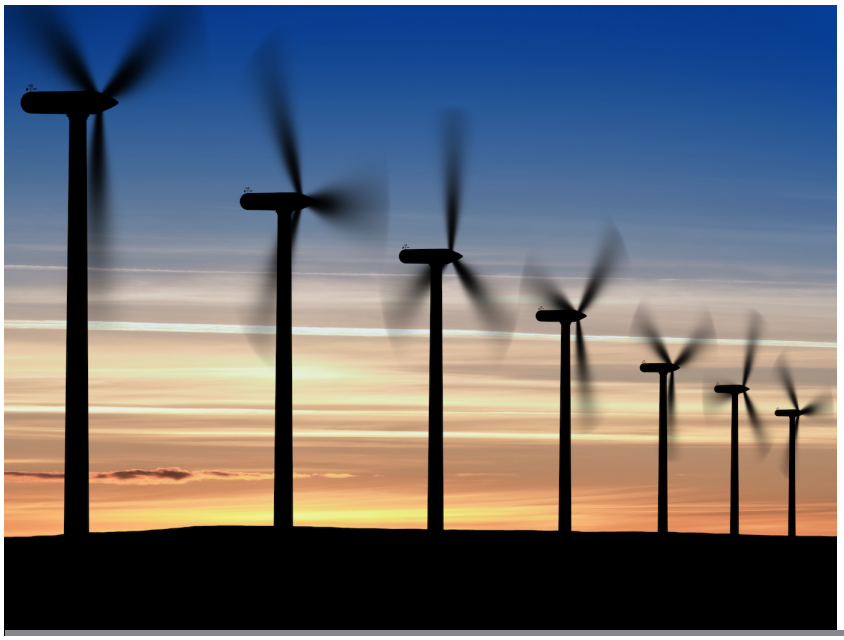

National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Propulsion

A New Twist Makes Rotating Machinery More Efficient and Quieter

Technology benefits propellers, industrial fans, compressors, and turbines

Innovators at NASA's Armstrong Flight Research Center have designed a new shape for propeller blades that dramatically increases their efficiency while reducing noise. Based on improvements achieved via a new wing design known as PRANDTL-D, this innovative propeller design uses an alternative spanload to reduce the tip load as well as the torque at the tip of the blade. These changes dramatically reduce the power needed for rotation while maintaining other blade design parameters (e.g., thrust, diameter, rpm). With a more than 15 percent improvement in propulsive efficiency and significantly reducing noise, the technology promises to reduce power consumption for propeller aircraft. These benefits are also relevant for a wide range of rotating machinery.

BENEFITS

- Efficient: Redistributes drag and lift across the spanload, reducing power consumption while producing the same thrust
- Economical: Allows blades to reduce necessary torque, reducing fuel costs
- Quieter: Produces dramatically less noise than conventional blade designs
- Simpler: Provides a solution that can be coupled with laminar flow or supercritical airfoils

THE TECHNOLOGY

Derived from a design approach for a new wing known as PRANDTL-D, this technology achieves similar improvements for propellers and other rotating machinery.

How It Works

To achieve the innovation's alternate spanload, Armstrong designers applied a non-linear twist to the propeller blade. The twist moves the load inward and dissipates the tip vortex over a wider area, minimizing its effect on drag. It also results in a decrease in load at the tip and reduced torque at the tip. These changes combine to achieve a dramatic reduction in power consumption without compromising the blade's other parameters. Specifically, the blade's diameter and rpm remain unchanged.

What Makes It Better

Unlike the conventional minimum induced loss (elliptical) spanload, which consumes large amounts of power at the tip of the blade, the new design unloads the tip and reduces torque, achieving significant improvements in efficiency. First-order analysis shows a more than 15 percent improvement in power consumption while producing the same thrust. The design also produces significantly less noise than conventional blade designs.

APPLICATIONS

The technology has several potential applications:

- Propellers: Aircraft and marine vessels
- Industrial fans: Exhaust, cooling, and ventilation
- Axial compressors: Air separation plants, blast furnaces, fluid catalytic cracking in petroleum refineries, gas turbomachinery, and propane dehydrogenation
- Power turbines: Nuclear, gas-fired, coal-powered, hydroelectric, wind, ocean tide/low head water

PUBLICATIONS

Patent No: 10,414,485

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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