Breaking the Symmetry with Flexible Blades

JULIA COSSE, DAEGYOUM KIM, MORTEZA GHARIB, California Institute of Technology — Savonius turbines take advantage of shapes that experience higher drag when moving with the wind and lower drag when moving against the wind. Generally curved blades (e.g. semi circles) have supplied this characteristic drag differential, which allows the turbine to spin. While flexibility is often associated with drag reduction via reconfiguration, it is less well known that this same mechanism can be used for drag enhancement. Inspired by these unique properties we designed a turbine and placed it in a wind tunnel to further investigate the potential of flexible materials. The model was built such that it can be equipped with blades made out of different materials and the blade pitch angle can be chosen arbitrarily. As expected, the turbine didn’t rotate when rigid blades were fixed to the turbine because both sides of the turbine experienced identical drag forces. However, when flexible blades were used, the wind reconfigured the shape of the blades such that there was a drag differential across the turbine which resulted in rotation. The characteristics of the flexible blades will be described in detail along with an analysis of their performance.

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