

Designing Soft Inflatable Jumpers

Ben Gorissen

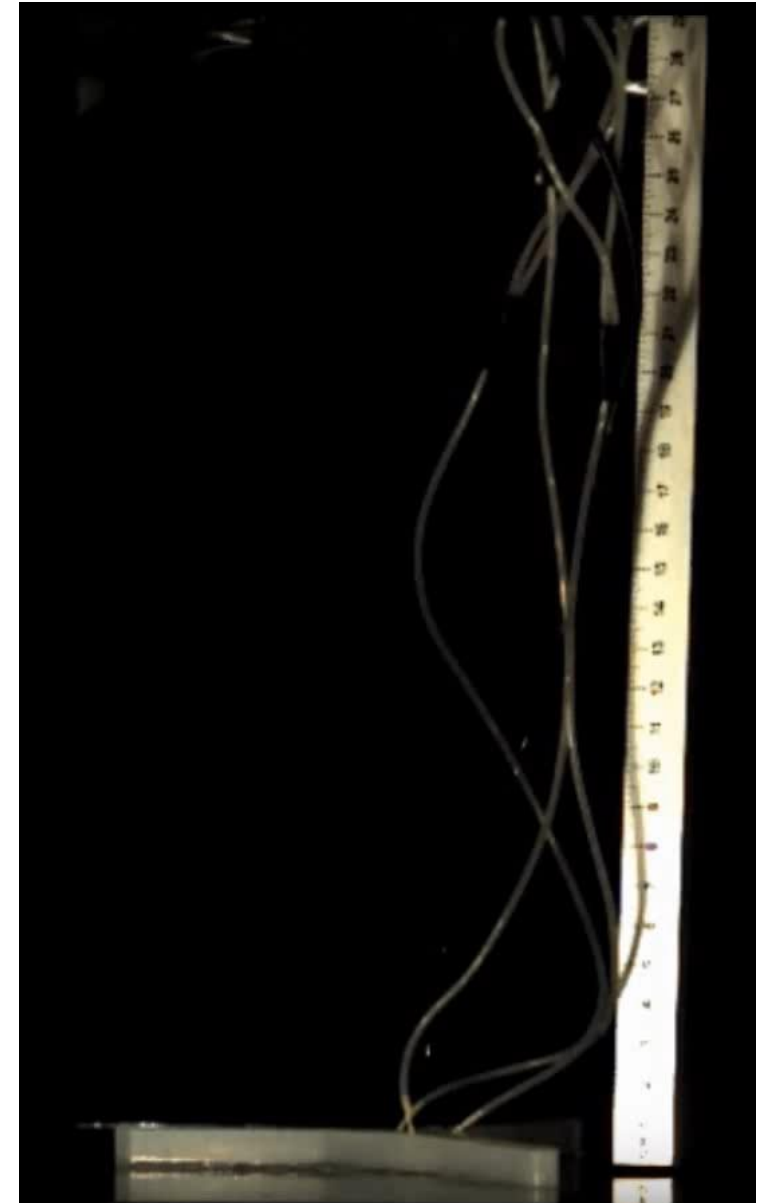
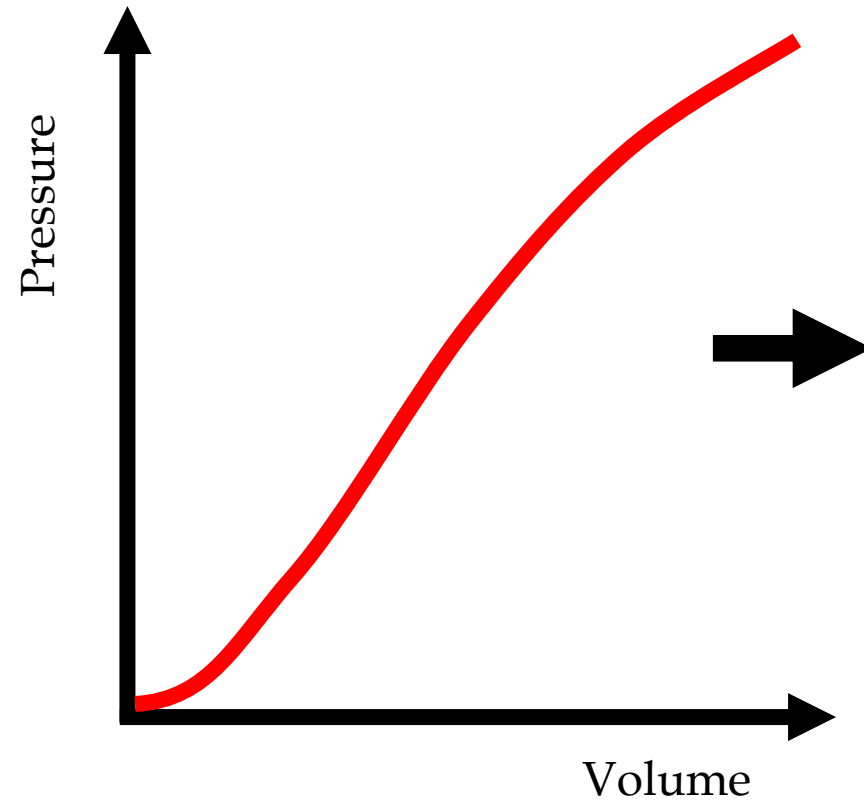
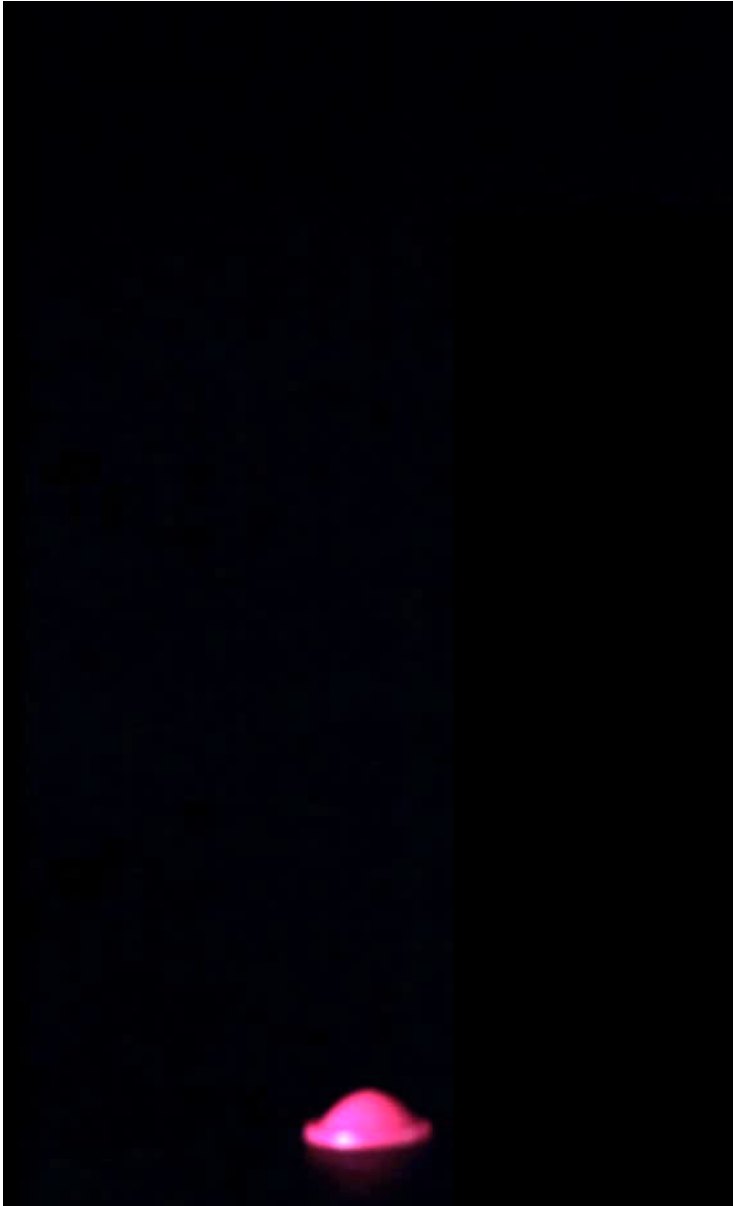
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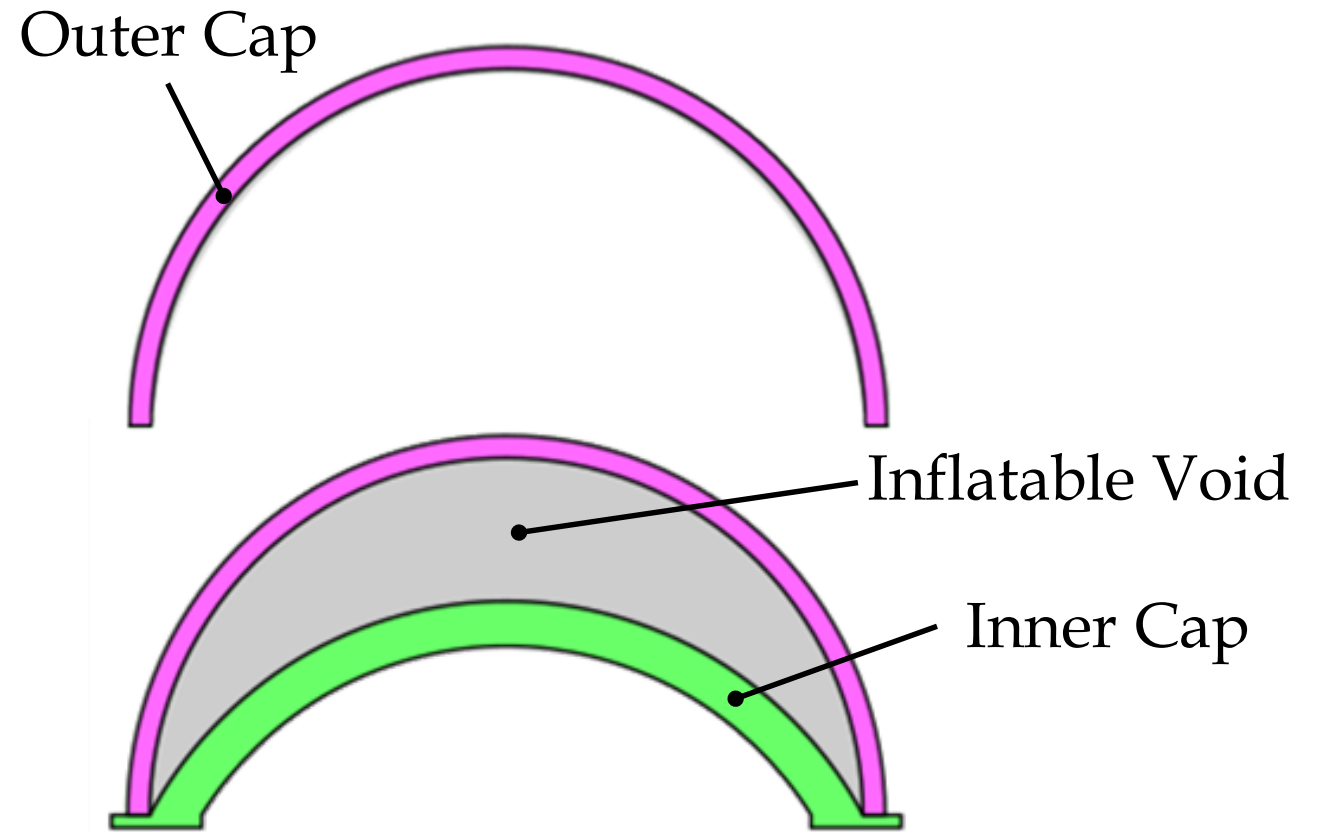
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School of Engineering
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Inflatable Soft Robots

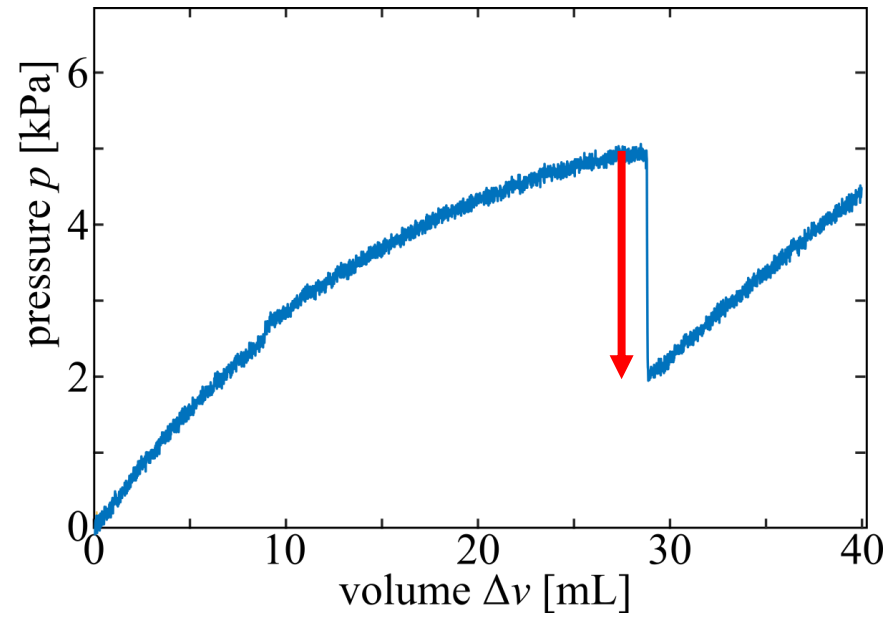


[Shepherd, Angewandte Chemie, 2012]

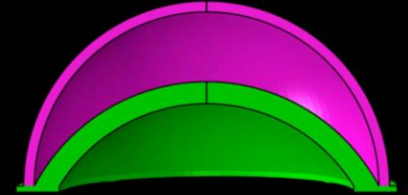
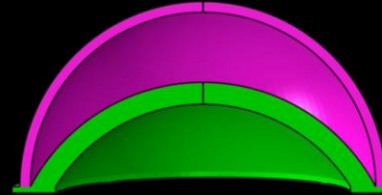
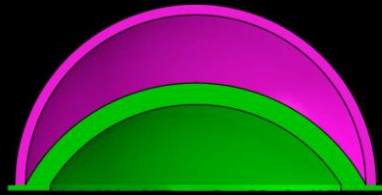
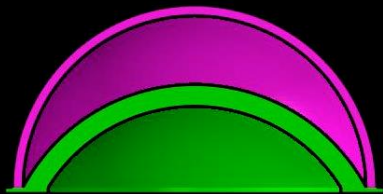
First jumper



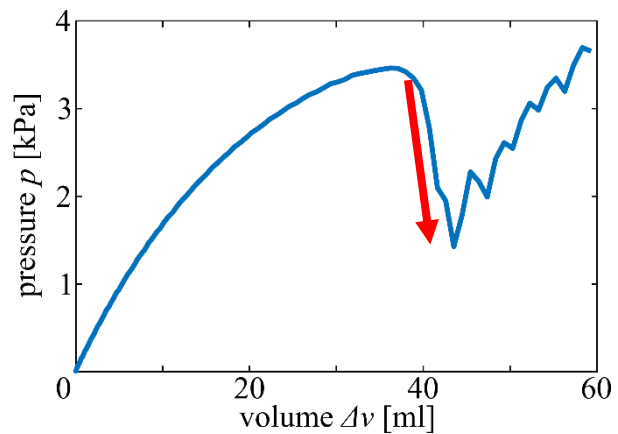
Inflation test



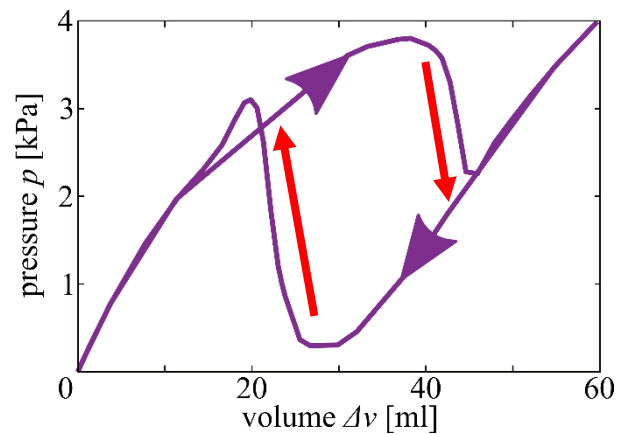
Finite Element Modeling



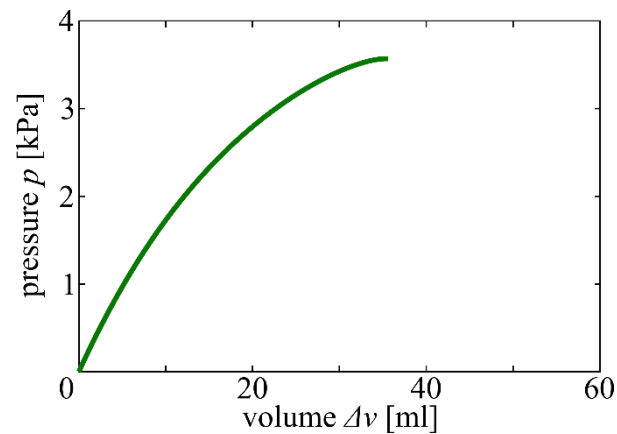
Dynamic Explicit



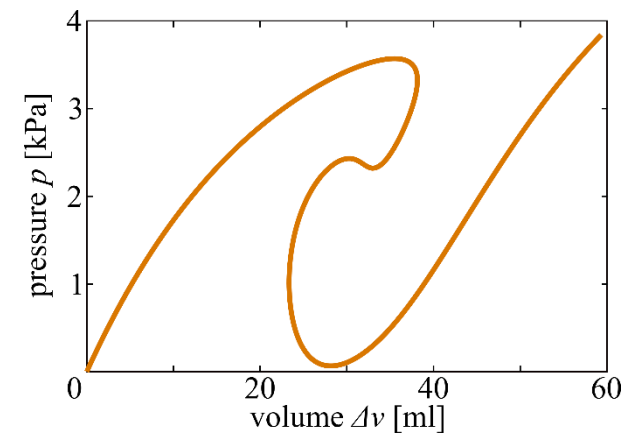
Dynamic Implicit



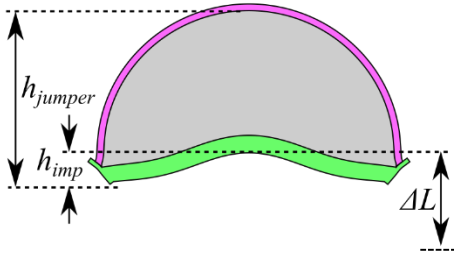
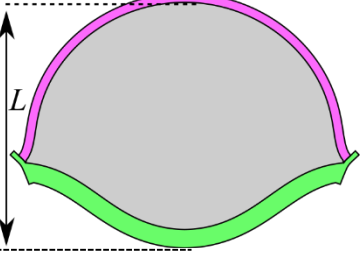
Static General

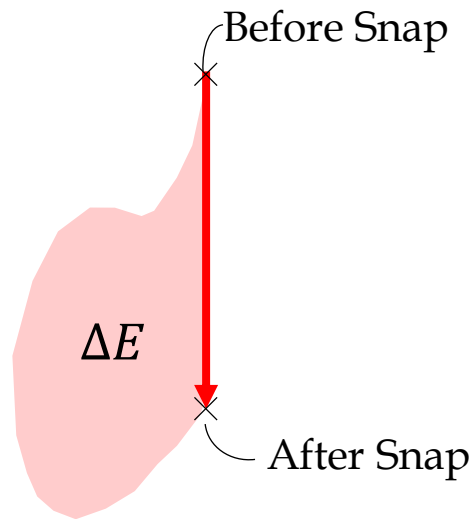


Static Riks

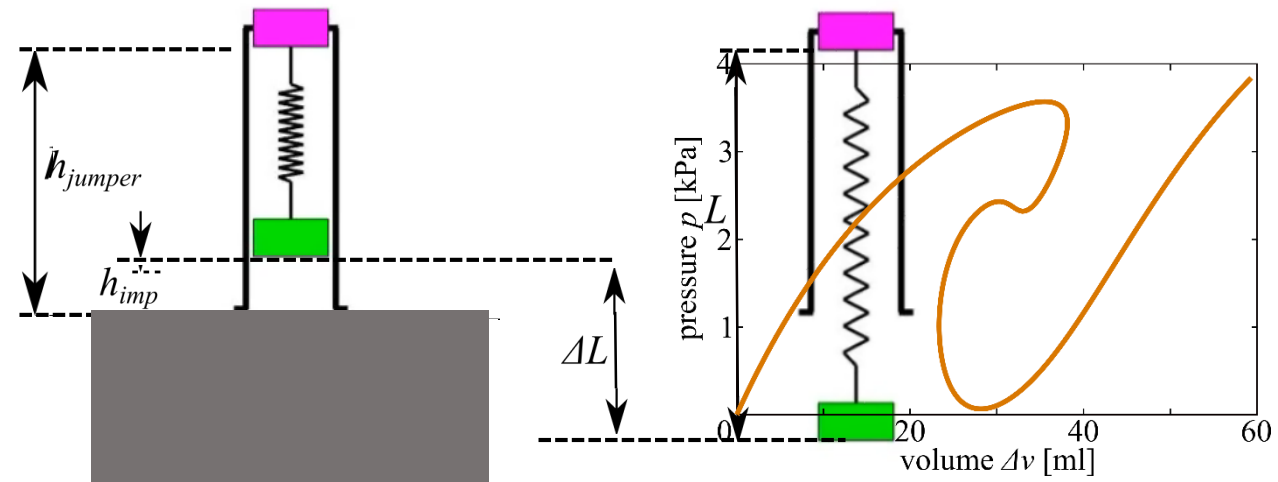


Static Riks

Energy Release	Before Snap	After Snap
$\Delta E = \int p dV$		

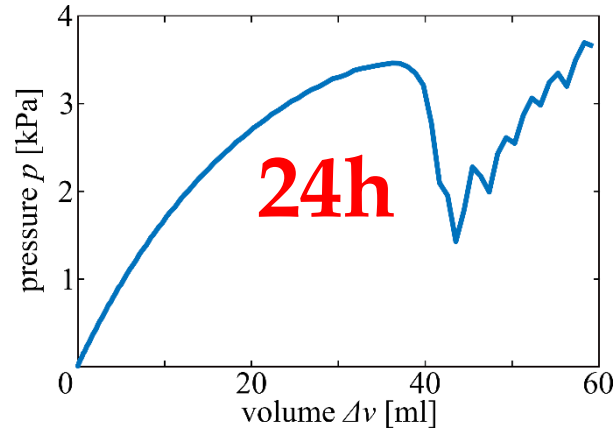


$$\Delta E = \frac{1}{2} k (\Delta L)^2$$

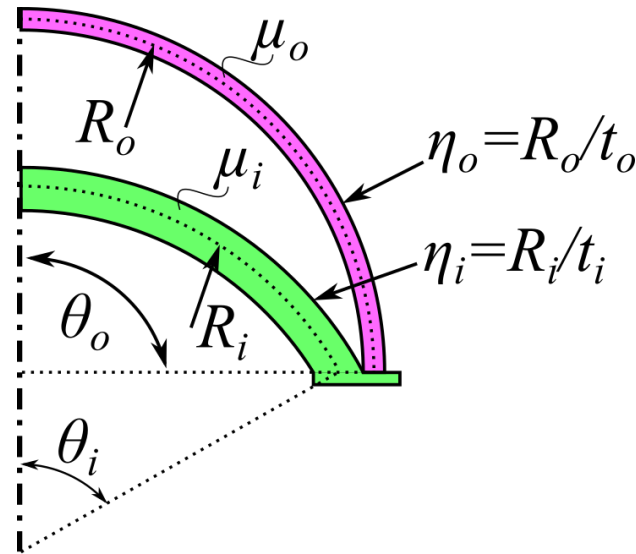
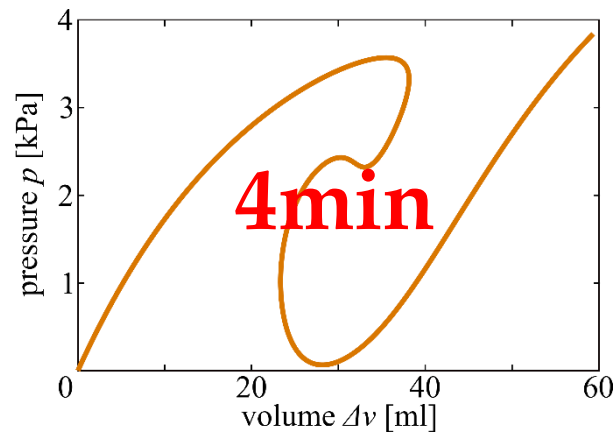


Finite Element Modeling

Dynamic Explicit



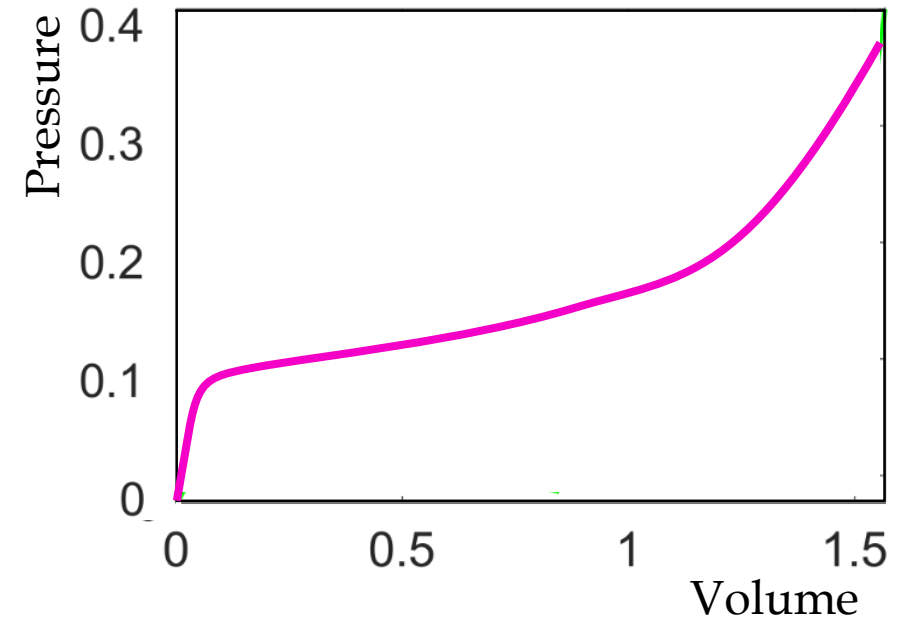
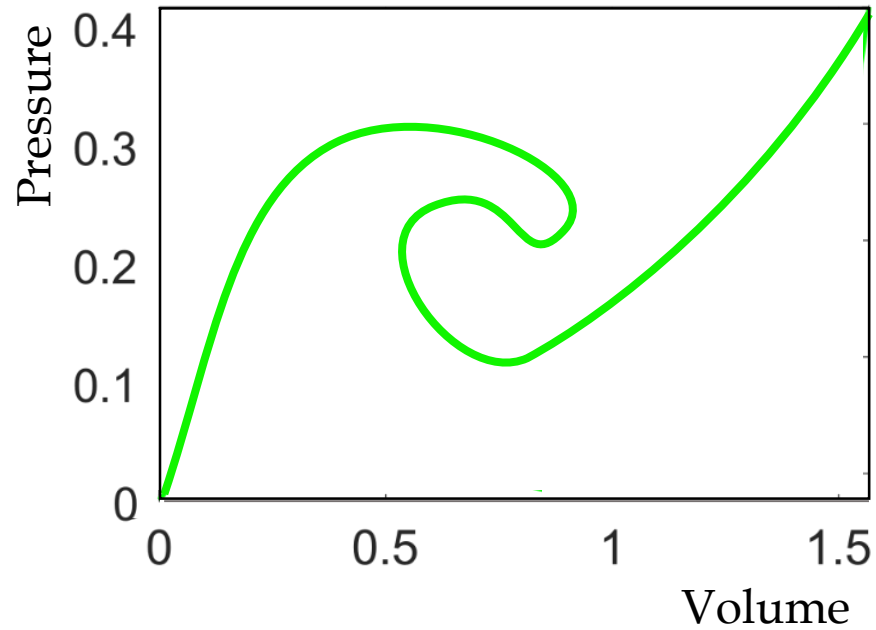
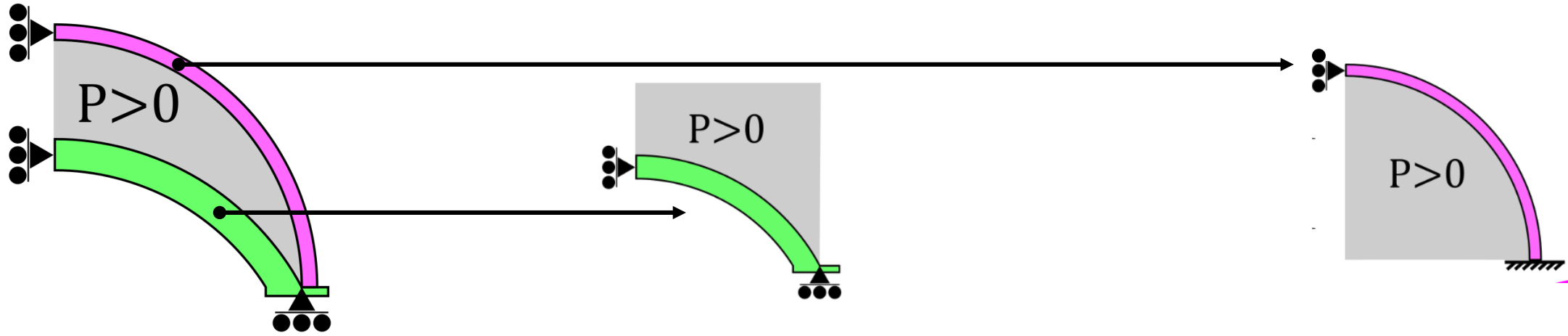
Static Riks



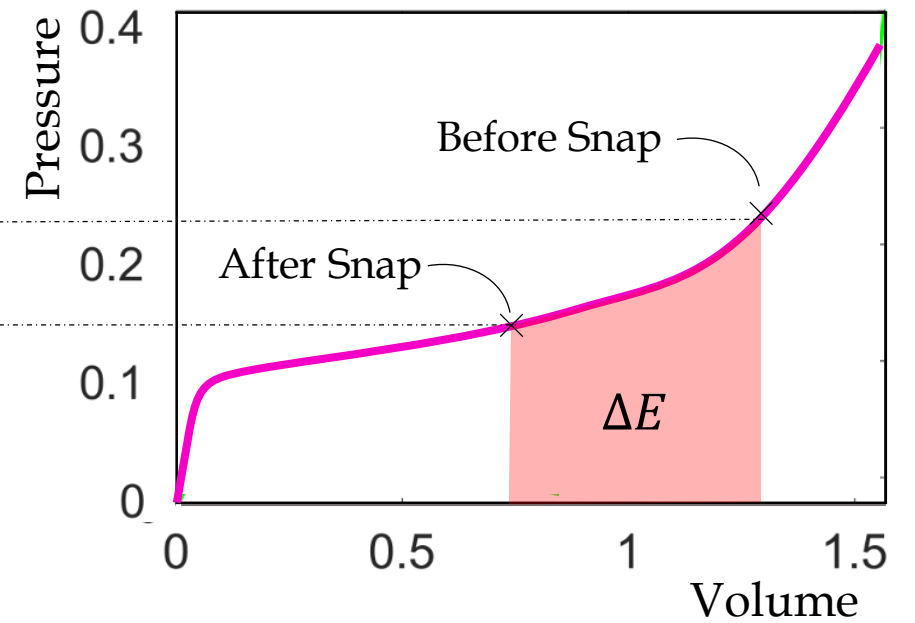
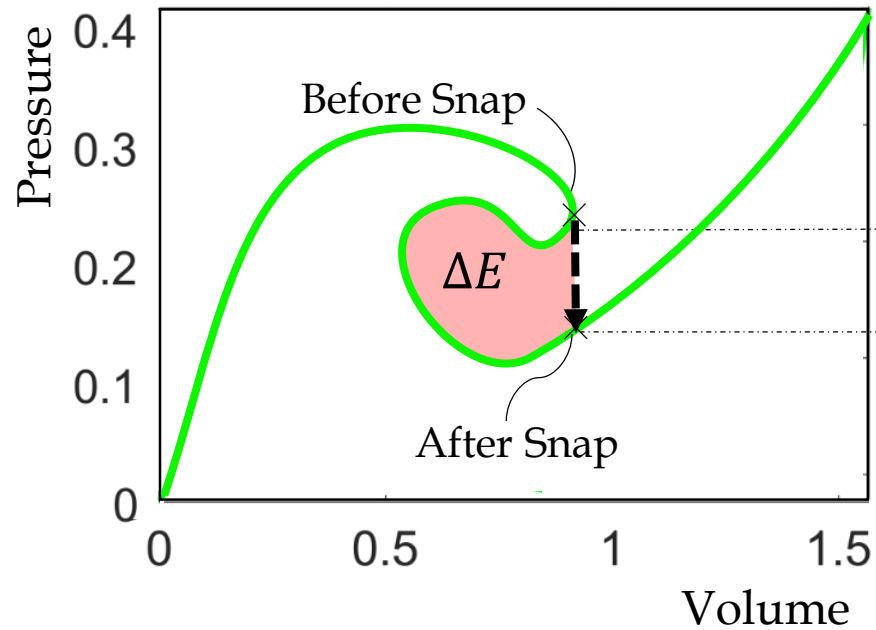
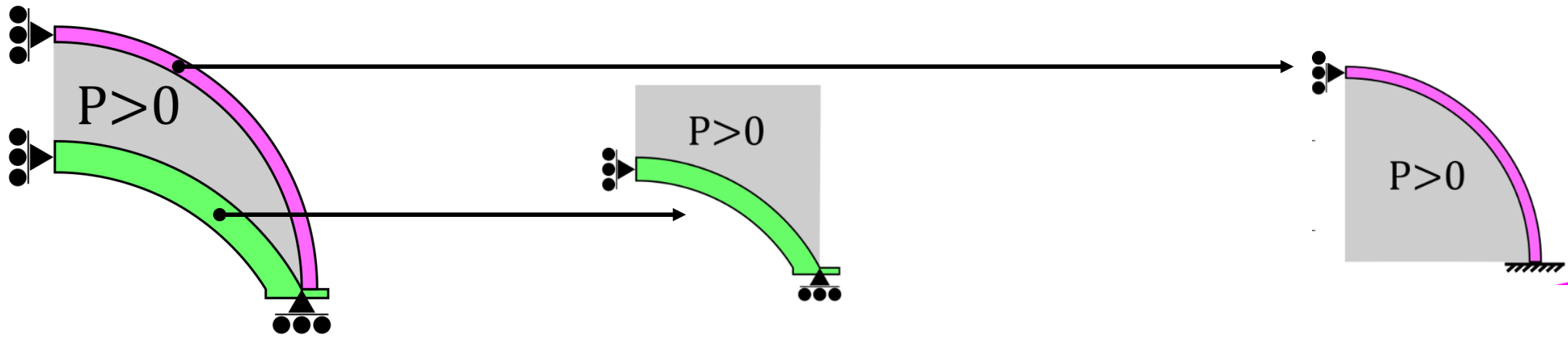
Design Space

- Opening angles:
 - $\theta_i \in [40^\circ, 80^\circ]$
 - $\theta_o \in [40^\circ, 90^\circ]$
- Normalized radii:
 - $\eta_i \in [5, 12.5]$
 - $\eta_o \in [5, 20]$
- Shear moduli ratio
 - $\frac{\mu_i}{\mu_o} = \{1; 5.8\}$
- Length scale
 - $R_i = 30 \text{ mm}$

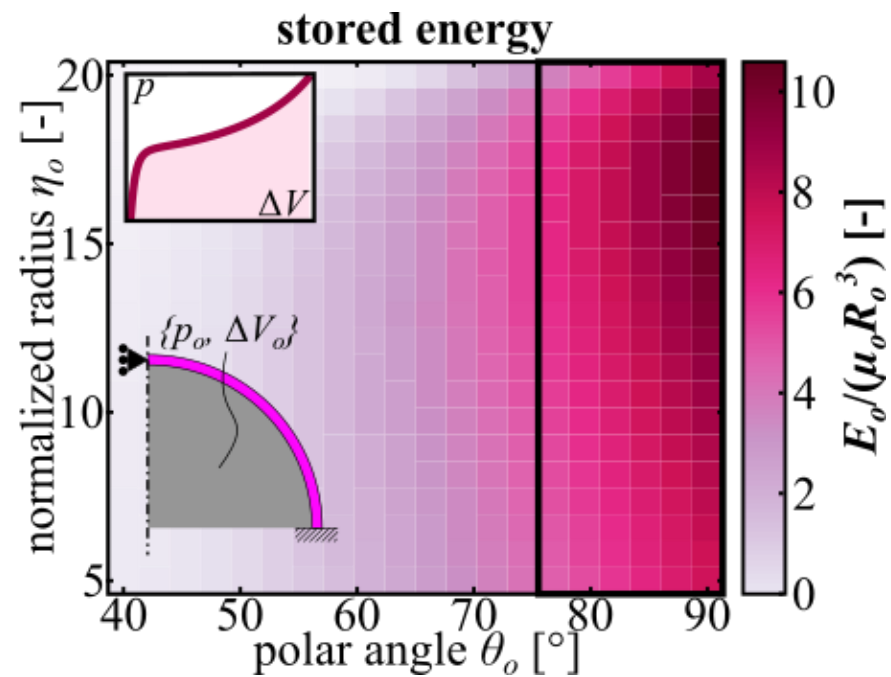
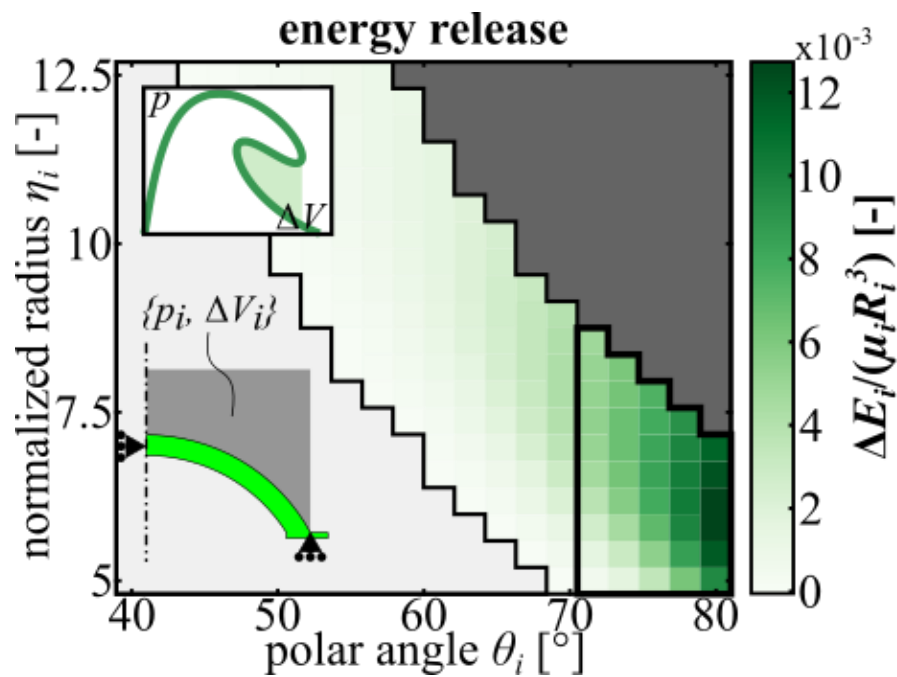
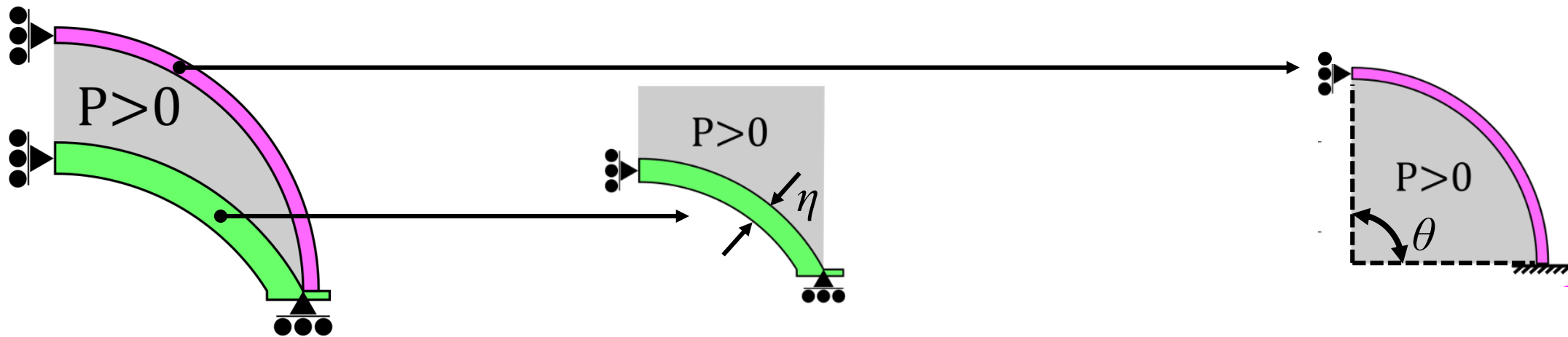
Jump Optimization



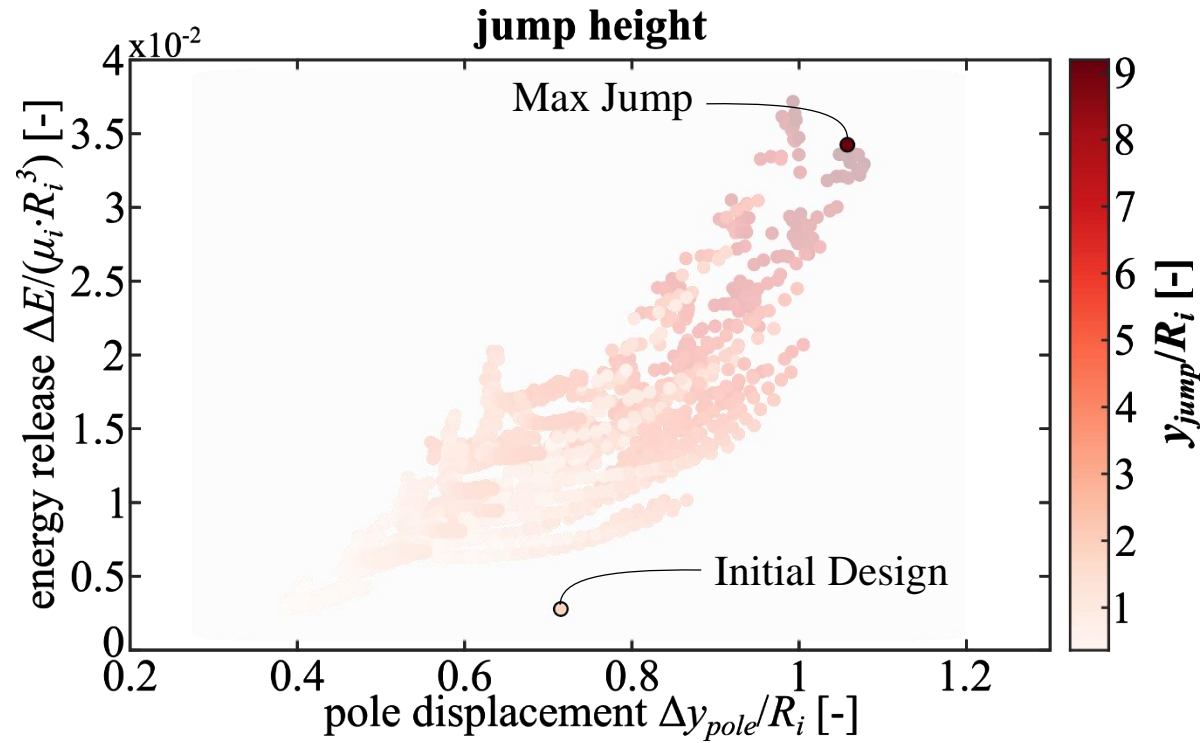
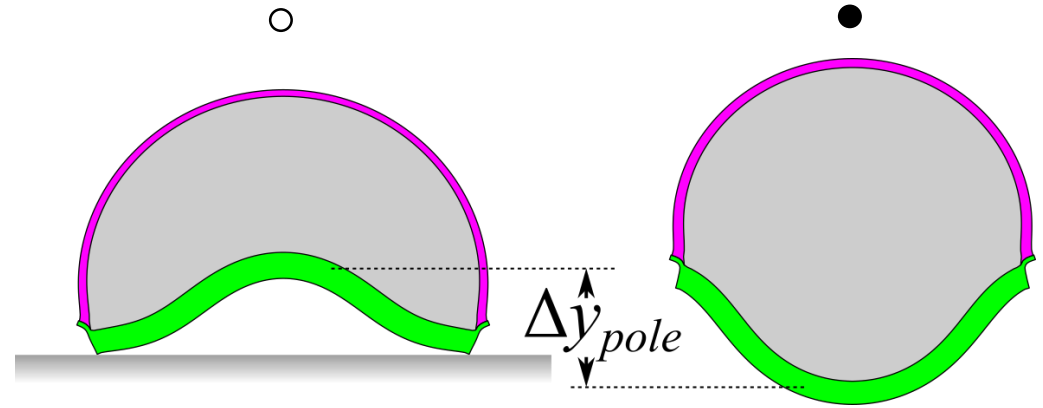
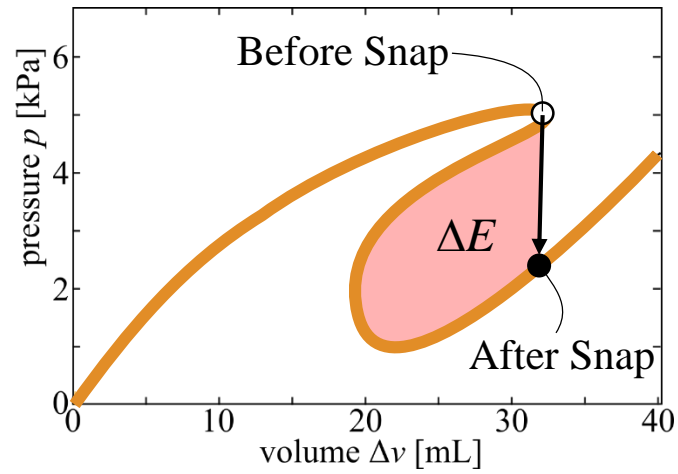
Jump Optimization



Jump Optimization

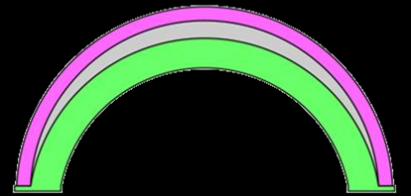
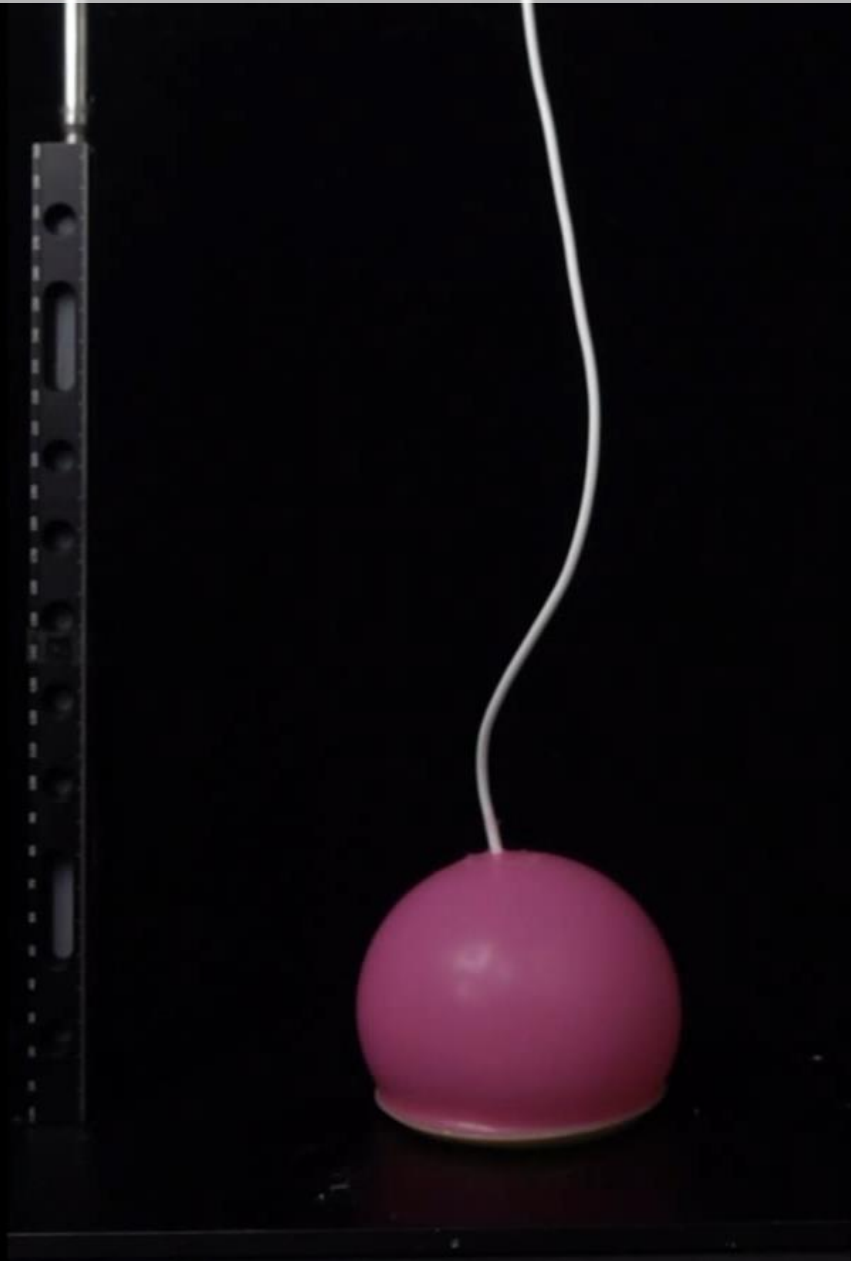
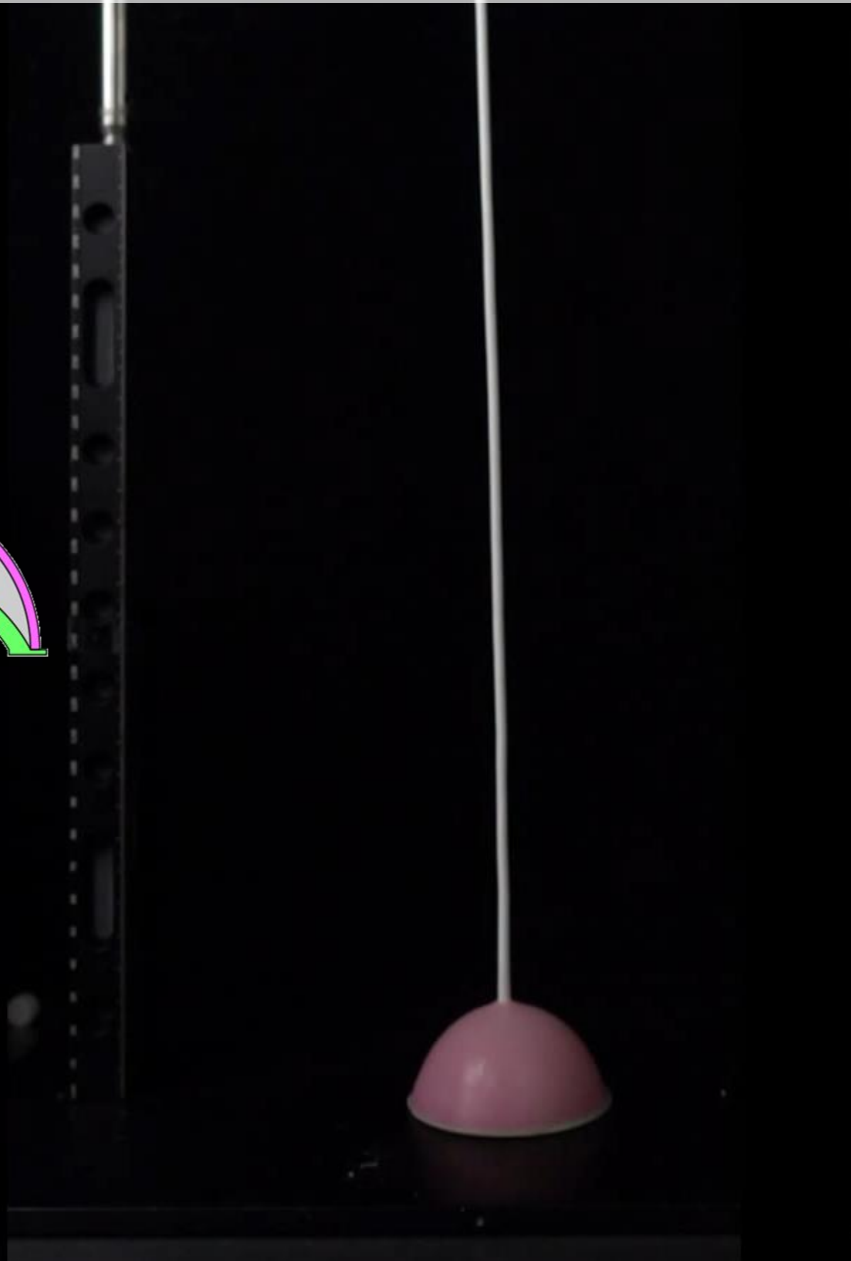
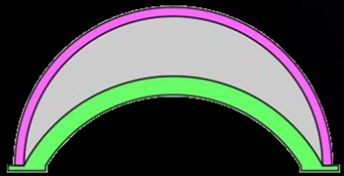


Jump Optimization

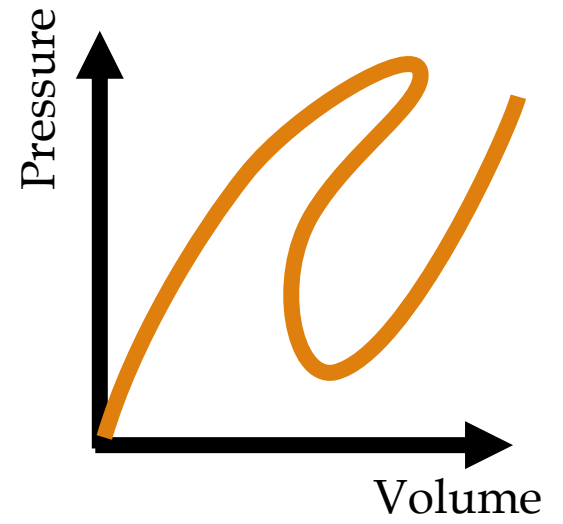
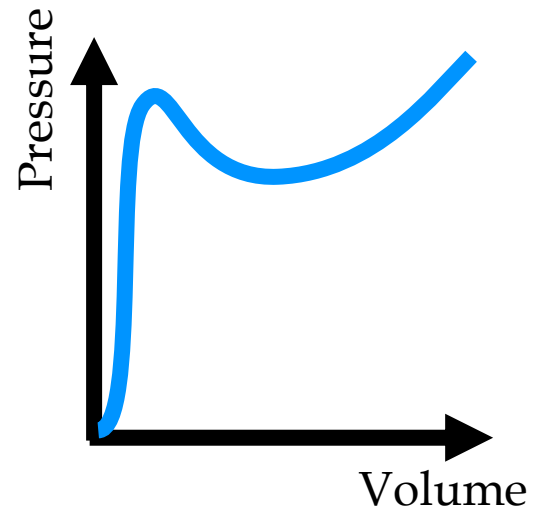
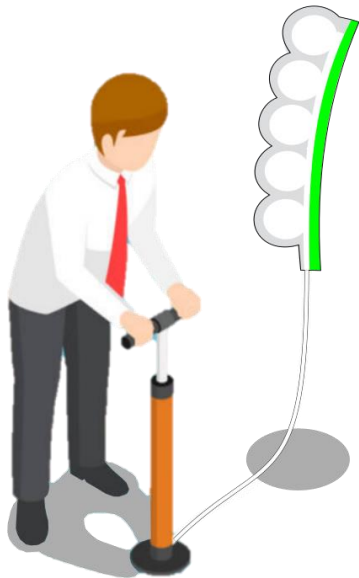
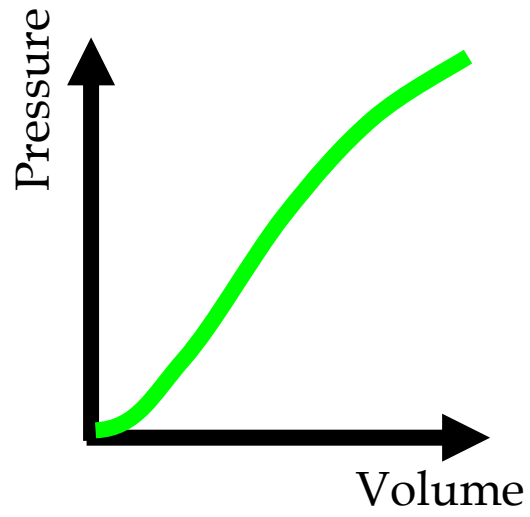


Initial Design

Max Jump

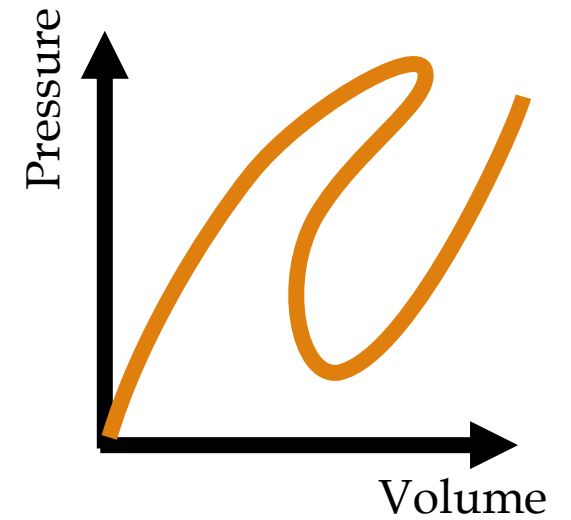


Conclusion



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- ❖ Try to **avoid explicit** simulations
- ❖ **Isochoric snap-through** leads to energy release
- ❖ **Geometry** plays crucial role
- ❖ **Reversible** jump



Thanks to



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Mehdi Torbati