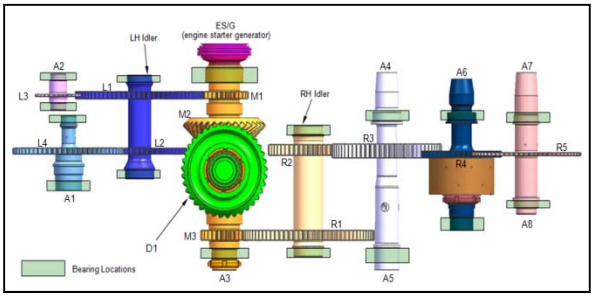
Accelerating Innovation: Avetec at a Glance

Avetec Completes ATF Gearbox Design and Analysis with Simulink Model

Modern aircraft gearboxes are expected to distribute an ever-increasing amount of power to the aircraft's subsystems. To increase reliability and efficiency, standard aircraft components are being replaced with more electric subsystems; therefore much of the generated power will be electrical in nature and pass through the generator to the component. However, these electric components may also introduce new problems that need to be understood and addressed. An example is in the replacement of electro-hydraulic actuators with electromechanical actuators. During different types of return movements, the electromechanical actuator will act as a source of electrical regenerative energy that flows back through the system.

This regenerative energy must be managed since, depending on how the energy is dissipated, it could add to the aircraft's overburdened thermal management system. One alternative method is to allow the regenerative energy to flow back into the gearbox and allow the gears, and possibly the attached subsystems, to absorb the energy. Under this scenario much of the regenerative energy could be dissipated through torsional gear shaft vibrations and other gear related dynamics.

The magnitude of this effect and how it might impact gearbox component lifetimes and the operational dynamics of attached subsystems is unknown. To understand these systems and subsystems, the Air Force Research Laboratory's (AFRL) Integrated Vehicle Energy Technology Demonstration (INVENT) program funded Avetec to develop steady state and transient MATLAB®/Simulink® models of a representative advanced tactical fighter's (ATF) gearbox system. The models were also to include gear backlash dynamics.



Avetec researchers just completed development of the Simulink® model. The figure at the right and the table below-right give indications of the complexity of the system.

Avetec Senior Research Scientist Dr. Tony Corvo spearheaded the effort along with Research Scientist Karleine Justice and Research Intern Matt Rutledge. System information was provided by Rolls-Royce Inc., and the Air Force provided pulse profiles for the actuator regenerative energy.

The model can easily calculate typical system dynamics such as normal modes, torsional angles, velocities, shaft torques and a host of other variables. The model also demonstrated under what conditions backlash may occur. For more information contact Dr. Tony Corvo at (937) 322-5000 x2065 or at tcorvo@avetec.org.

Item	Number
Gears	15
Accessories	9
Shafts	15
Bearing points	21
Source and load torques	11
System parameters (inertias, damping coefficients etc,…)	142
Equations	88
State Variables ($\theta_i - \theta_j, \omega$)	59