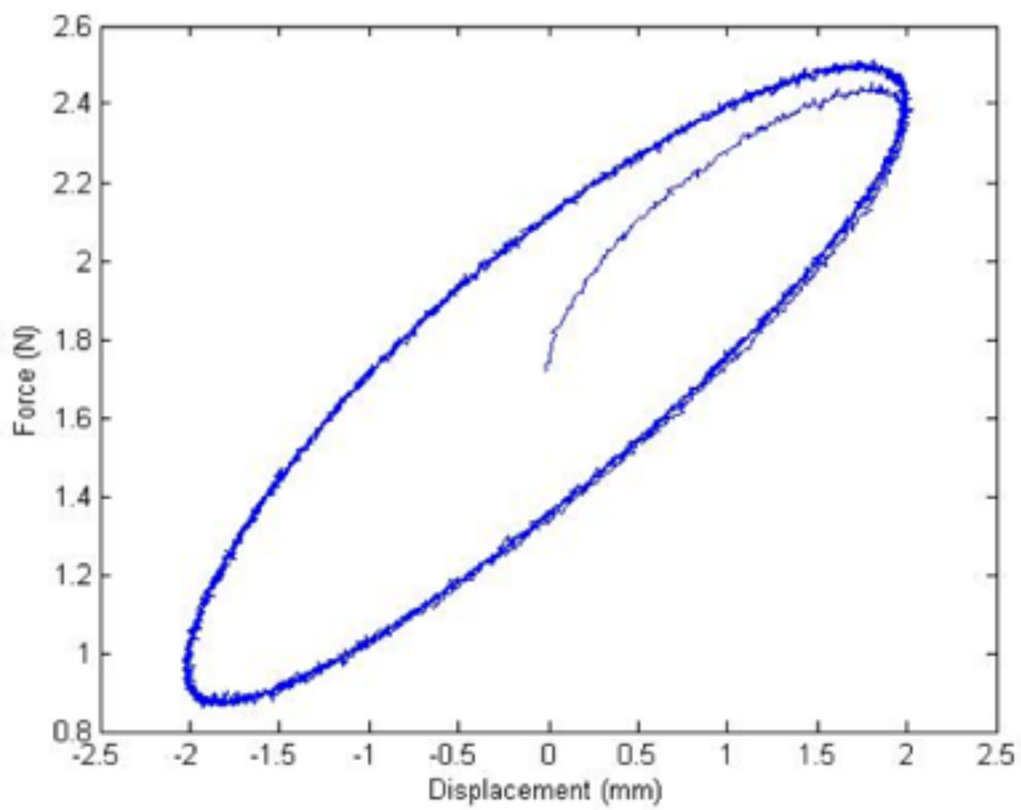
Hysteresis of EAP

Brief Introduction

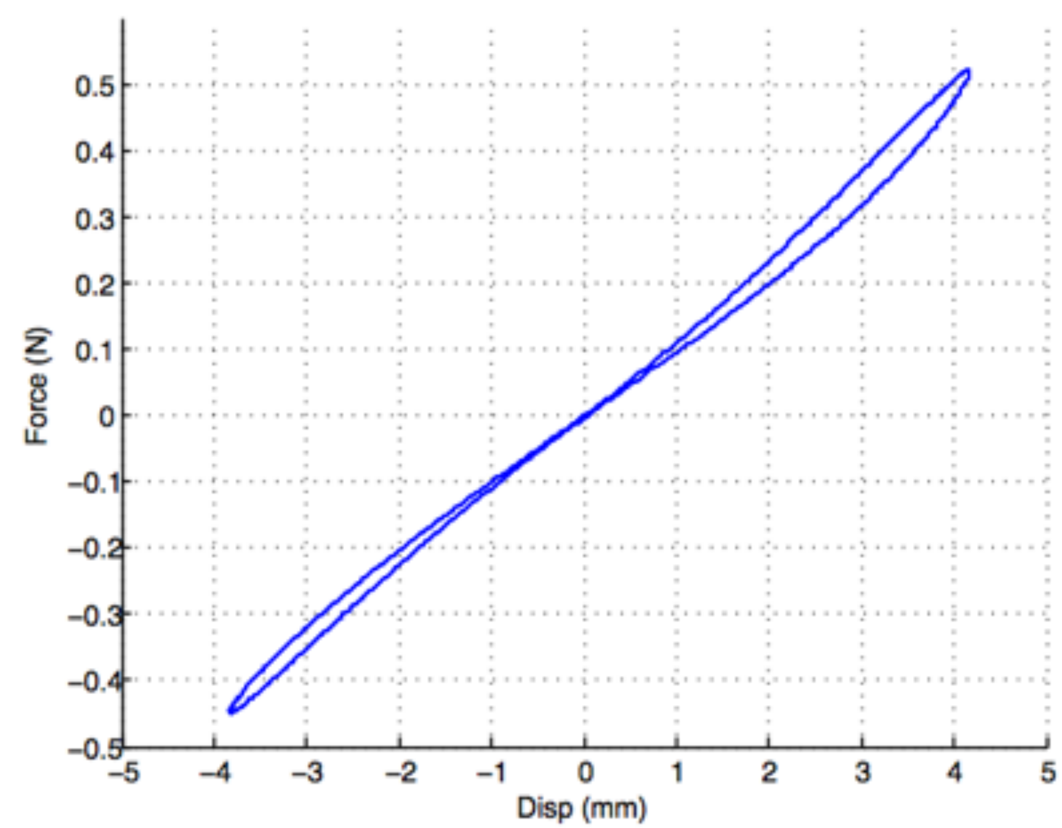
Shiquan

Two Configurations Tests

- Mainly because of viscoelasticity of EAP (Previous report has detailed discussion)
- Average strain change rate in the tests:
  - Planar: 33.4/s   Diaphragm: 7.7/s



Planar



Diaphragm

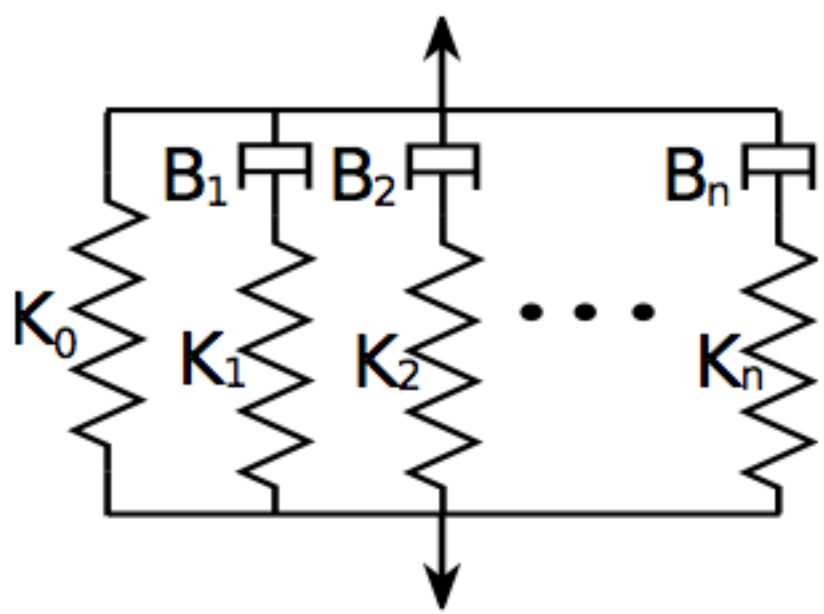
Viscoelasticity of EAP

- Basically Spring + Damping
- Highly depends on strain change rate
- Energy dissipation
- The hysteresis probably is good for the application ?
  - Impact -> big strain change rate -> large hysteresis -> energy dissipation
  - Low pass

Quasi-linear Viscoelastic (QLV) Model

- Used in Sanjay's paper and verified by experiments
- Transfer function $$\frac{\mathbf{F}}{\mathbf{X}} = k_0 + \sum_{i=1}^{n} \frac{k_i s}{s + \frac{k_i}{b_i}}$$
- Related parameters:

QLV Params	CV	CC
k_0	1.35	1.44
k_1	1.63	1.66
b_1	1.14e-2	1.22e-2
k_2	0.71	0.66
b_2	3.00 e-2	3.18e-2
k_3	0.29	0.48
b_3	0.52	0.61
k_4	0.37	0.50
b_4	0.088	0.17

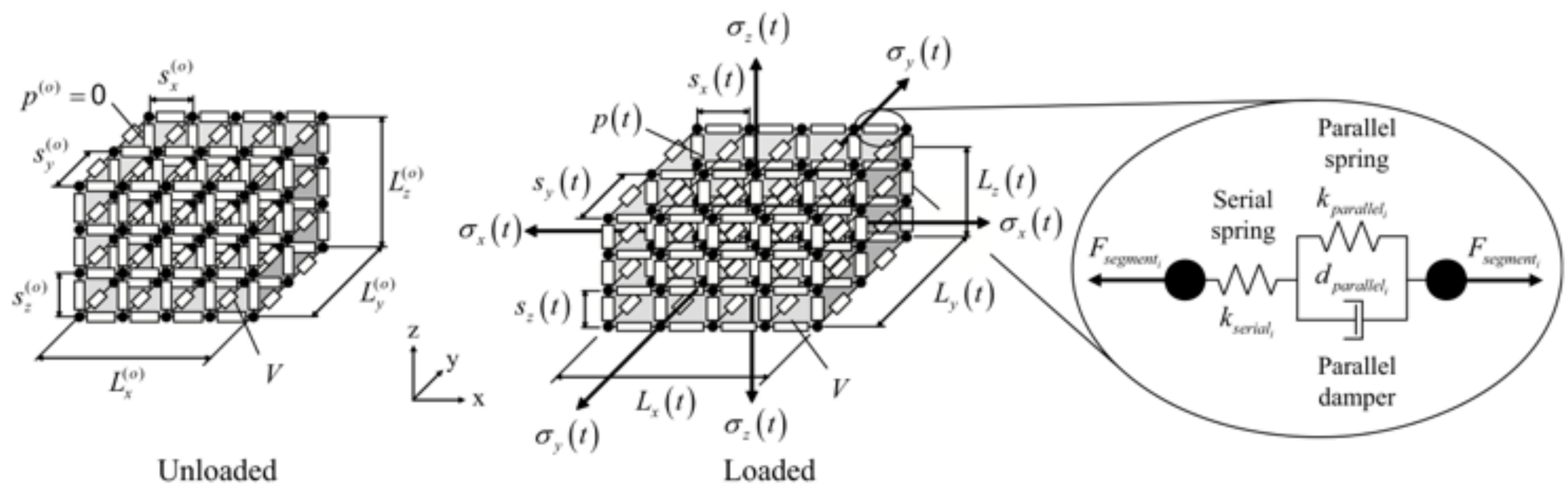


Another model :Visco-hyperelastic Film Model

- Lack of experiment verification
- Stress versus stretch ratio:

$$K_s K_p \left(\frac{1}{\sqrt{\lambda_{\text{test}}}} - 1 \right) + D_p K_s \frac{\mathrm{d}}{\mathrm{d}t} \left(\frac{1}{\sqrt{\lambda_{\text{test}}}} \right)$$

$Ks = 2.31\times10^{-2}$ Nmm^{-2}, $Kp = 5.20\times10^{-2}$ Nmm^{-2} and $Dp = 3.3 \times 10^{1}$ N s mm^{-2}



References

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