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Structural Simulation of Jellyfish Propulsion: Focus on Post-Contraction Dynamics

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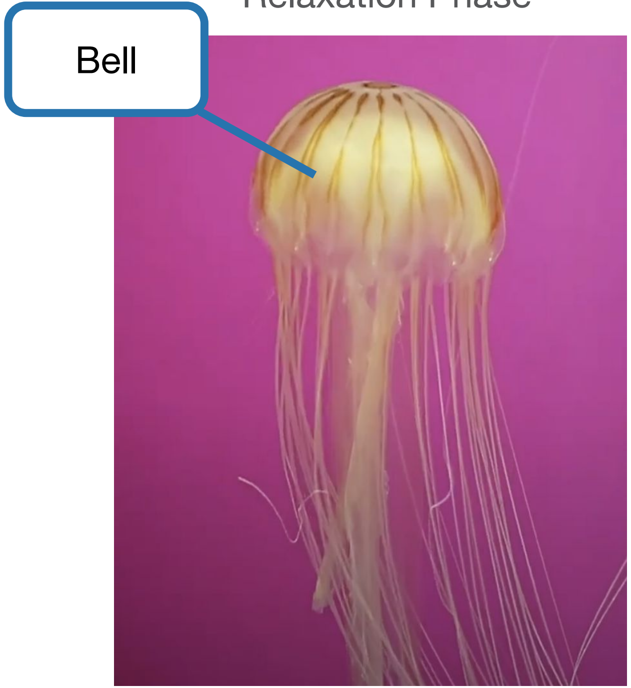
Background On Jellyfish Movement

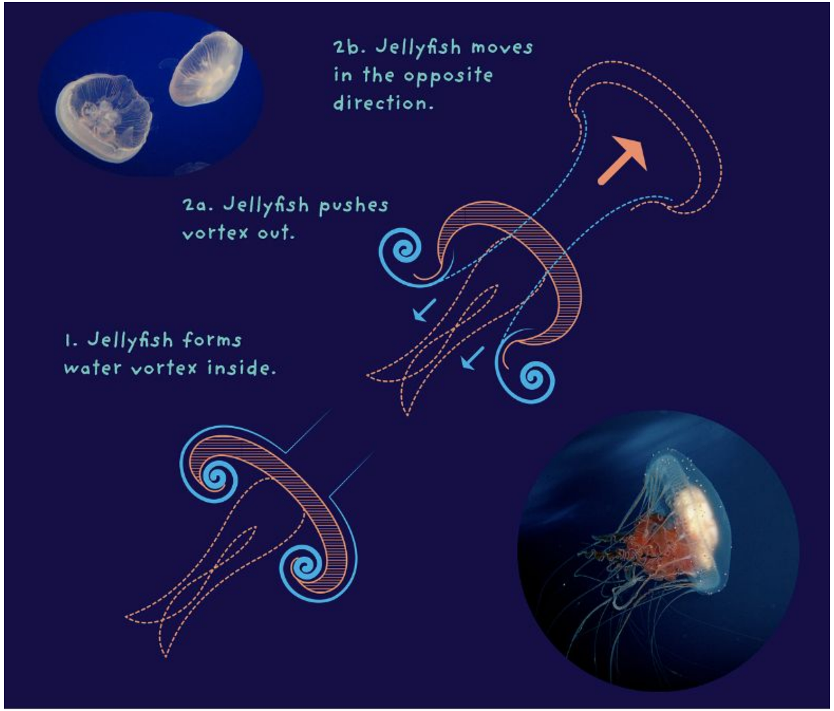
Jellyfish Propulsion Mechanics:

- Jellyfish achieve efficient swimming by contracting their bell to expel water, followed by a passive relaxation phase that aids energy recovery
- We will be modeling this relaxation phase where 32% of travel distance is covered

Relaxation Phase



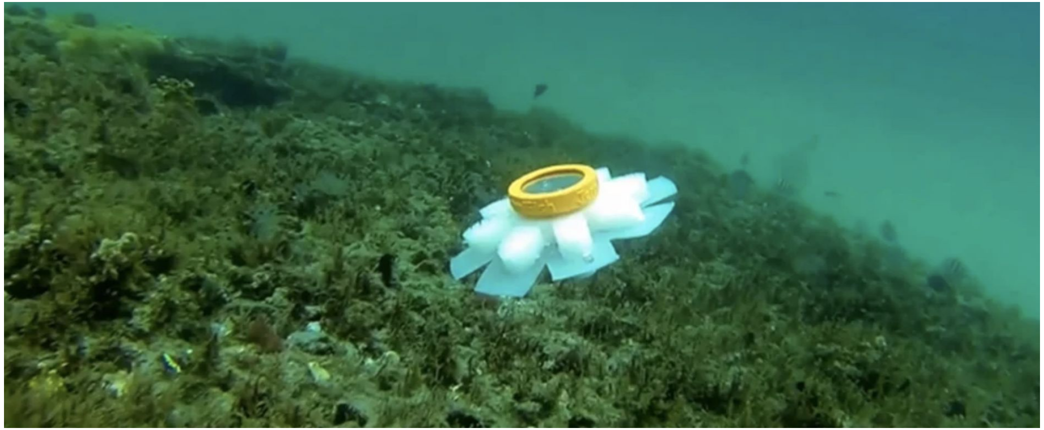
Jellyfish Movement



Motivation

Why this matters:

- Provides insights for bio-mimetic designs in underwater propulsion
- Examines the structural flexibility required for efficient movement in viscous environments
- Jellyfish-like robots are useful for exploring difficult to reach environments



NAVSEA SeaJelly

Structural Model and Methods

Model Components:

- **Rods** - simulate trailing tentacles and passive fluid interactions
- **Rings** - represent the bell's elastic recovery phase, providing a restoring force
- **Plates** - mimic the bell surface, capturing the role of elasticity in propulsion

Equations of Motion:

- $$m\frac{d^2x}{dt^2} + c\frac{dx}{dt} + kx = F_{\text{drag}}$$
- $$F_{\text{drag}} = -\frac{1}{2}\rho C_d A v^2$$

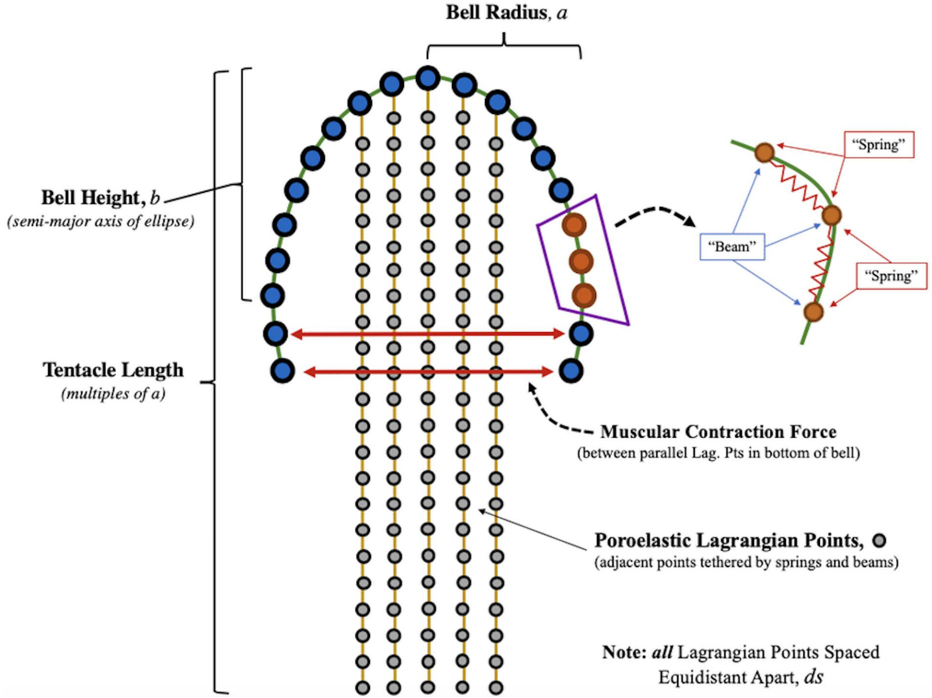
Expected Outcomes and Conclusion

Expected Insights:

- Analysis of how flexible structures achieve passive energy recovery
- Examination of the interplay between flexible structures and drag

Conclusion:

- This simplified model offers a foundational understanding of jellyfish propulsion mechanics and potential applications in soft robotic and aquatic designs



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