National Aeronautics and Space Administration

technology solution

Mechanical and Fluid Systems

Lightweight, High-Strength Hybrid Gear for Rotorcraft

Has lower weight, vibration, and noise

Innovators at NASA's Glenn Research Center have developed a method for incorporating lightweight, high-strength composites into the gears of rotorcraft drive systems. The hybrid gear has a metallic shaft and outer gear rim, with composite layup between the shaft interface and the gear tooth rim. The composite layup serves to lighten the gear without reducing its torque-carrying capability, and to reduce the noise and vibration typical of gear systems. Glenn's hybrid gear transfers the same level of torque found in all-metallic gearing, while the composite materials reduce weight and lower noise and vibration.

BENEFITS

- Lowers weight: 20 percent lighter than all-metallic gears
- Reduces noise and vibration: Lowers gear noise caused by the non-linear gear meshing stiffness
- Efficient: Offers the same shaft speed, torque, and temperature capabilities as an all-metallic gear
- Lowers manufacturing costs: Reduces the amount of forging material needed

THE TECHNOLOGY

NASA Glenn's hybrid gear can transfer the same level of torque as an all-metallic traditional gearing component in a rotorcraft drive system where light weight and high load capacity are essential. Glenn's hybrid gear is also quieter with lower vibration transmission at a decreased cost. Currently, large-scale gears are machined from forgings. The use of NASA Glenn's hybrid gear fabrication method would reduce wasted material removed in forgings while creating a much lighter gear through the use of composite materials. Metallic gearing components do little to dampen the noise induced by the gear meshing process. With a composite web, this metallic path for vibration and noise transfer will be disconnected due to the material change.

This hybrid gear fabrication method can accommodate complex shapes and the use of various composite materials to optimize mechanical performance, acoustic performance, and manufacturing efficiency for complex gear geometry.

This is an early-stage technology requiring additional development. Glenn welcomes co-development opportunities.

A hybrid gear could reduce the weight and cost of wind turbine gearing

The hybrid gear is ideal for helicopters where light weight and high load capacity are essential

APPLICATIONS

The technology has several potential applications:

- Aerospace manufacturing of gear components
- Military rotorcraft drive systems
- Drive systems in land vehicles
- Construction machinery
- Wind turbines

PUBLICATIONS

Patent No: 9,296,157

More Information

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NP-2015-04-1501-HQ

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LEW-18516-1