

H2Woah: We Try to Catch the Fog, We Hope We Do Not Mist It

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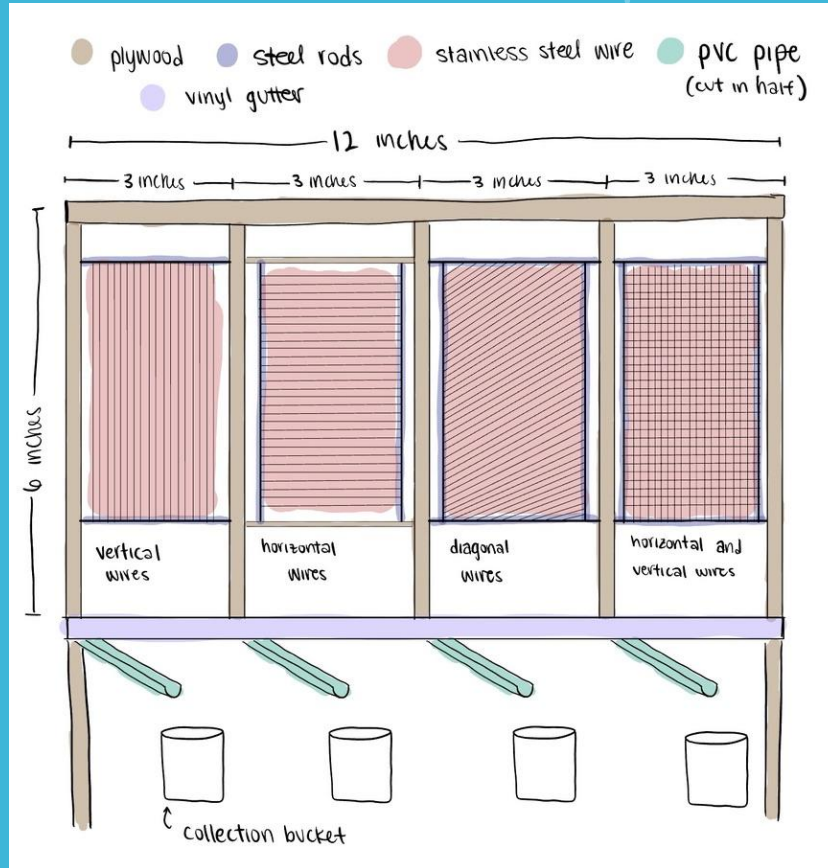
Background and Objectives

Design Focus: What is the best wire orientation with the same area for optimized water collection in a fog harp?

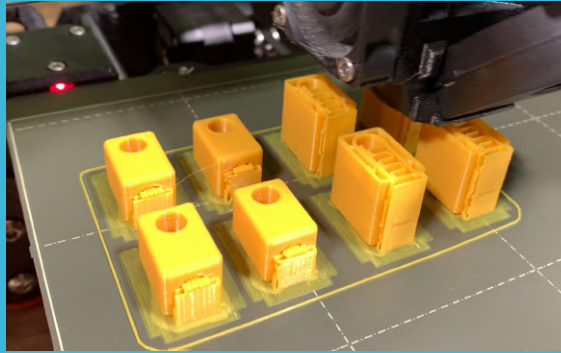
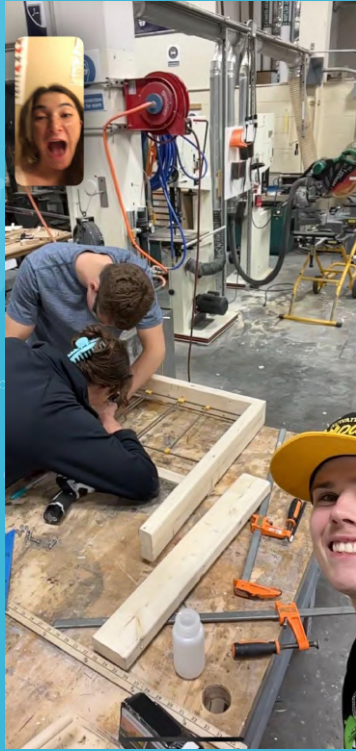
- Renewable source for freshwater using fog
- Decided to test four different designs:
 - (1) Vertical
 - (2) Horizontal
 - (3) Diagonal
 - (4) Mesh (both horizontal and vertical)



Schematic

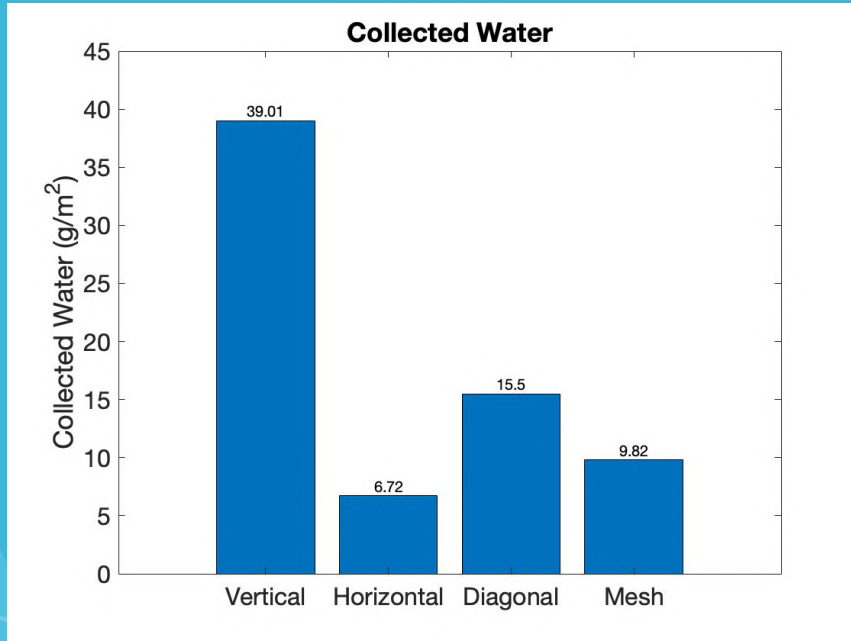


The Build



Preliminary Results

- 3 hour data collection
- 1 hr of additional water production
- No external sensors used to characterize fog



Data Acquisition

- Time – 55 minutes for all trials
- Use of three sensors: temperature, relative humidity, and total pressure
- Measured collected water weight



Filtered Fraction and Aerodynamic Collection Efficiency (ACE)

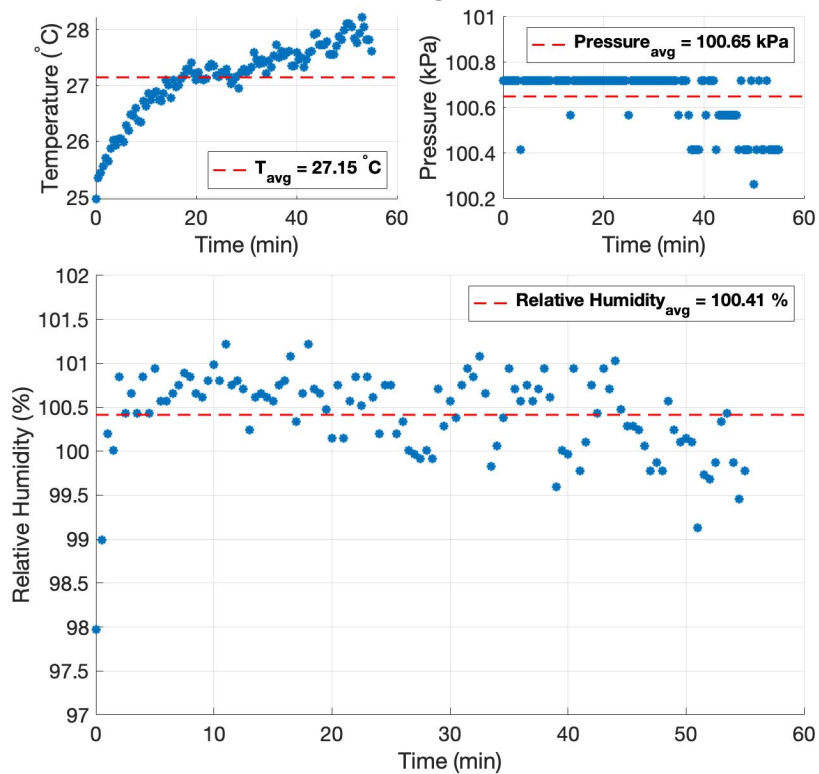
$$\lim_{d_{\infty} \rightarrow d} \eta_{tot} = \eta_{ACE} = \underbrace{\frac{A_{\infty}}{A}}_{\varphi} \underbrace{[(1 - (1 - s)^N)]}_{\chi}$$

	Model 1 (vertical wires)	Model 2 (horizontal wires)	Model 3 (diagonal wires)	Model 4 (mesh wires)
Calculated η_{ACE}	0.87	0.73	0.8	0.63
Calculated s (shade coefficient)	0.13	0.27	0.2	0.37

Model from Rivera (2011) shows a max ACE for values of s between 0.5 and 0.6

Relative Humidity + Temperature + Pressure

Trial 2 Fog Conditions



Trial 1:

$$T_{avg} = 26.20^{\circ}\text{C}$$

$$P_{avg} = 101.1\text{ kPa}$$

$$RH_{avg} = 99.75\%$$

Trial 2:

$$T_{avg} = 27.15^{\circ}\text{C}$$

$$P_{avg} = 100.65\text{ kPa}$$

$$RH_{avg} = 100.41\%$$

Trial 3:

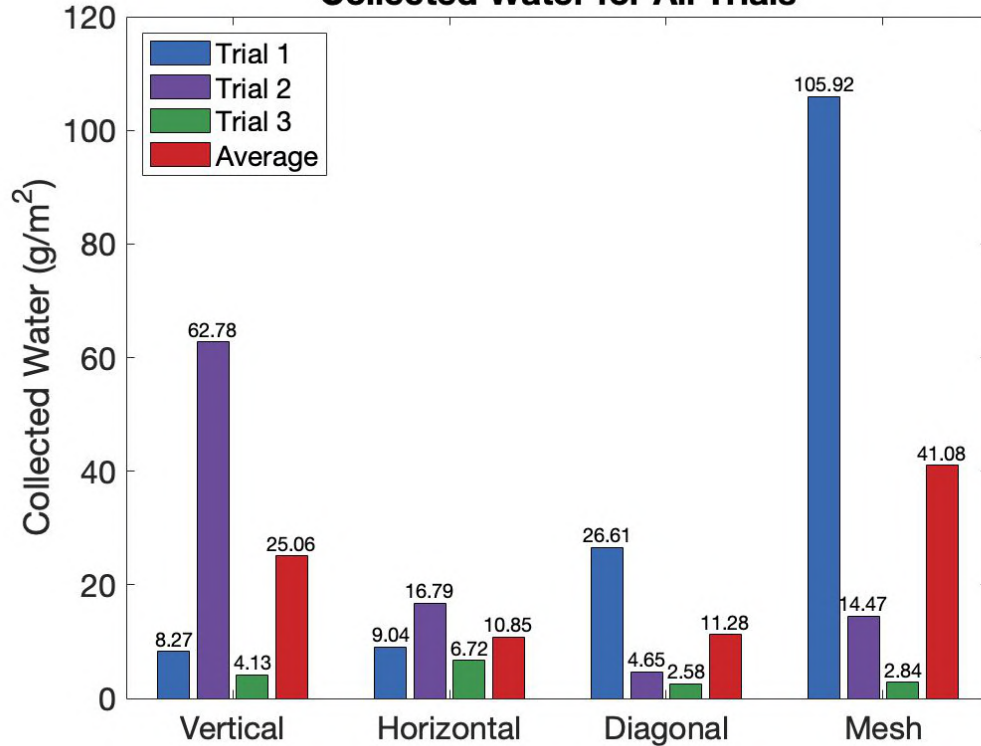
$$T_{avg} = 28.31^{\circ}\text{C}$$

$$P_{avg} = 100.42\text{ kPa}$$

$$RH_{avg} = 99.80\%$$

Collected Water from All Trials

Collected Water for All Trials

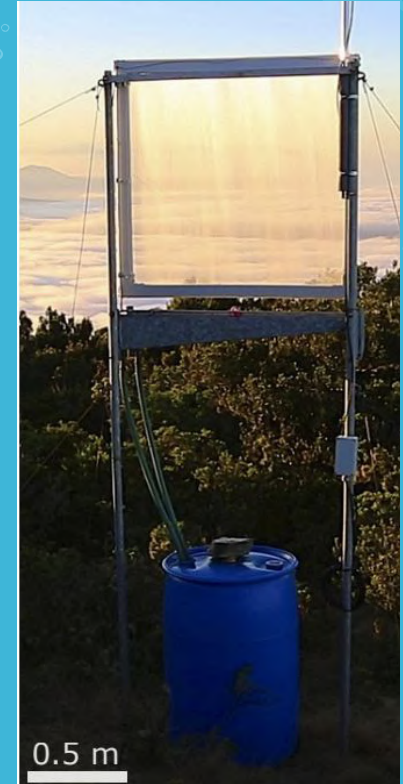


- Results shows that Mesh is optimal
- However, there exists large uncertainty due to fog non-uniformity
- Holistically, Vertical was optimal

Project Economics

- ~\$70 for .15 m² (240 in²)
- It would cost ~\$90 for .806 m² (1250 in²) of the vertical design only

Item	Quantity	Unit Cost	Total Cost
Everbilt 1/4 in.-20 tpi x 36 in. Stainless-Steel Threaded Rod	4	\$6.98	\$27.92
250 ft. 18 lb. 24-Gauge Galvanized Steel Wire	1	\$4.98	\$4.98
2 in. x 4 in. x 8 ft. Prime Whitewood Stud	3	\$7.48	\$22.44
5 in. x 10 ft. White Vinyl K-Style Gutter	1	\$5.38	\$5.38
#9 x 2-1/2 in. Philips Bugle-Head Coarse Thread Sharp Point Polymer Coated Exterior Screws (1 lb./Pack)	1	\$8.97	\$8.97
Total Cost			\$69.69



Musaddaq (2020)

Comparison to Other Literature and Sources of Uncertainty

- Our experiment supports Virginia Tech's claim that parallel, vertical wires is the best wire orientation for fog harps
 -
- Sources of uncertainty:
 - Not a perfect water collection system
 - Bottles not lined up perfectly
 - Wires not perfectly arranged
 - Gutters' slope too small
 - Future iterations would use a more triangular shape



Conclusions

- Vertical orientation is the best design in terms of water collection AND cost effectiveness
- Future Routes:
 1. Increasing fog uniformity
 - a. Ideally testing in outdoor conditions
 2. Industrial Design Implementation
 - a. Varying wire thicknesses
 - b. Varying distance between wires
 - c. Estimate how much freshwater demand fog harps would offset
 3. Test water quality





Thank You!!!



References

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