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# Simulation for Brachial Plexus Injury Inducing Device

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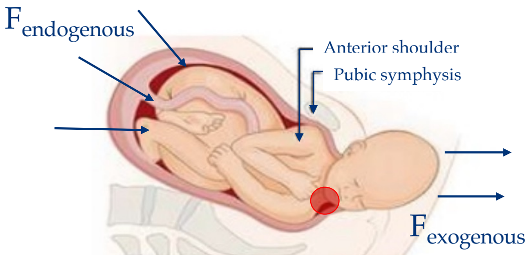
## Problem: Neonatal Brachial Plexus Injury

- 3 in 2000 births → 20 - 30% no total neurological recovery
- No measure between degree of injury and forces during birth
- Existing Solution: Developing device to perform controlled *in vivo* stretch of the neck to induce BPI in a neonatal piglet model

**Goal:** Create a computational model to estimate distraction force induced to the neck by the device

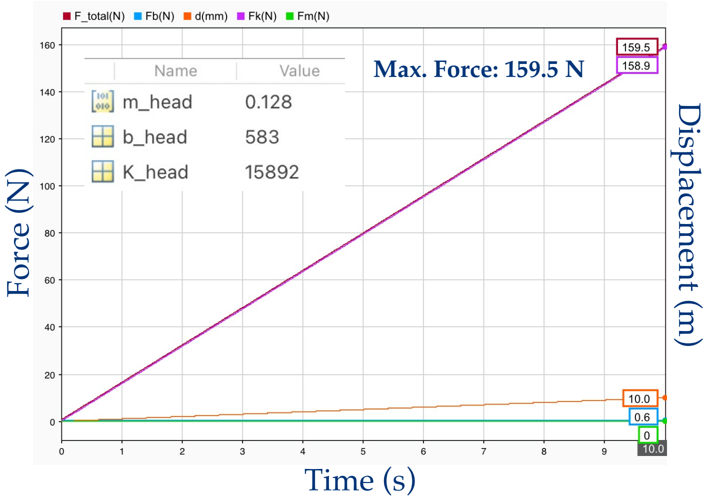



### Design Inputs

R1. Displacement rate up to **10 mm/s**
R2. Max. displacement up to **100 mm**
R3. Estimate force up to **250 N**

## Testing Results

Test 1. 10 mm/s for 10 s @ **30%** **κ** ratio



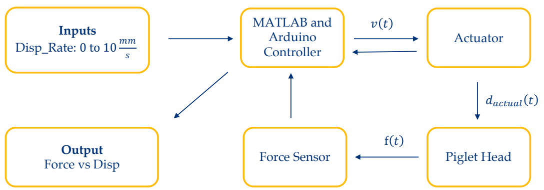

| Rate up to 100 mm | Stiffness | Max. Force |
|---|---|---|
| 10 mm/s | 15892 $\frac{N}{m}$ | 159.5 N |
| 1 mm/s | 15892 $\frac{N}{m}$ | 1589.8 N |
| 10 mm/s | 7946 $\frac{N}{m}$ | 80 N |
| 10 mm/s | 31784 $\frac{N}{m}$ | 318.4 N |

Possible Errors

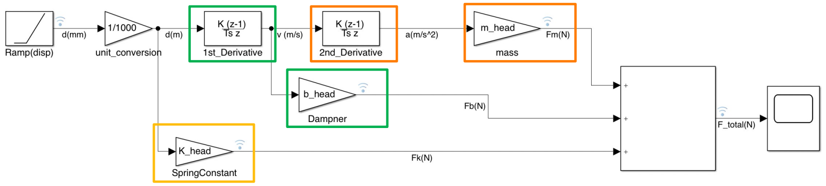
1. Inaccurate assumptions
2. High strain rate of 112%

## Solution

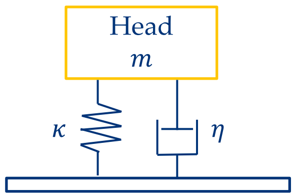
### Flow Diagram of System




$$F_{Total} = \kappa \cdot x(t) + \eta \cdot \dot{x}(t) + m \cdot \ddot{x}(t)$$




### Model of Piglet Head




| Parameters | Piglet Head |
|---|---|
| $m\ (kg)$ | 0.128 |
| $\eta\ \left(\frac{Ns}{m}\right)$ | 583 |
| $\kappa\ \left(\frac{N}{m}\right)$ | 15892 |

## Future

### Revisions

1. Improve accuracy for stiffness assumptions, viscoelastic behavior, and validation with device build components
2. Incorporate all device components with interface connectivity

### Impact

- Adapting a piglet model will aid researchers to understand the injury mechanisms of BPI
- Computational modeling will provide more accurate testing for the device components for the current build – such as model suggestions on high load from high strain rates