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Buoyancy-Induced Columnar Vortices for Power Generation
MARK W. SIMPSON, ARI GLEZER, Georgia Institute of Technology — Large-scale inherent instability of a thermally stratified, solar-heated air layer is exploited for power generation by deliberately enhancing the formation of intense columnar vortices such that each vortex drives a vertical-axis turbine. In nature, buoyancy-driven vortices ("dust devils") occur spontaneously, with core diameters of 1-50 m at the surface, heights up to one kilometer, with induced air flow of considerable angular and linear momentum. Meter-scale laboratory experiments have demonstrated the nucleation and sustainment of strong buoyancy-driven vortices over a plane heated surface driven by a controllable power source. The present investigation focuses on the characterization of the columnar vortex and passive control of its core structure and strength for harvesting mechanical energy. It is shown that vortices having cores with nearly-uniform vorticity distributions can be "anchored" to small ground protrusions, and their circulation and angular momentum can be controlled by geometrical modifications of these surface protrusion and simple flow vanes.

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