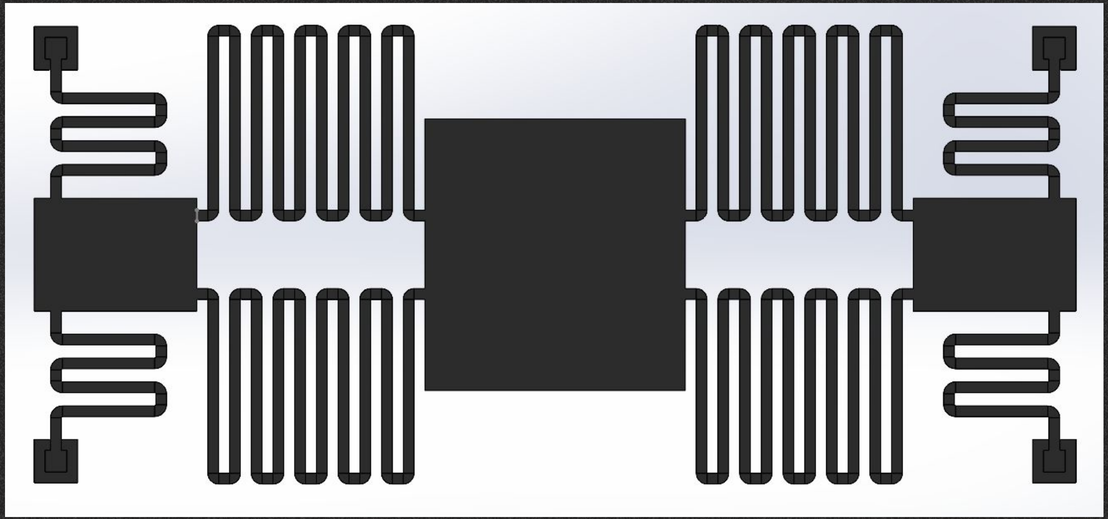
Lifted Tsang Suspension Assembly



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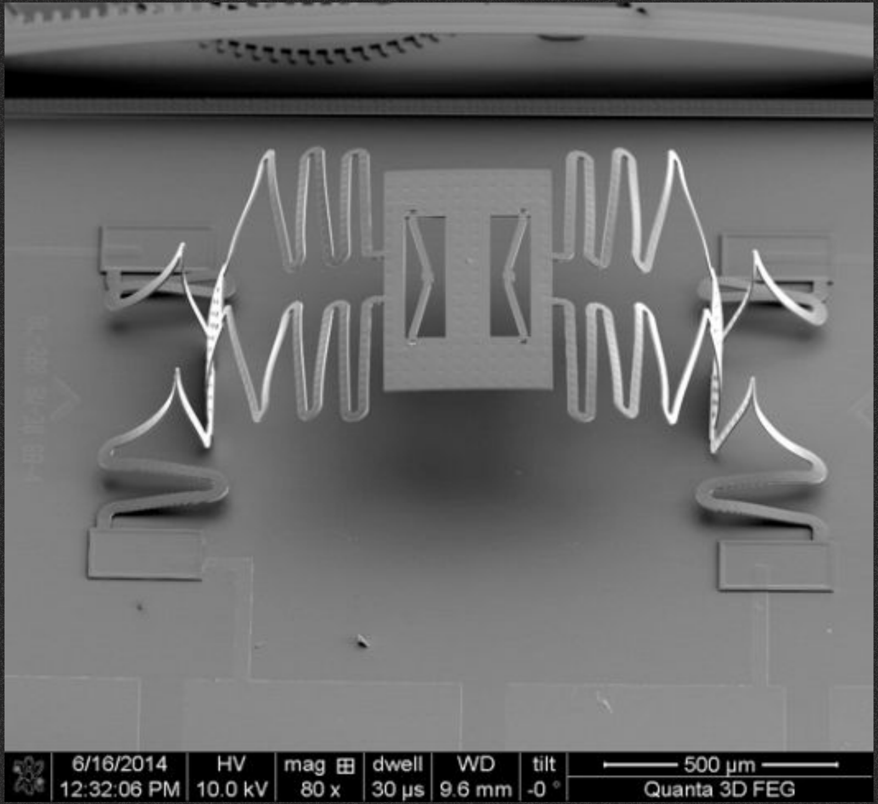
Group 4

MOTIVATION

- To create technologies that benefit from thermal and electrical isolation from the substrate to operate with greater efficiency and higher sensitivity
  - Gyroscopes
  - Antenas
  - Accelerometers
- Tsang Suspensions can isolate these technologies from the substrate by becoming a free-standing structure after being mechanically assembled or being rotated out of frame.



Arevalo Carreno, Armando Arpys & Conchouso Gonzalez, David & Rawashdeh, Ehab & Castro, Desiret & Foulds, Ian. (2014). Platform Isolation Using Out-of-plane Complaint Mechanisms.

Goal

Analyze lifting mechanism using opposing Tsang suspension.

DESIGN PROCESS

PHASE 1

Research & Setting goals

PHASE 2

Identifying constraints & Initial Sketch

PHASE 3

Klayout Design & Solidworks simulation

PHASE 4

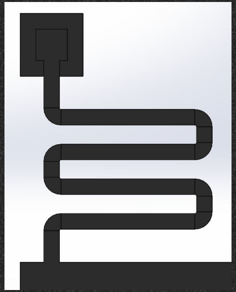
Fabrication & quality analysis

PHASE 5

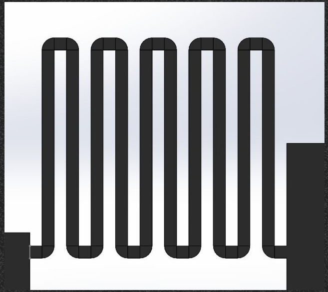
Testing various model to identify best design

DESIGN - FEASIBILITY, VARIABLES, AND SIMULATIONS

DESIGN VARIABLES



SPRING A



SPRING B

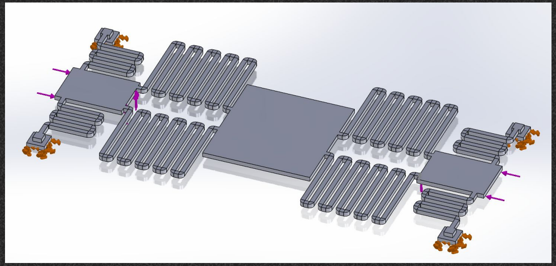
$$F = -kx$$

f { Spring width, Spring Length (↑↑ Direction), and Number of turns }

f { Experimenting with SU-8 Layers }

SIMULATION LOADING CONDITIONS

2 Horizontal Forces + Couple Moment

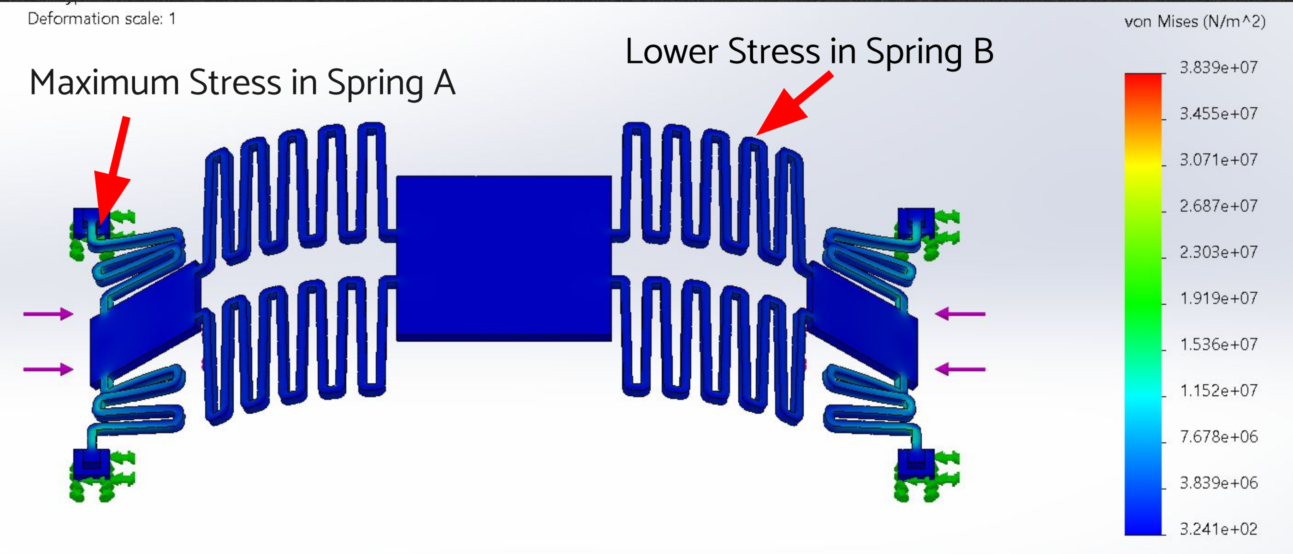


MODEL ASSUMPTIONS

1. Friction between the Tsang Assembly and the Substrate will provide enough force to counteract the horizontal force from SPRING B and keep the assembly in equilibrium at 90 degrees ***
   a. To reduce the magnitude of friction required, we are testing 3 designs with varying Spring Constants.

***(in some test cases we have anchors in case the friction isn't sufficient)

DESIGN - STRESS DISTRIBUTION / COMPARISON



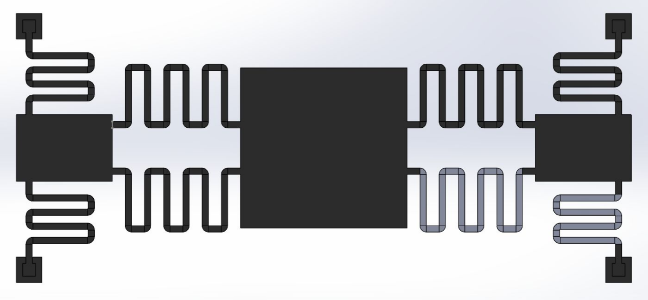
Expect this to perform best

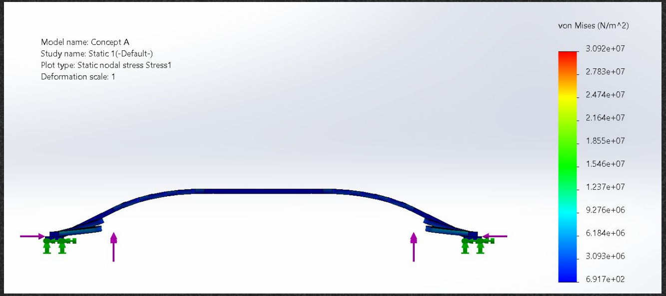
	Description	Maximum Stress	
Design A	Low Spring A + Strong K Spring B	30.9	**Mpa**
Design B	Spring A + Medium K Spring B	36	**MPa**
Design C	Spring A + Low K Spring B	38	**MPa**

DESIGN – TESTING PLAN

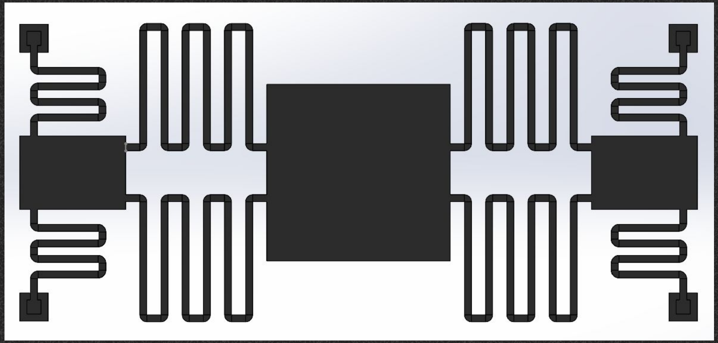
Test Plan								
Design	Spring A	Spring B	Spring A-Layer	Spring B-Layer	Actuator Layer	# of Tests	Breaks?	Stationary at 90 Degrees?
A	Low K	High K	SU8-1	SU8-1	SU8-2	2		
			SU8-1	SU8-2	SU8-1	2		
			SU8-1	SU8-1	ANCHOR	2		
			SU8-1	SU8-2	SU8-2	2		
B	Medium K	Medium K	SU8-1	SU8-1	SU8-2	2		
			SU8-1	SU8-2	SU8-1	2		
			SU8-1	SU8-1	ANCHOR	2		
			SU8-1	SU8-2	SU8-2	2		
C	Medium K	Low K	SU8-1	SU8-1	SU8-2	2		
			SU8-1	SU8-2	SU8-1	2		
			SU8-1	SU8-1	ANCHOR	2		
			SU8-1	SU8-2	SU8-2	2		

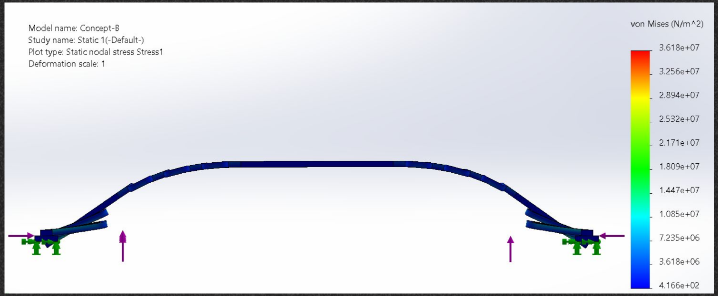
DESIGN A - ANALYSIS



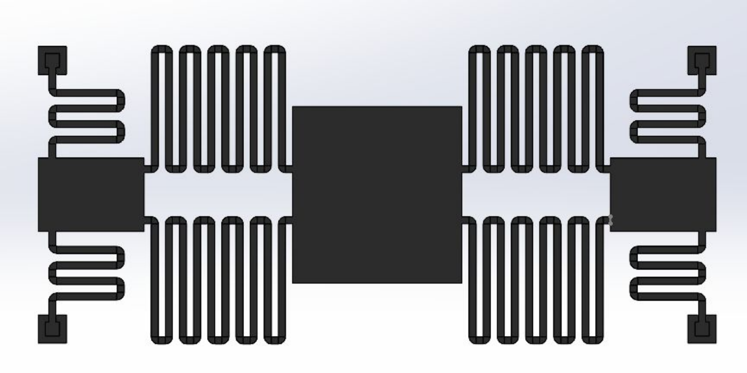


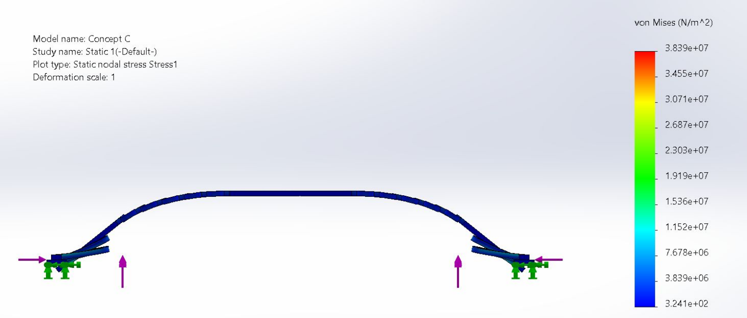
DESIGN B - ANALYSIS



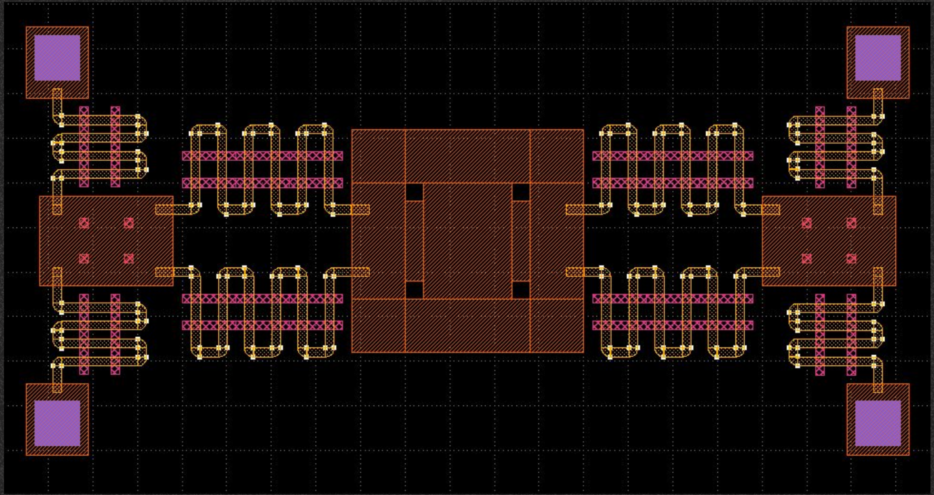


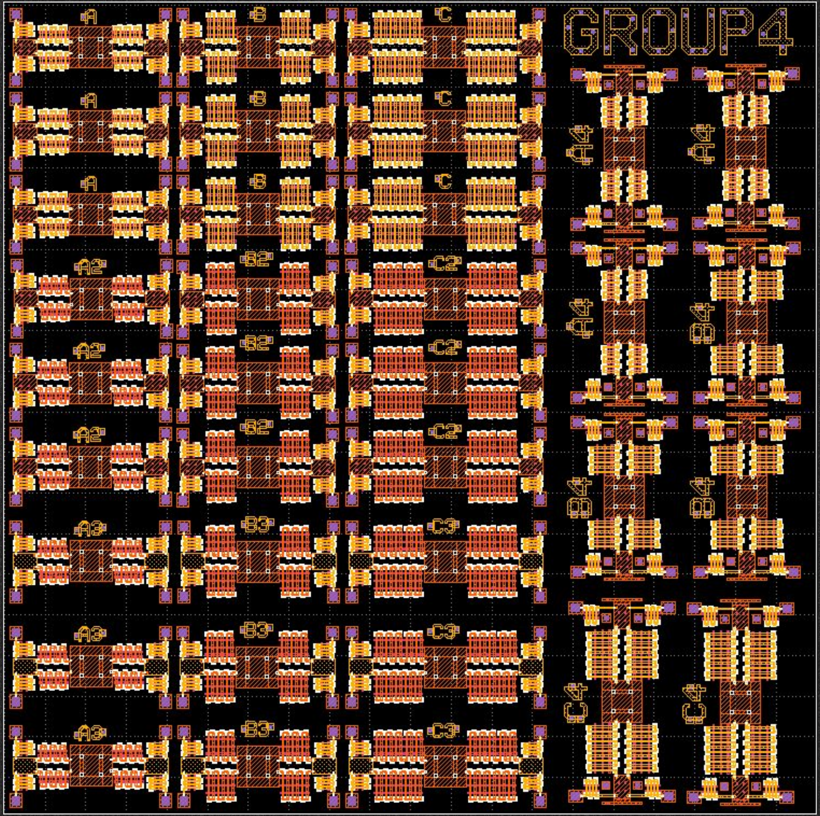
DESIGN C - ANALYSIS



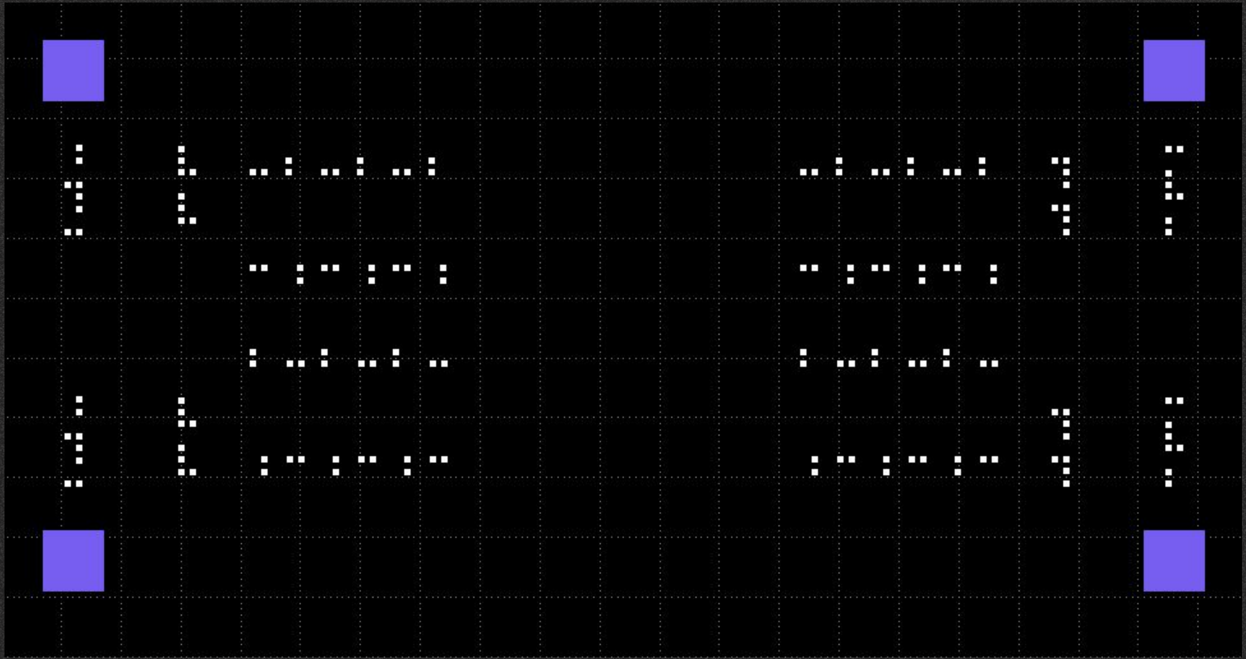


DESIGN – LAYOUTS

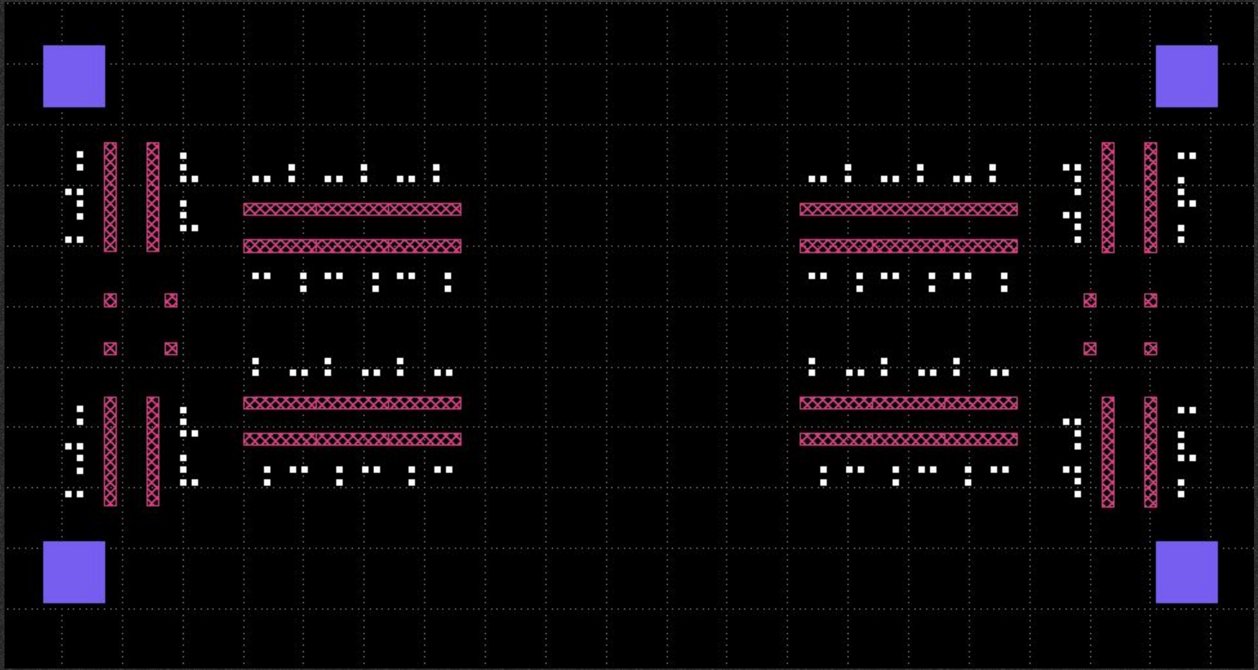




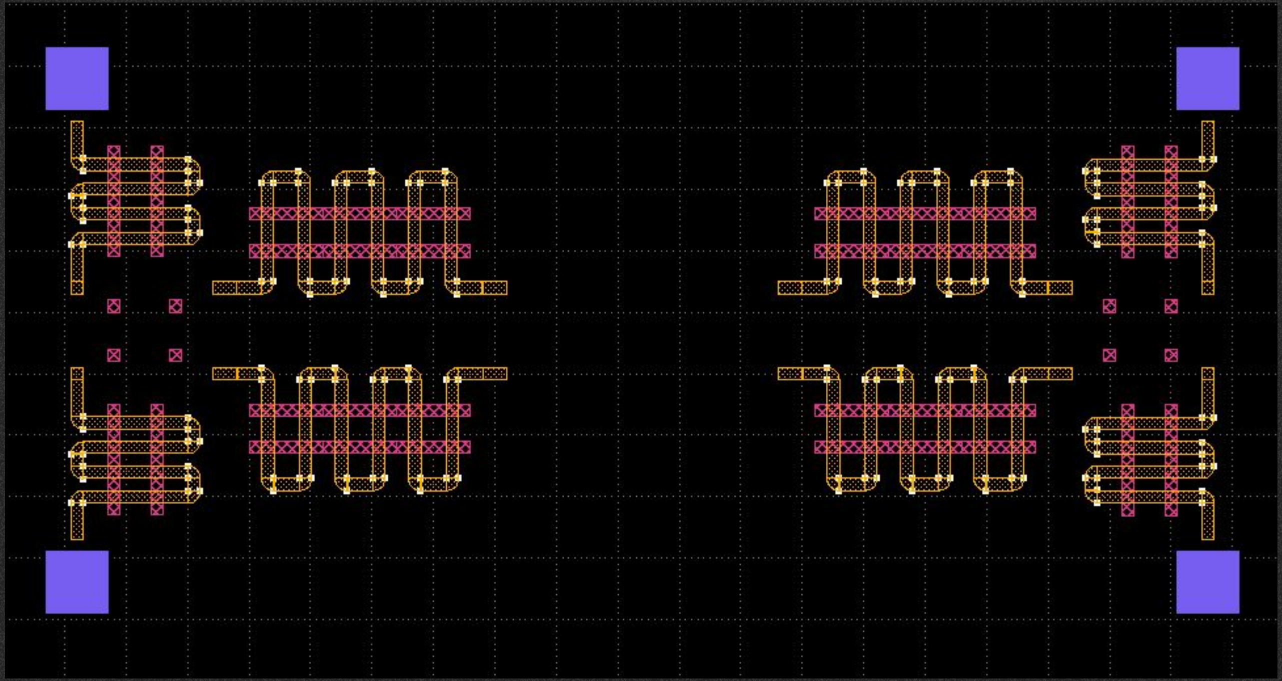
Anchors



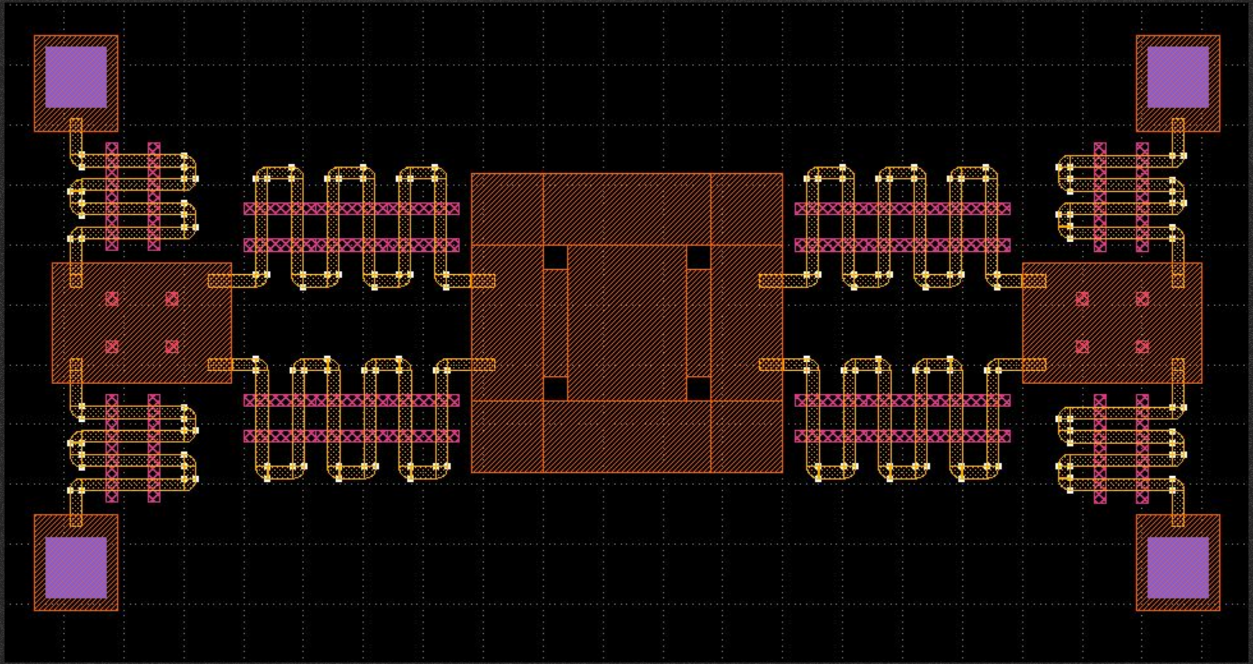
Dimples



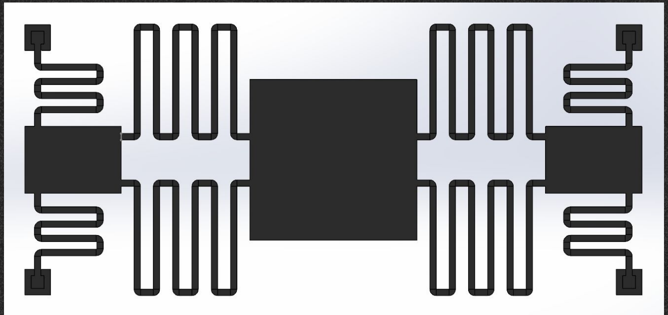
SU8_1

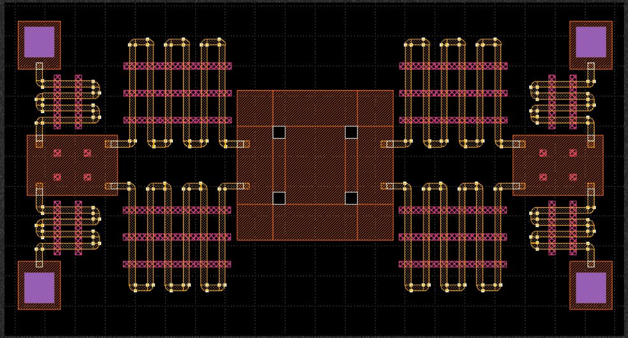


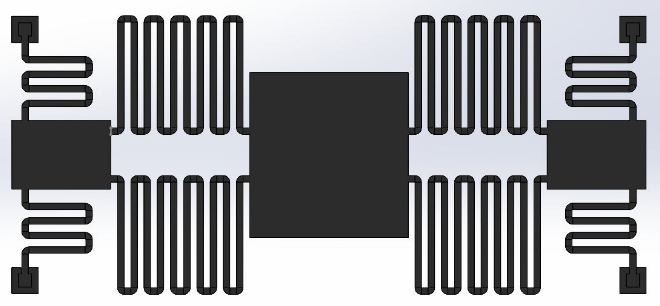
SU8_2

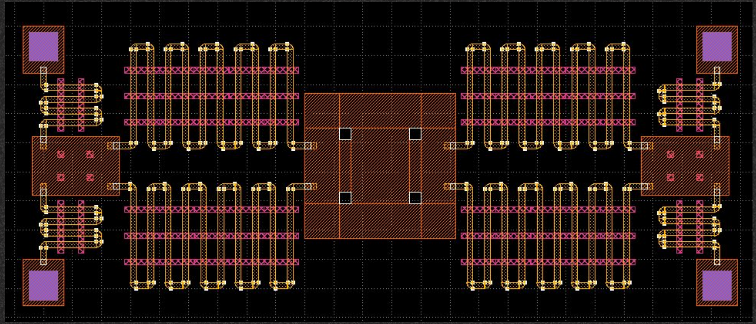


BACKUP DESIGNS









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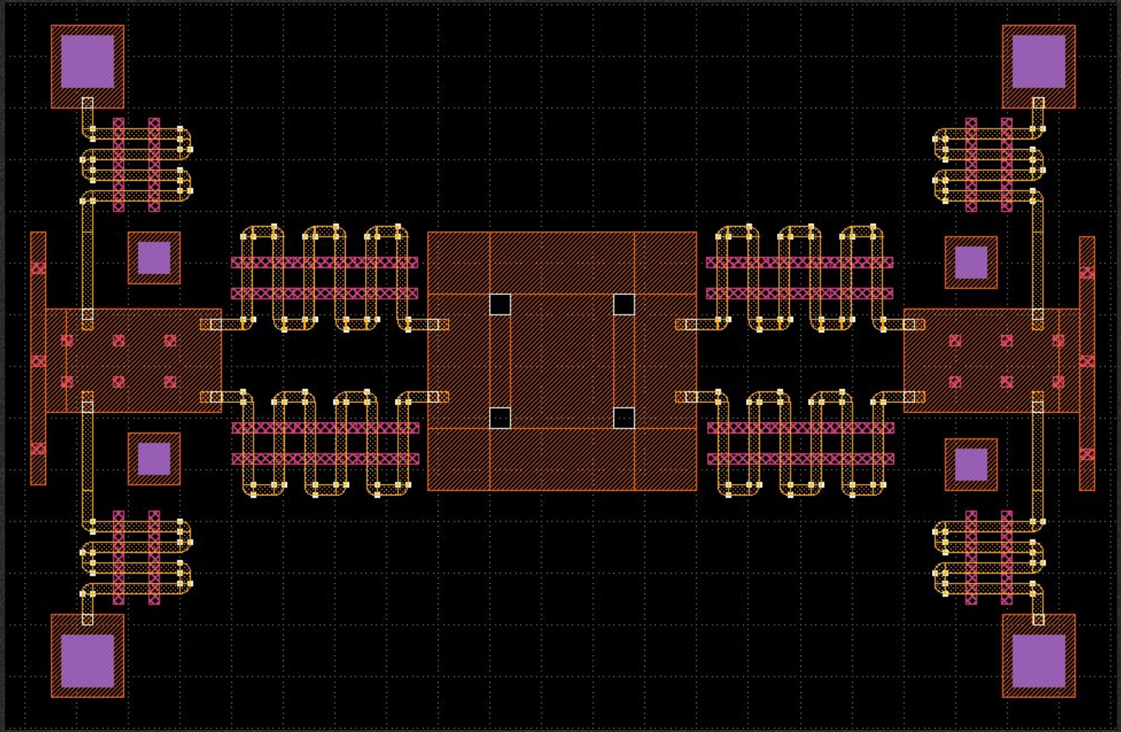

FORWARD PLAN

- Fabrication
- Testing designed mechanism
    - Material and spring performance analysis
    - Use backup designs if needed.
- Redesign to further improve design based on initial learnings and further reduce spring constant of Spring A to reduce maximum stresses.
- Apply Learnings to Fabrication Round 2 +

THANKS!

DO YOU HAVE ANY QUESTIONS?

References

Castro, David & Arevalo Carreno, Armando Arpys & Rawashdeh, Ehab & Dechev, Nikolai & Foulds, Ian. (2014). Simulation of a Micro-Scale Out-of-plane Compliant Mechanism.