Advanced Power Transfer Components and Concepts

S&T Campaign: Sciences for Maneuver
Energy and Propulsion

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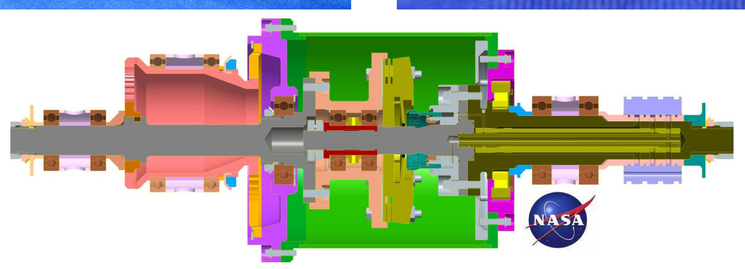
Research Objective

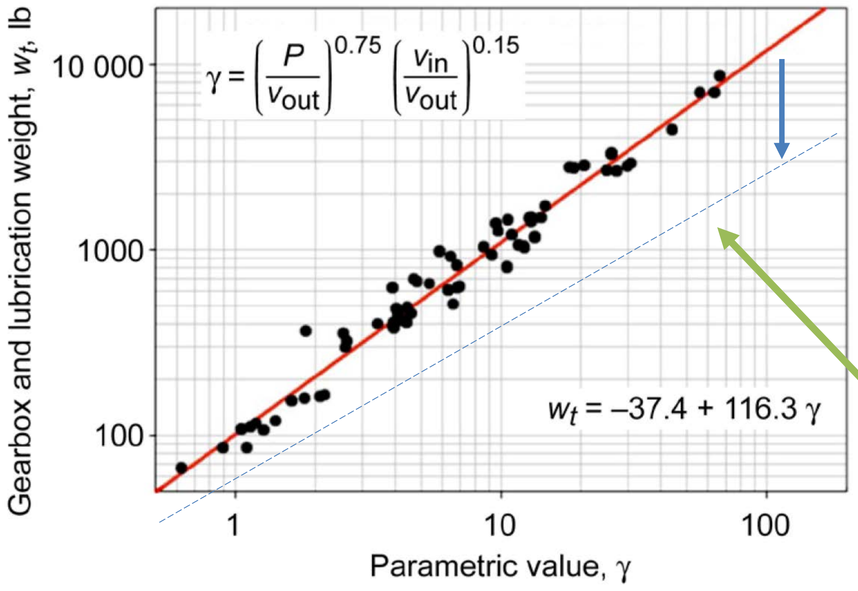
Advance the state-of-the-art in propulsion power transfer through advanced components and concepts to enable a step increase in power density, reduce vibration and noise transmission, increase survivability, and increase efficiency



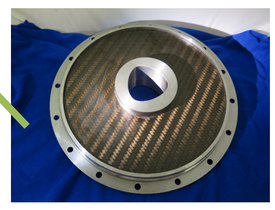
Top: Examples of weight saving drive system technologies (hybrid composite gears, hybrid ceramic bearings)
Bottom: Two-speed, rotorcraft transmission concept

Challenges

- Innovative approaches to reduce drive system weight are needed to increase range and payload capacities of future aircraft
- Current helicopter drive systems in particular are still very dependent on oil for cooling and lubrication of mechanical contacts. Thus, loss-of-oil events create performance issues
- Rotorcraft transmissions and drivelines currently account for a large percentage of the vehicle empty weight



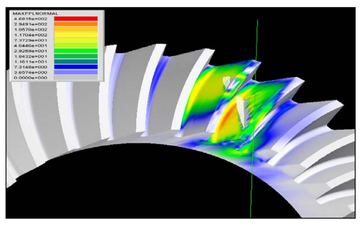
Desired future shift in drive system weight

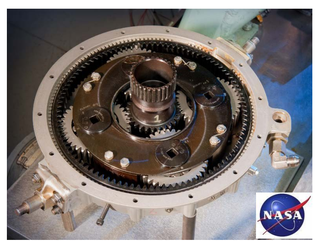


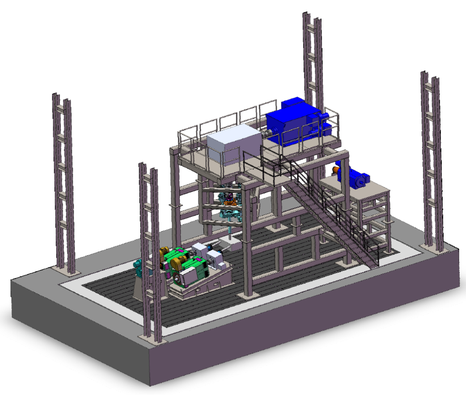
Parametric curve fit for rotary-wing aircraft gearbox and drive and lubrication system weight.[+]

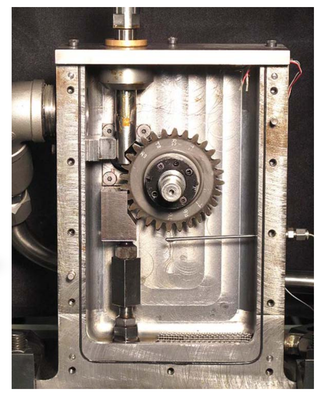
ARL Facilities and Capabilities Available to Support Collaborative Research

- ARL facilities available at Aberdeen Proving Ground
  - Vehicle Innovative Powertrain Experimental Drive (VIPER) Facility (expected in 2018)
  - Ball-on-disc and reciprocating tribometers
  - Bearing fatigue rigs
- Leveraged facilities at NASA Glenn Research Center
  - Gear test rigs (incl. spiral bevel, spur, face, and helical)
  - Single gear tooth bending rigs
  - 500-hp helicopter transmission test rig
  - Variable speed aircraft transmission rig
  - Composite shaft test rig
- Software and modeling tools
  - Advanced Numerical Solutions (ANSOL) finite element code for gears, bearings and transmissions
  - Variable speed transmission modeling and optimization codes
  - Gear windage modeling codes









Complementary Expertise/Facilities/ Capabilities Sought in Collaboration

- Expertise in helicopter drivelines and mechanical components
- Expertise in high-power hybrid electrical systems including modeling and simulation
- Modeling and simulation for hybrid mechanical components
- Knowledge and expertise in clutches and mechanical interlocks for high torque applications with minimal wear and debris generation
- Expertise in variable speed transmissions for high-power applications
- Facilities for testing high-power, variable -speed transmissions

[+] M. T. Tong, S. M. Jones, W. J. Haller, and R. F. Handschuh, "Engine Conceptual Design Studies for a Hybrid Wing Body Aircraft," NASA Glenn Research Center, Cleveland, OH, Technical Memorandum NASA/TM-2009-215680, Nov. 2009.