

Motivation, Goal, Impact

Motivation: 3453 aquaculture organizations nationwide that experience biofouling [1]

Goal: Increase cleaning efficiency and reduce cleaning time

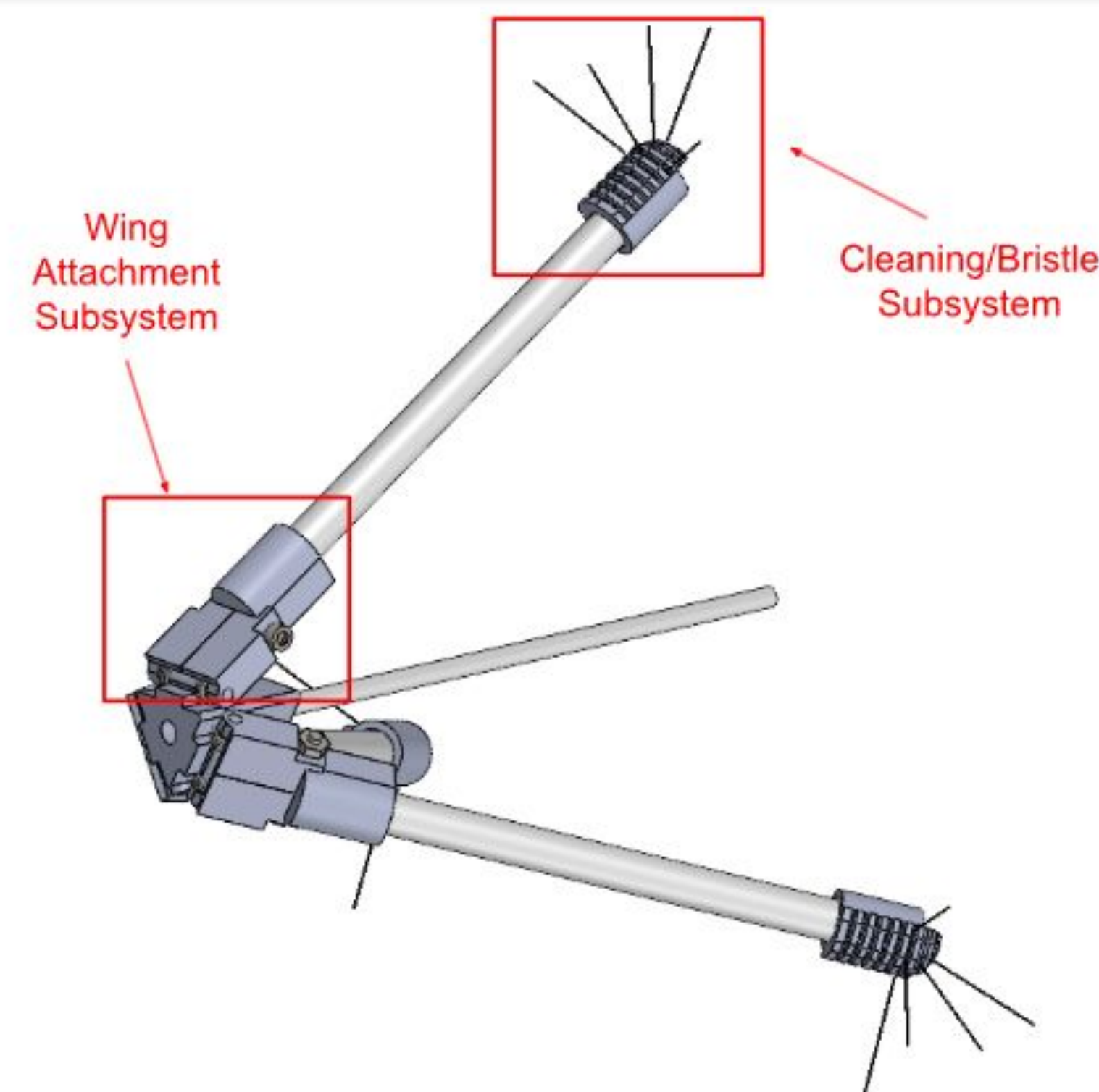
Impact: Overall increase in aquaculture life output



[1] USDA NASS, "USDA releases the 2023 Census of Aquaculture results," Dec. 16, 2024.

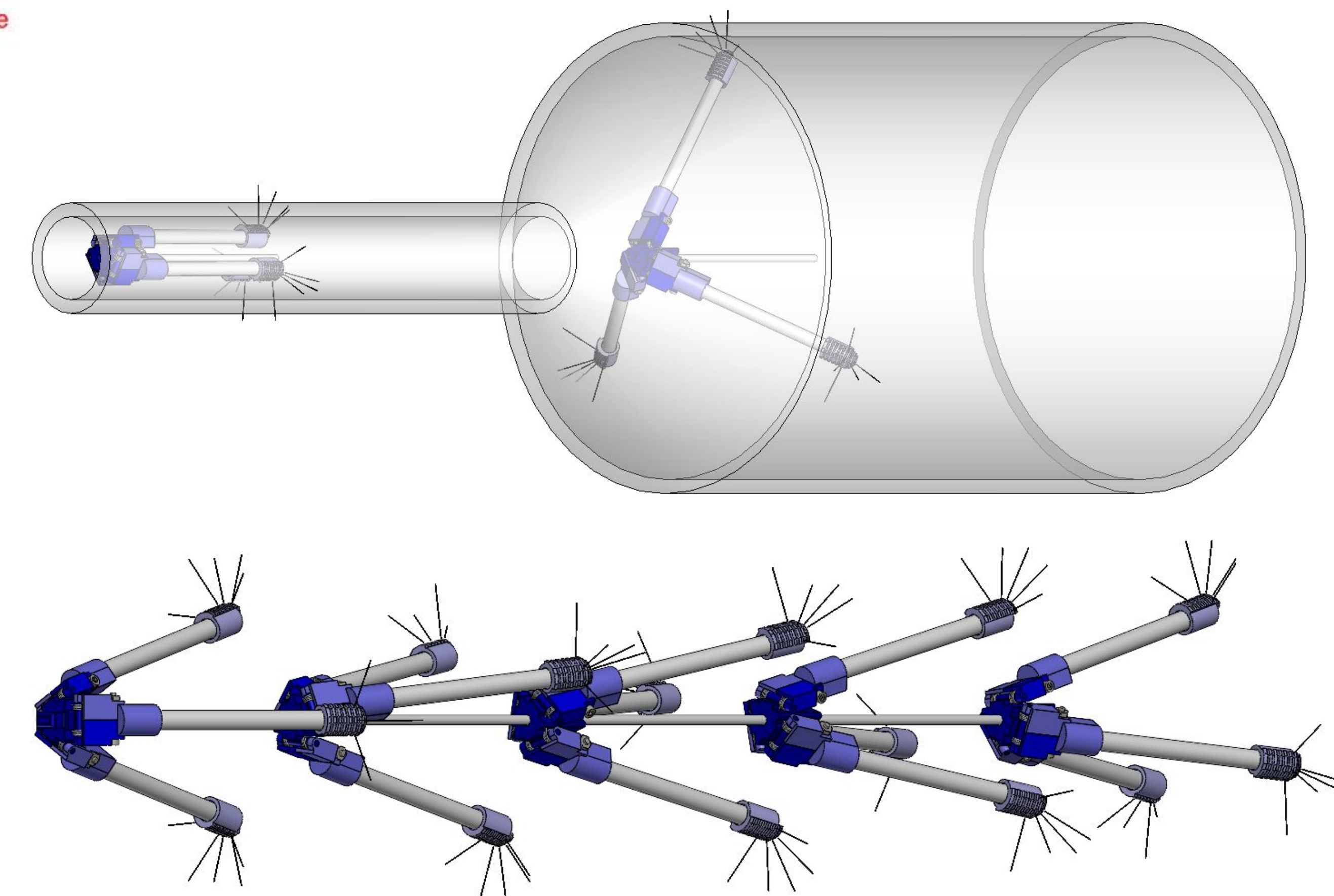
Requirements

- Accommodate 1.5" to 8" pipe diameters
- Achieve $\geq 90\%$ fouling removal efficiency
- Traverse 90 degree bends
- Work with existing pipe infrastructure
- Simple to operate/maintain

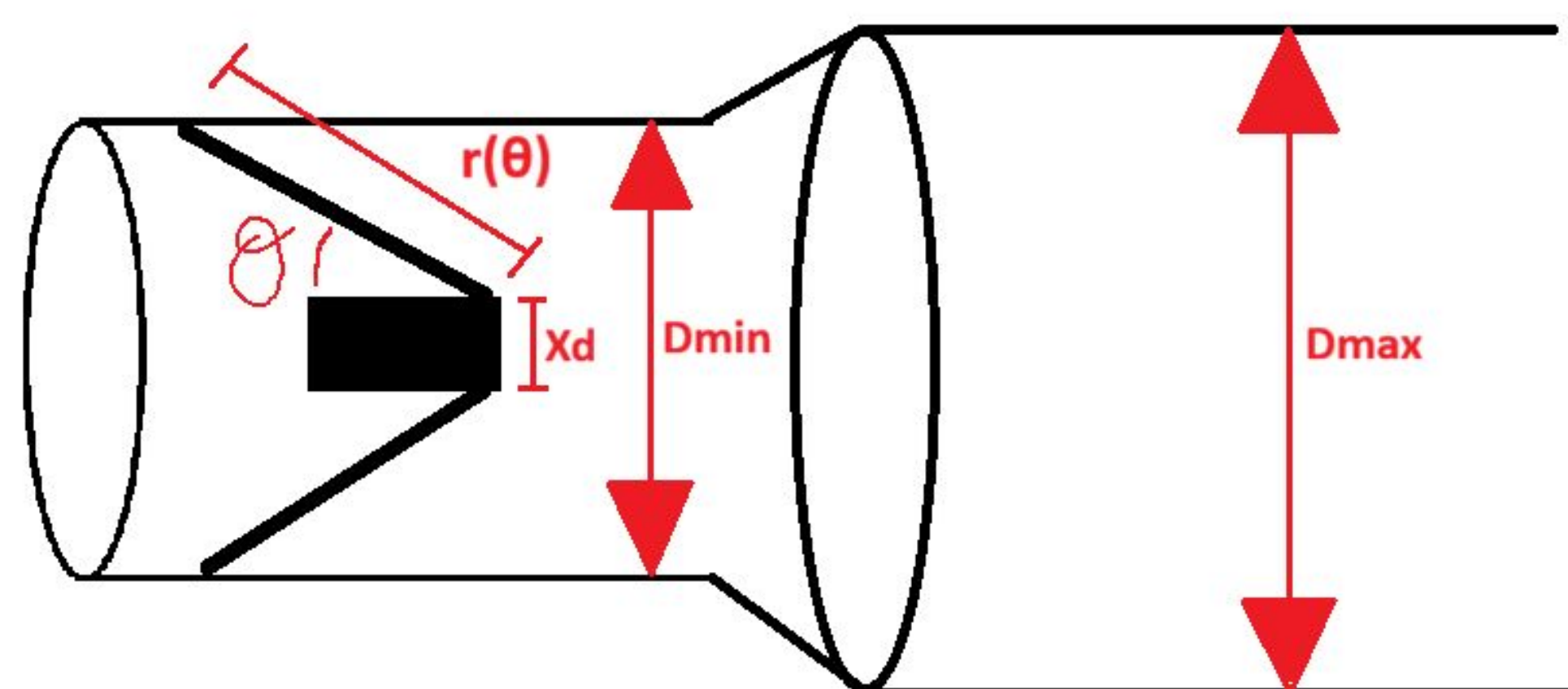


Each body contains 3 cleaning wings that deform to diameter with torsional springs; the entire system is connected to each other

Final Design



Design Calculations & Decisions

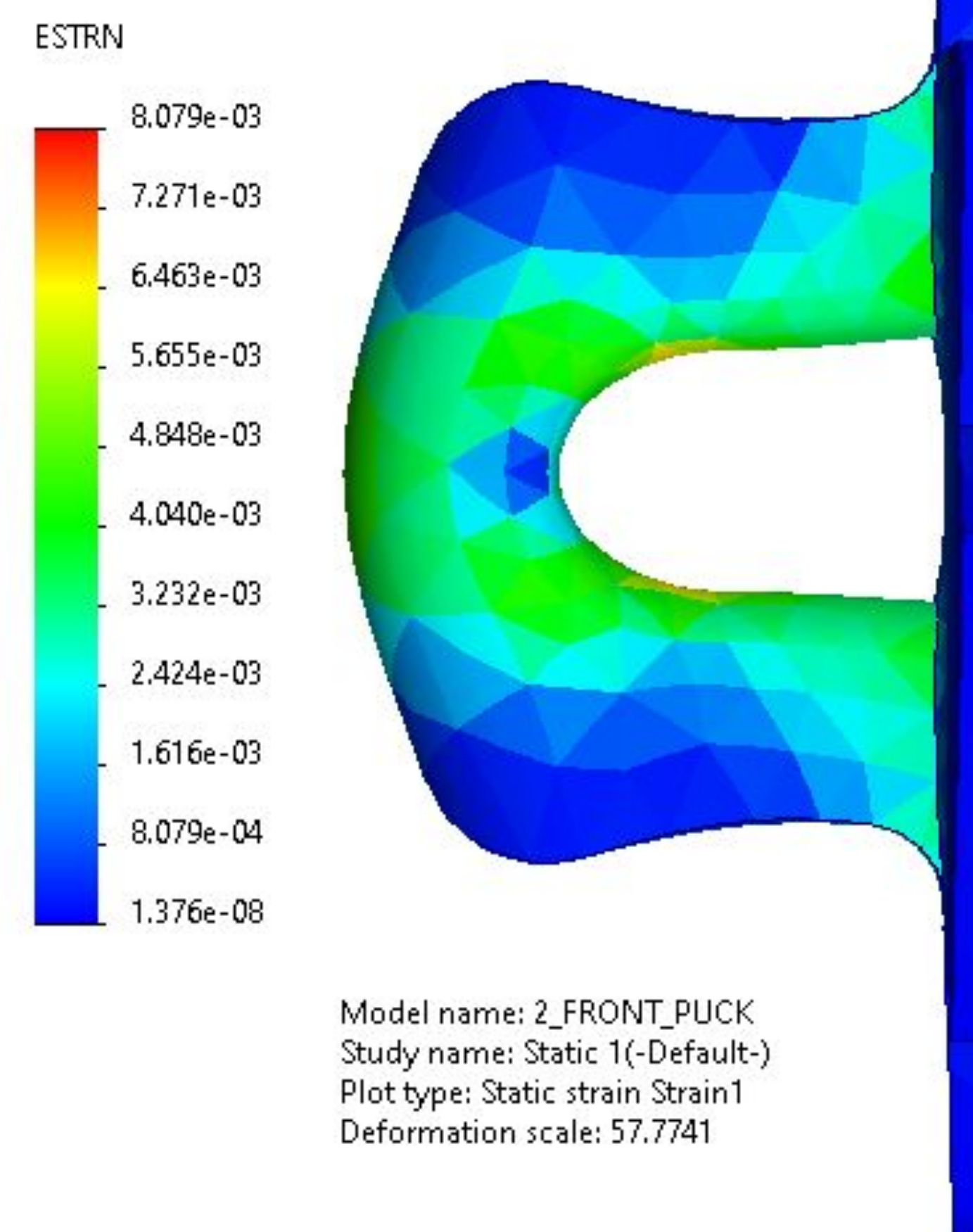


$$r(\theta) = L \sin(\theta) = \frac{D - X_D}{2}$$

Device Diameter (X_D): We found the desirable device diameter by balancing the relationship between pipe diameter and the allowable deformation angles

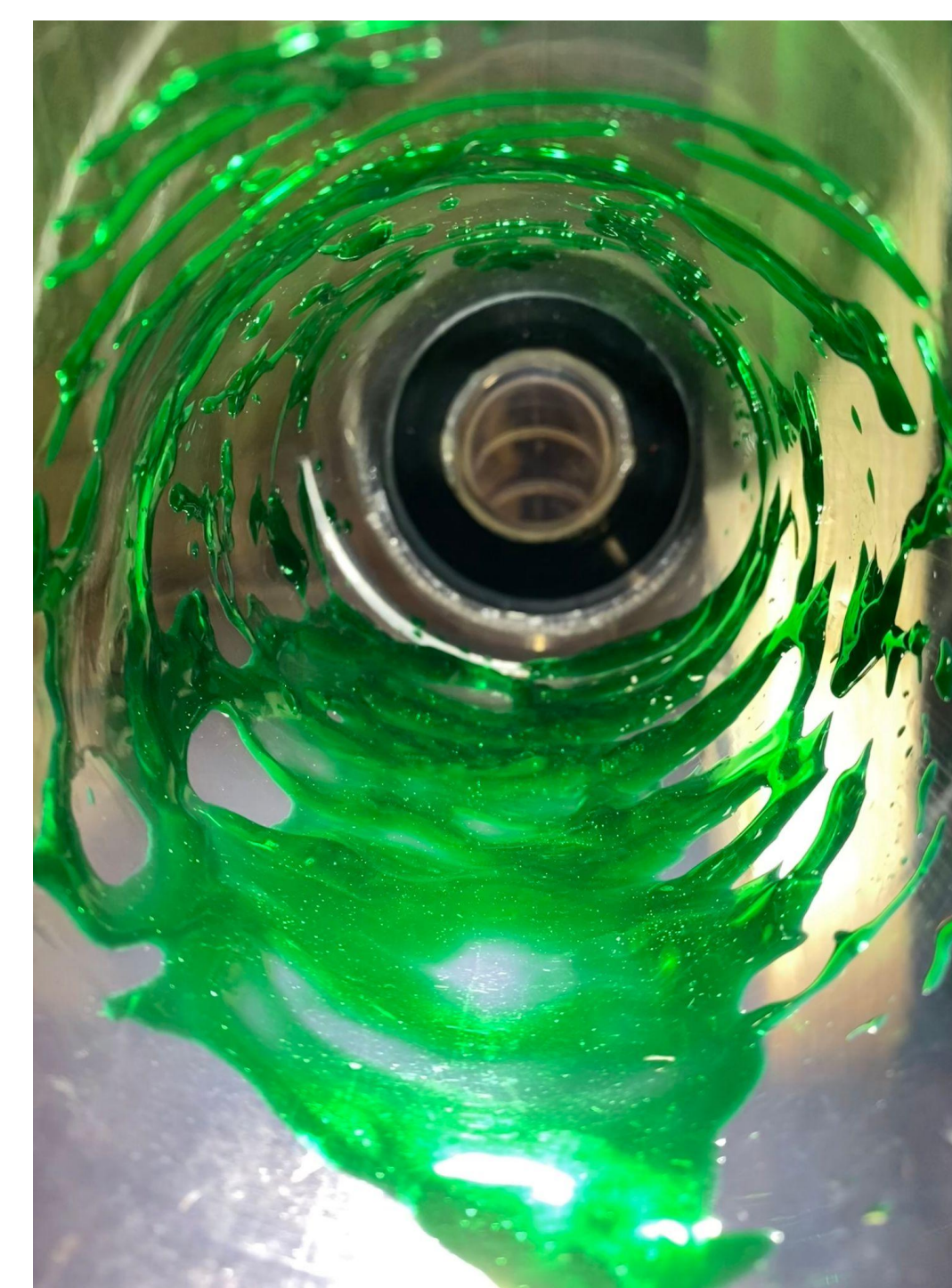
Wing Length (L): We found the precise wing length needed to ensure direct contact with the range of pipe diameters

Size and Placement of Hook: By conducting FEA iterations, we found a best area-placement position using our current design



Prototype & Test Results

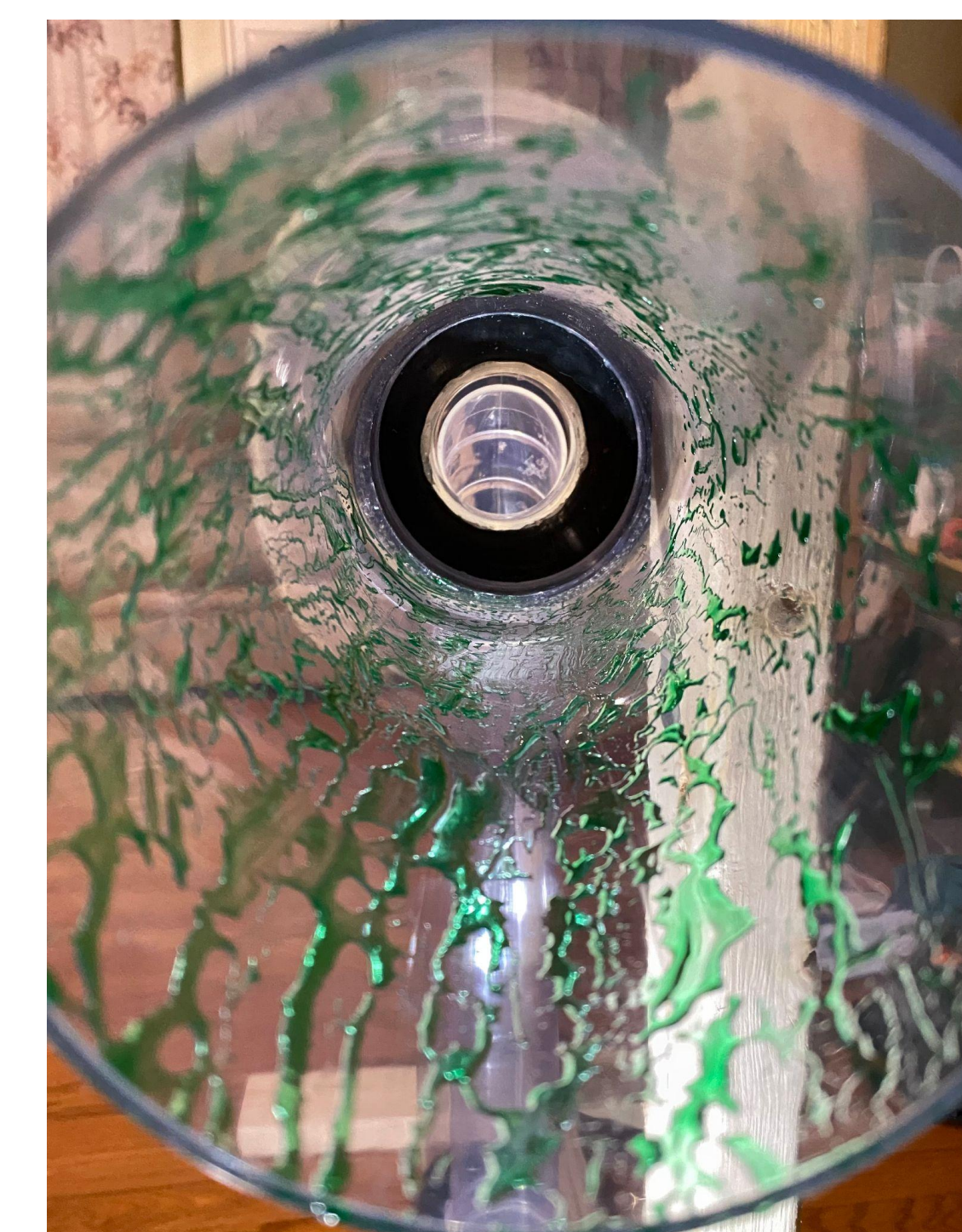
- Transparent PVC piping rig using aloe vera to simulate biofouling
- Using both visual and mass-based data, we concluded that our prototype [DOES] work for the $\geq 90\%$ fouling removal efficiency



Before



During



After