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Redwood-Inspired Fog Harps

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Virtually all real-life fog harvesters are comprised of mesh netting, which suffers from dual constraints: coarse meshes cannot efficiently capture the micrometric fog droplets suspended in the wind, while fine meshes become clogged which disrupts the aerodynamics of the fog stream. Coastal redwoods obtain 34% of their water from fog drip, as fog droplets are able to effectively slide along the parallel needle arrays to fall onto the soil. Inspired by the redwood trees, we develop “fog harps" comprised of an array of fine, vertically oriented wires that bypasses the clogging constraint of conventional meshes. The lack of horizontal cross-wires allows captured droplets to slide unimpeded at small Bond numbers, which prevents clogging even when using micrometric wires. We observed up to a three-fold enhancement in the fog harvesting rate for scale-model harps compared to equivalent mesh netting. The water harvesting rate of our fog harps increased as the wire diameter decreased from 1.3 mm down to 250 μm. A theoretical model predicts that the fog collection efficiency plateaus for the wire diameter of 250 μm, indicating that the smallest wires tested here may be approaching the performance ceiling. Large fog harps (1 m $\times$ 1 m) were fabricated using a spinning frame, inspired by the bobbin winding mechanism of sewing machines. For field tests, the large fog harp and an equivalent mesh frame were installed at a local farm that experiences abundant fog. Preliminary results showed that the fog harp harvested up to five times more water compared to the mesh over a three-day period. The enhanced water collection rate of our redwood-inspired fog harps should increase the number of regions where fog harvesting is economically viable.

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