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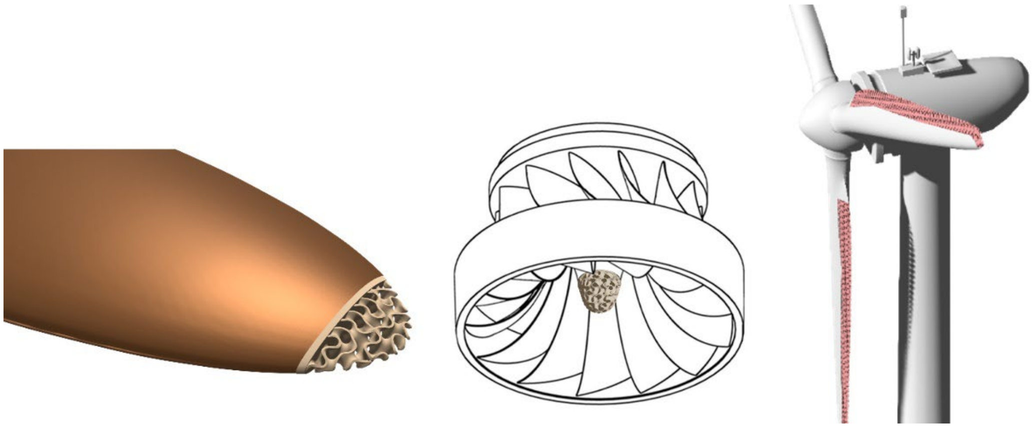
Licensing Opportunity | TTO – Technology Transfer Office

Vortex-Mitigating Flow Control Structure



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Description

Many hydraulic and aerodynamic systems—such as turbines, pumps, propellers, and rotating blades—experience vortex shedding, producing alternating wake patterns that cause drag, acoustic noise, energy loss, and harmful vortex-induced vibrations (VIV). Existing solutions, including streamlined trailing edges, splitters, serrations, or active flow control methods, often fail to fully suppress vortex formation, introduce mechanical complexity, or reduce efficiency.

The invention integrates a vortex-mitigating structure composed of tortuous interconnected channels arranged within a bounded geometry. This structure, which can be inspired by topologies such as gyroid-like networks, passively disrupts the coherent formation of alternating vortices in the wake. By guiding the fluid through complex internal paths, the device significantly reduces unsteady forces, mitigates vortex generation, and stabilizes flow without requiring energy input.

The component may be directly integrated into a fluid-engaging body (e.g., a blade, fin, or surface) or added as a modular element to the region where vortex formation typically originates.

Advantages

- Low Passive, energy-free operation: No actuators, moving parts, or power supply required.
- Strong vortex suppression: Disrupts the alternating vortex street that typically forms behind bluff or streamlined bodies.
- Reduced vibration and drag: Stabilizes wake flow and minimizes vortex-induced loads.
- Lightweight, robust structure: Tortuous-channel network offers high stability with minimal mass.
- Customizable geometry: Adaptable to a wide range of flow conditions and device shapes.
- Additive-manufacturing compatible: Enables rapid prototyping, scaling, and tailoring for specific industrial needs.

Applications

- Smart Hydraulic machinery: Water turbines, pump impellers, hydro-mechanical equipment.
- Rotating machinery: Propellers, rotor blades, turbines (wind, water, industrial).
- Marine systems: Hull appendages, foils, stabilizers requiring wake stabilization.
- Industrial flows: Pipes, ducts, heat-exchange structures suffering from flow-induced vibration.
- Aerospace and automotive: Components exposed to unsteady aerodynamic forces.