High-Strength Wind Turbine Blades and Wings

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OTHER INFORMATION

KEYWORDS

wind turbine blade, blade design, biplane, monoplane, spar design, geometry modeling, fluid-structure interaction

CATEGORIZED AS

- **Energy**
  - Wind
- **Transportation**
  - Aerospace

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SUMMARY

UCLA researchers in the Department of Mechanical and Aerospace Engineering have developed a novel biplane blade configuration that optimizes aero-structural performance for wind turbine blades and other airfoil applications.

BACKGROUND

Modern wind turbine blades utilize a single element from root to tip (i.e. "monoplane" blades). Furthermore, modern blades use thick airfoils in the inboard region to support the large bending loads near the blade root. While the aerodynamic performance of thick airfoils is generally poor, this is the standard compromise between aerodynamics and structures in blade design. Normally, this compromise is sufficient for small- and mid-size turbines, because the aerodynamics of the inboard region are assumed to be minor. However, as wind turbine blades continue to increase in length to capture more power, these thick airfoils will likely get thicker, highlighting the inboard region's fundamental performance trade-off between aerodynamics and structures.

INNOVATION

Researchers from the Department of Mechanical and Aerospace Engineering have developed a novel blade design that optimizes both aerodynamic performance and structural strength in wind turbines. The design integrates monoplane and biplane configurations across the span of the blade and describes the composite layup of its internal structure: using composite materials for a box-beam spar structure forming the main load-carrying component. By taking advantage of a biplane configuration, the blade design can minimize airfoil thickness, optimizing aerodynamic and power performance, while the blade gap greatly improves the bending moment of inertia of the inboard region and strength of the overall structure. The invention may be used either for the manufacture of the design or for building a computer model that simulates the performance of the design. One particularly attractive implementation of this design is for use as a large (100 meter) biplane wind turbine blade for increased power production. This invention may also be industrially applied to the manufacture and use of fluid turbine blades, airplane wings, pumps, and propellers.

APPLICATIONS

- Wind turbine blades
- Fluid turbine blades
- Airplane wings
- Fluid pumps
- Propellers

ADVANTAGES

- Enhanced aerodynamic performance
- Strengthened blade structure
- Can build longer blades than current monoplane design
- Increased power production

STATE OF DEVELOPMENT

Computer simulations of initial designs have been completed.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,739,259	08/22/2017	2012-752

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