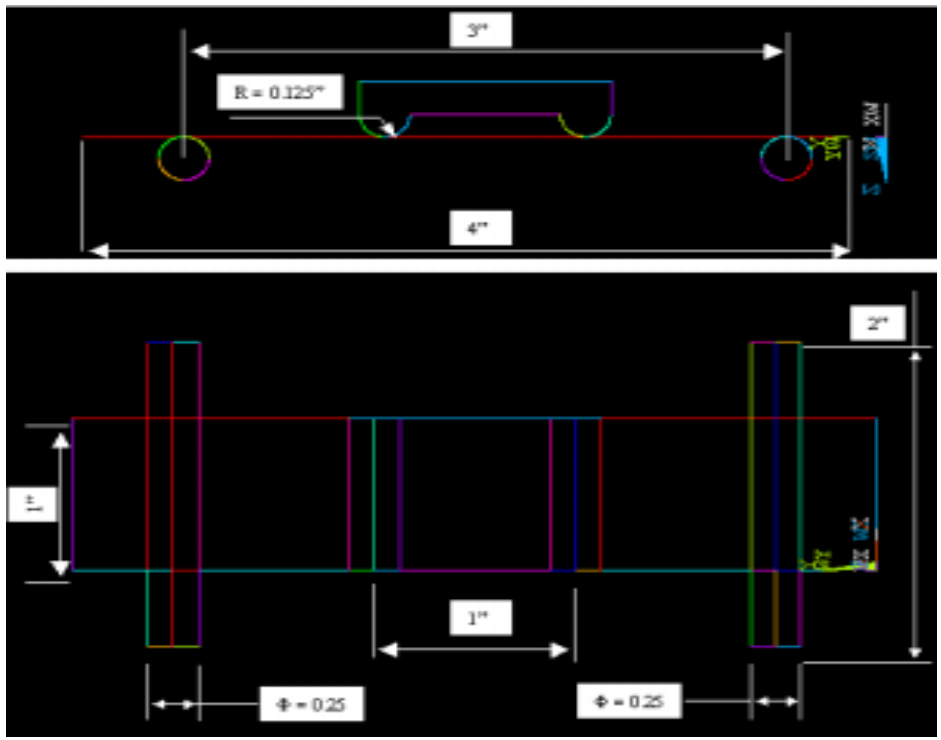
Goal of the Project

- Long term goal was to optimize the Finite Element Modeling Methodology.

- Objective of the current project
  - To create model with the given dimensions
  - Compare displacements and strains with the ARL model

Modeling Procedure

- Model geometry



Properties

- Circuit Board
- Orthotropic material
- Density = 1.84E-4 lb-s^2/inch

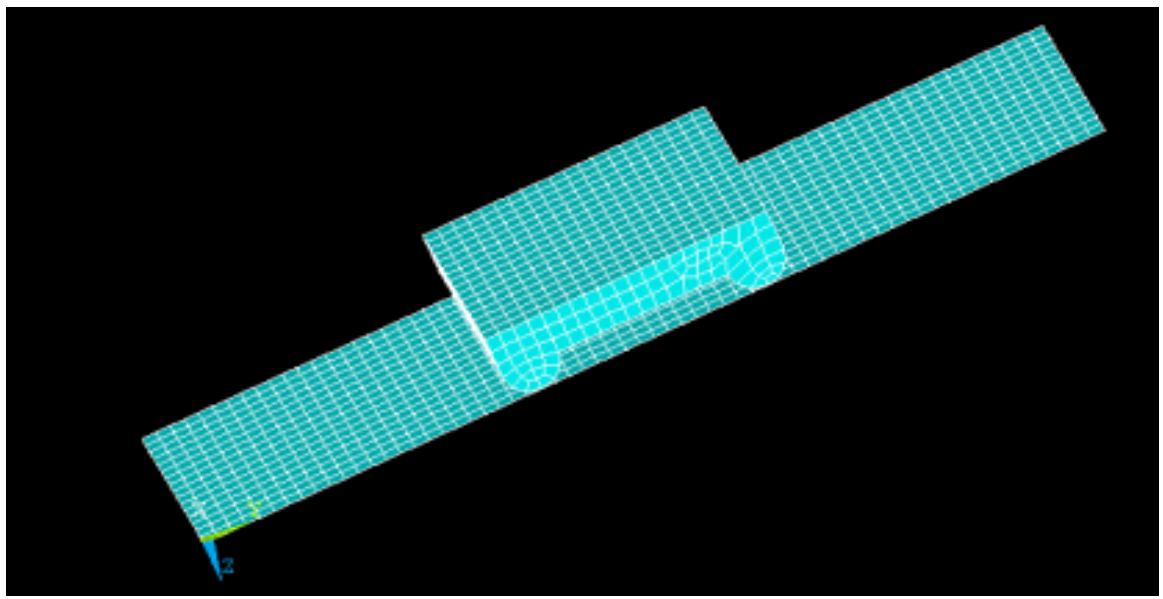
Young's modulus	Poisson's ratio	Modulus of Rigidity
Ex = 2.86E6psi	NUXY = 0.14	Gxy = 5.37E5 psi
Ey = 2.86E6psi	NUYZ = 0.18	Gyz = 4.21E5 psi
Ez = 1.32E6psi	NUXZ = 0.18	Gxz = 4.21E5 psi

- Load Platen
- Elastic Isotropic material

Young's modulus	Poisson's ratio	Density
E = 0.3E8 psi	NU = 0.3	Rho = 0.725E-3 lb-s^2/inch

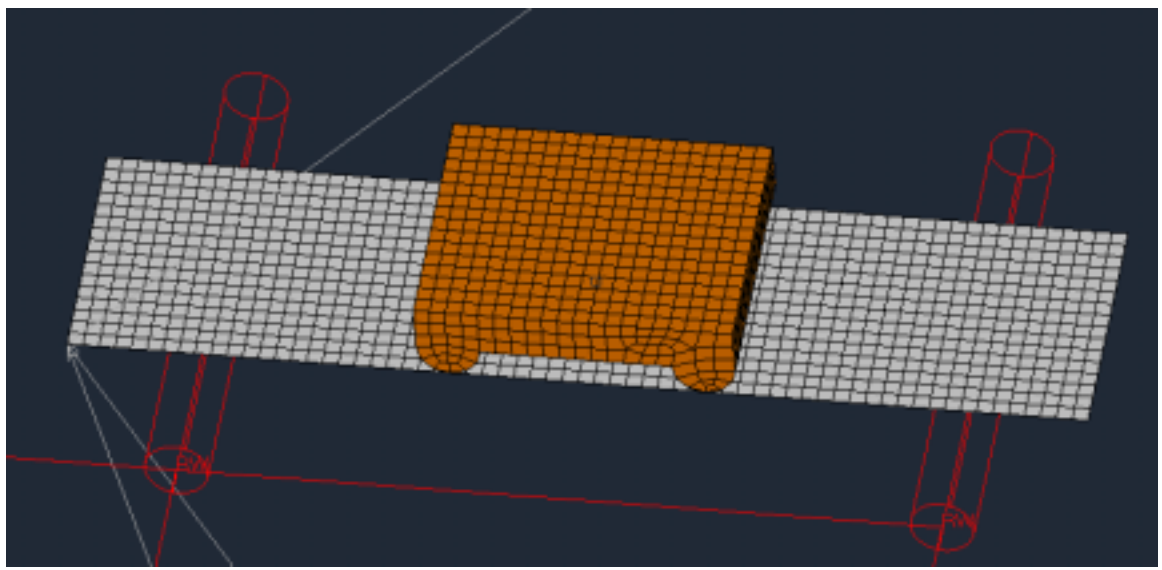
Discretization

- Unit length of geometry was divided into 16 divisions



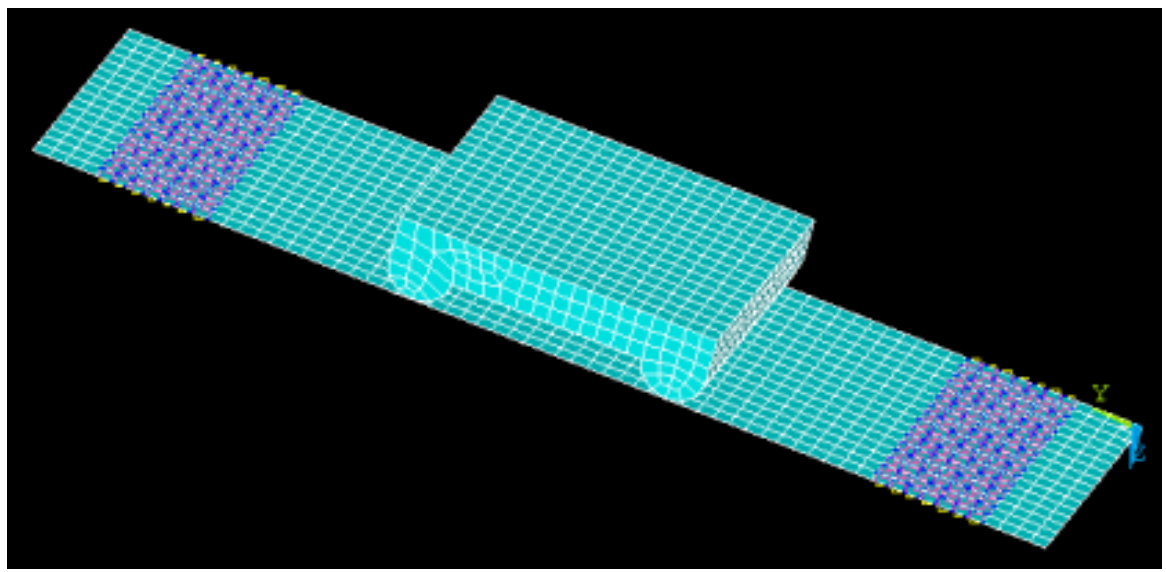
Rigid cylinders

- Rigid cylinders were added in Hypermesh

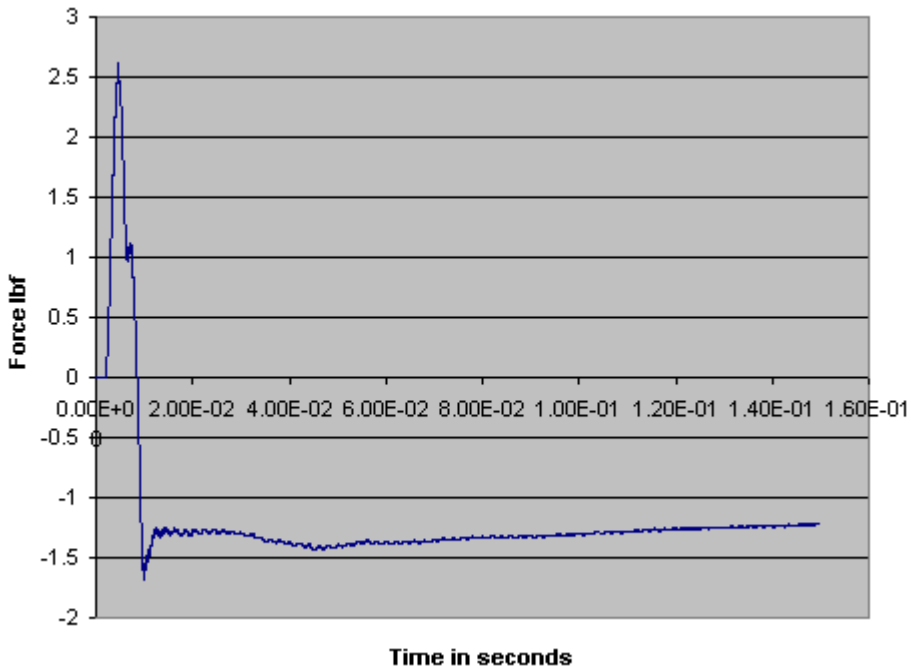


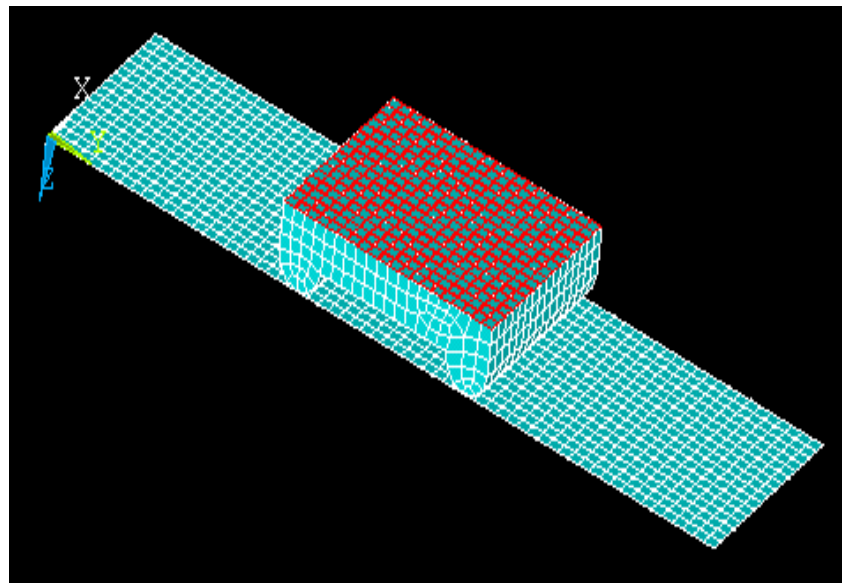
Contacts

- Surface to Surface contact was used between load platen and circuit board
- Set of slave nodes for rigid cylinders



Loads


3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
Force lbf
0.00E+0
2.00E-02
4.00E-02
6.00E-02
8.00E-02
1.00E-01
1.20E-01
1.40E-01
1.60E-01
Time in seconds



LSDYNA input cards

```
*MAT_ORTHOTROPIC_ELASTIC
         1 0.184E-03 0.286E+07 0.286E+07 0.132E+07  0.140000  0.180000
0.180000
0.537E+06 0.421E+06 0.421E+06       2.0
      0.0       0.0       0.0       0.5       0.0       1.0
      0.0       0.0       0.0       0.5       0.5       0.0       0.0
```

Card 1

Card 2

Card 3

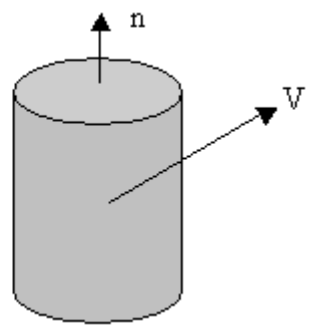
Card 4

```
*RIGIDWALL_GEOMETRIC_CYLINDER
       6
-0.5,.5,.125,-1.5,.5,.125,0
0.12499999       2.0
```

Card 1

Card 2

Card 3



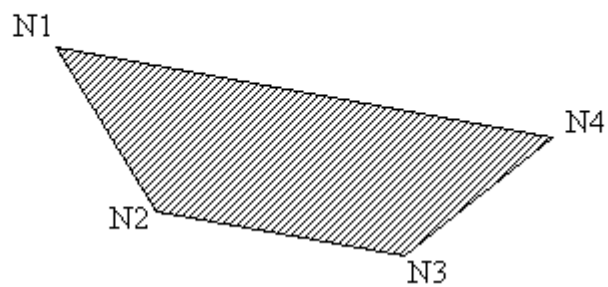
LSDYNA input cards

```
*DEFINE_CURVE
         3         0     1.000     1.000     0.000     0.000
                 0.0                 0.0
1.953200000000000E-05          -0.0020231
```

Card 1

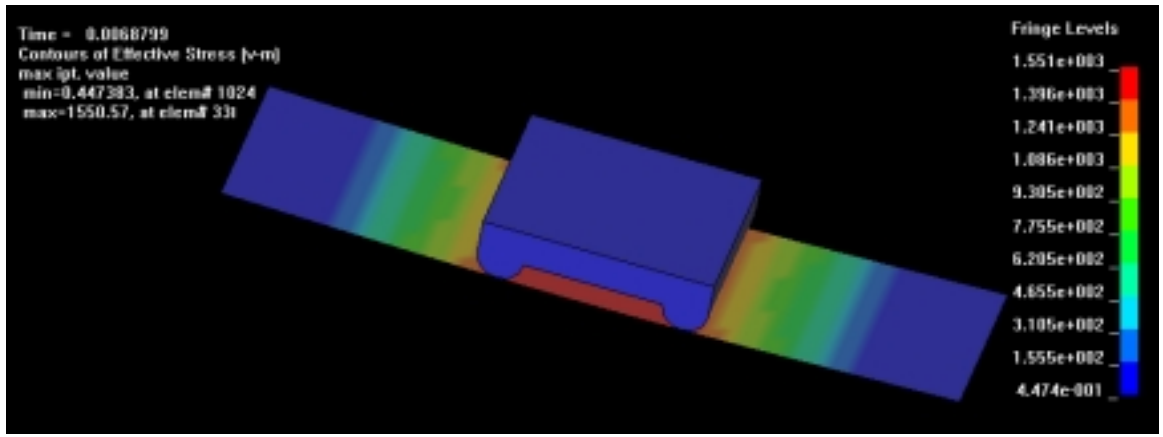
Card 2

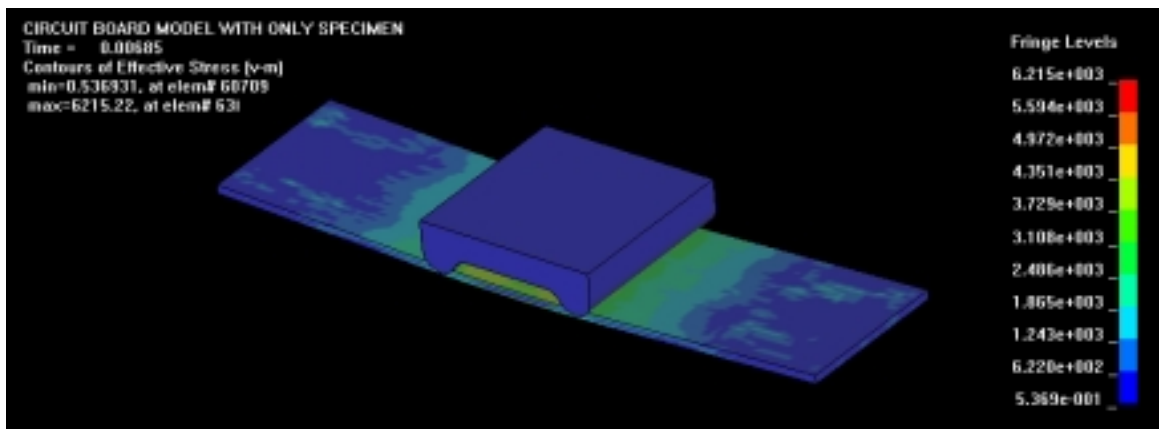
```
*LOAD_SEGMENT
         3     0.640     0.000      1543      1544      1920      1935
```



Results

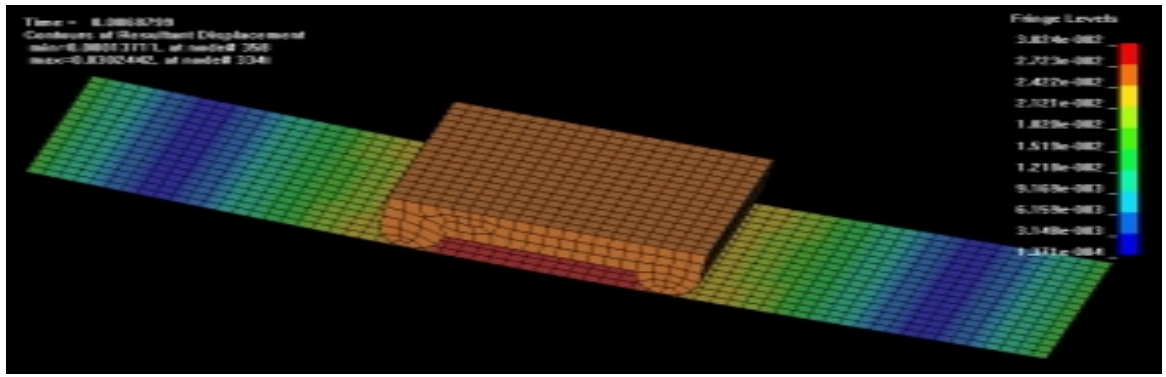
- Vonmises Stress comparison at 6.8 milli seconds

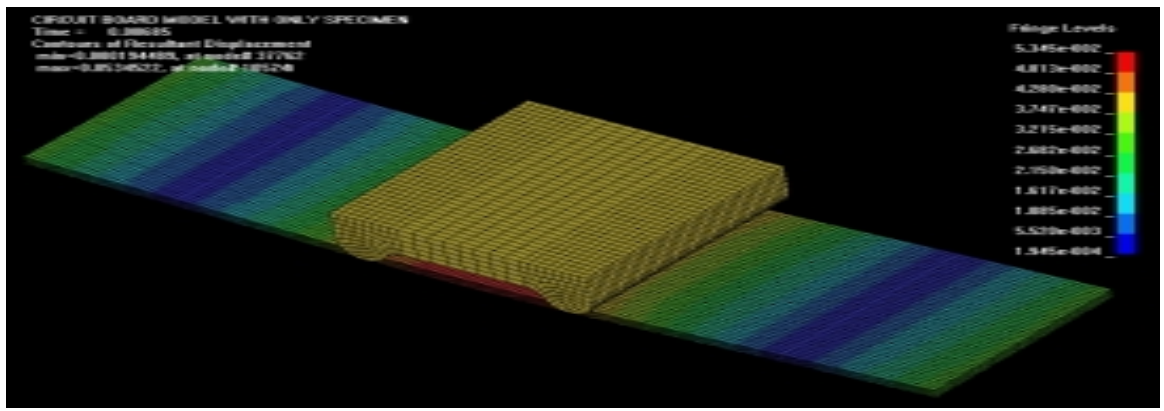




Results

- Displacement comparison at 6.8 milli seconds



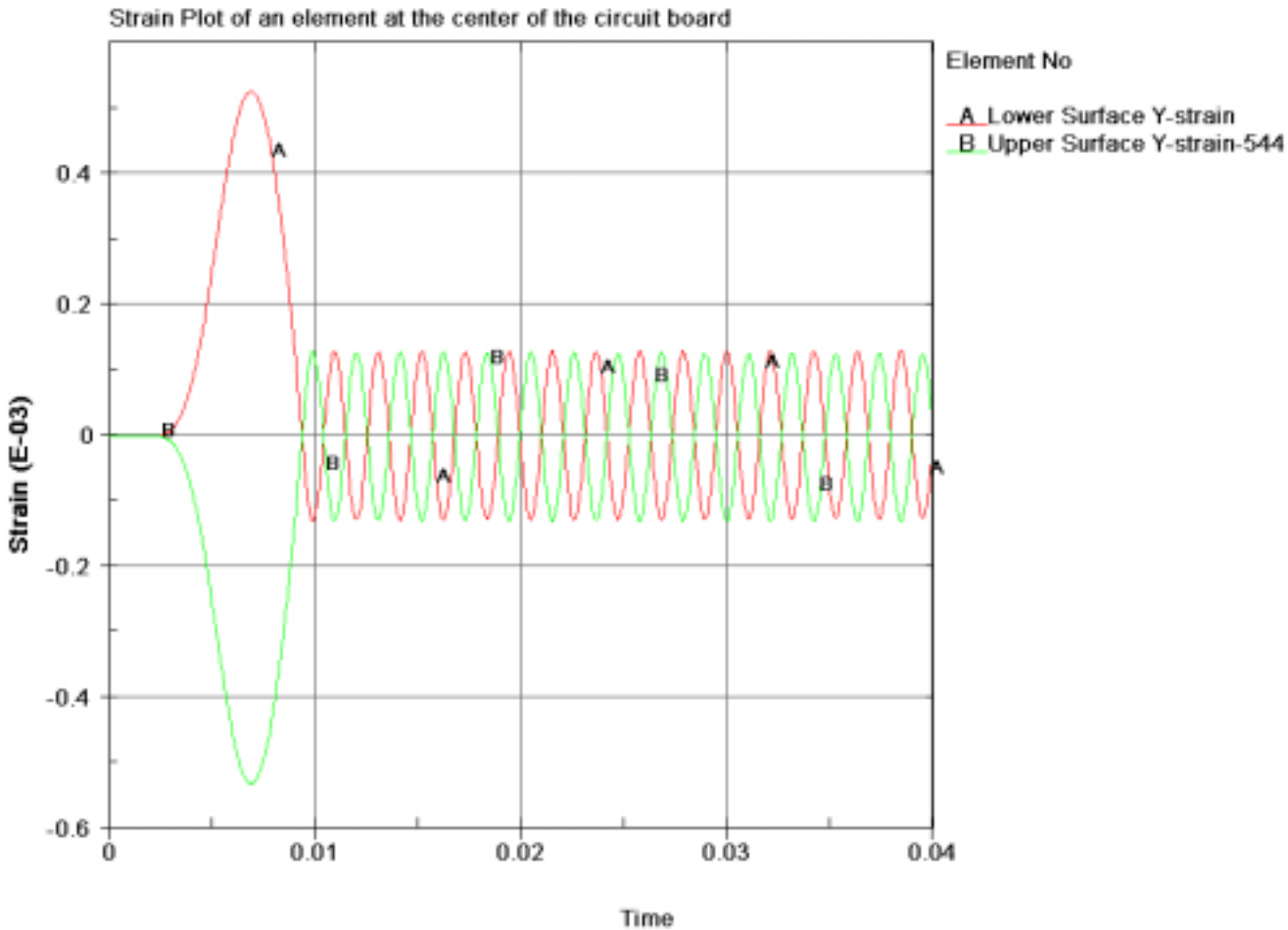


Results

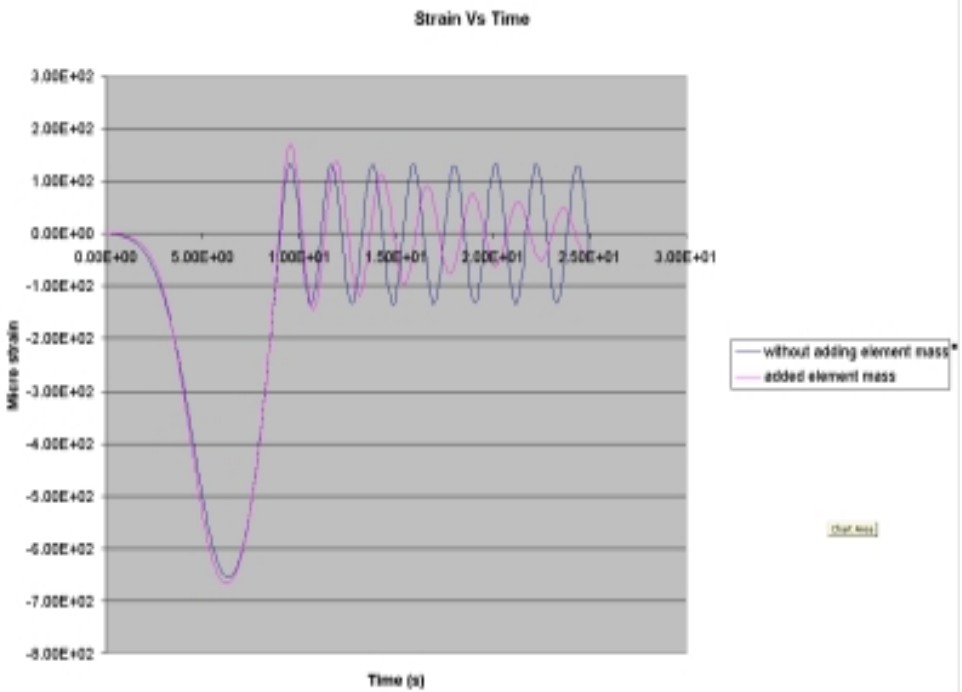
Time (Millisecs)	Von-mises stress psi		Resultant Displacement (Inches)		Upper surface Effective Strain	
	ARL	Our's	ARL	Our's	ARL	Ours
5	1.172e+3	7.469e+2	1.866e-2	1.44e-2	1.31e-3	2.266e-4
5.4	2.13e+3	1.001e+3	2.651e-2	1.93e-2	1.433e-3	3.02e-4
5.6	2.734e+3	1.124e+3	3.077e-2	2.167e-2	1.546e-3	3.386e-4
6	4.004e+3	1.339e+3	3.924e-2	2.588e-2	1.883e-3	4.027e-4
6.8	6.148e+3	1.549e+3	5.284e-2	3.019e-2	2.533e-3	4.663e-4
7	6.51e+3	1.547e+3	5.524e-2	3.02e-2	2.681e-3	4.659e-4

Results

Shell element model

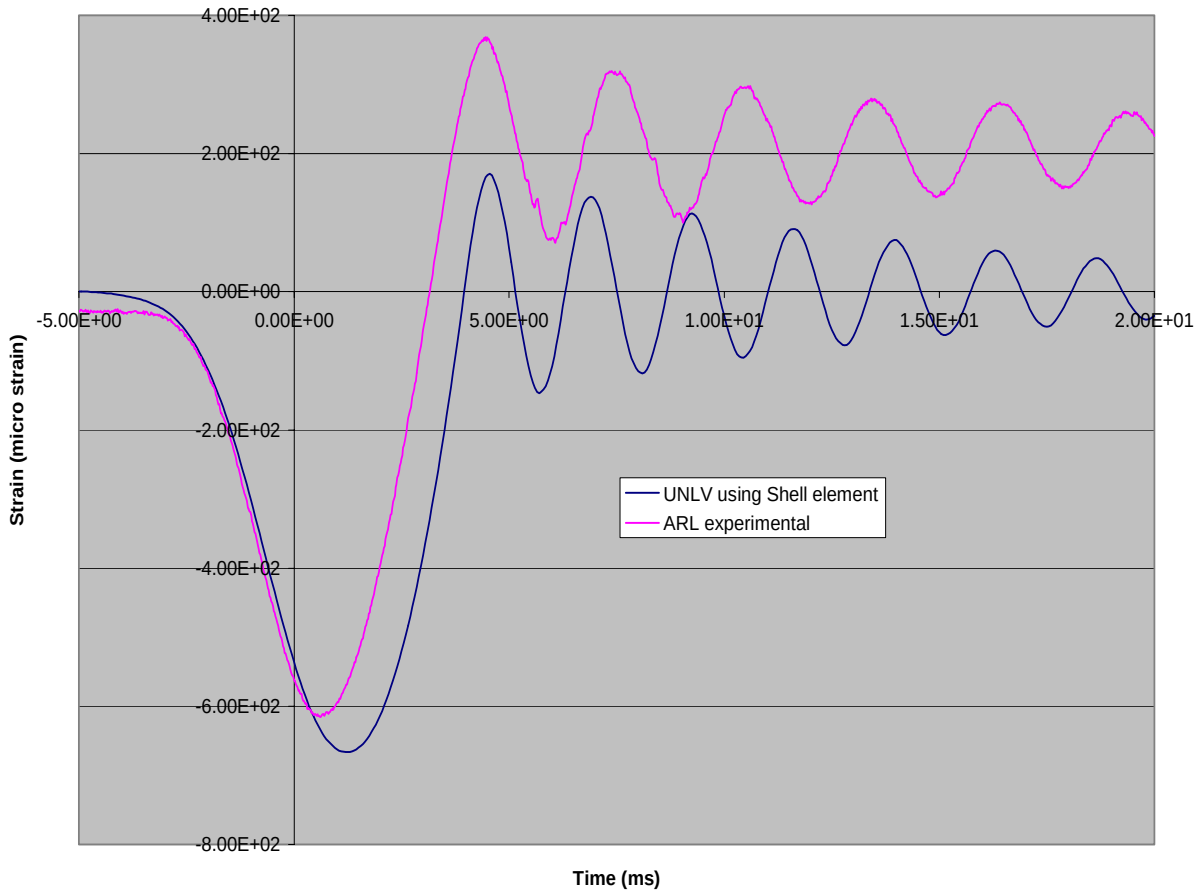


Comparison of Strain plot



Strain plot for an element at the center of the plate with mass added to the row of nodes to incorporate the mass of strain gage and wires attached to the circuit board and without mass.

Comparison of shell element model with ARL experimental results



Future Work

- Once the variation in the results is minimized, we have to start the optimization of the Finite Element Modeling Methodology.
- Reduce computational time associated with Simulation.
- Explore the nature of the problem to determine the most suitable optimization algorithm.
- Implement an algorithm to combine expert system techniques, in order to produce a more accurate finite element model that can reduce dependence on experimental data.

Questions ?