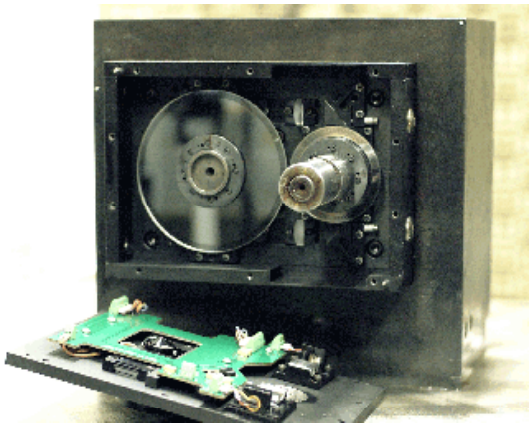
New Gear Transmission Error Measurement System Designed



Optical and electronic components of the new transmission error measurement system. Note the reflections in the two mirrorlike gratings. The sizes of the gratings are proportional to the size of the gears, which have a 1.8:1 ratio.

The prime source of vibration and noise in a gear system is the transmission error between the meshing gears. Transmission error is caused by manufacturing inaccuracy, mounting errors, and elastic deflections under load. Gear designers often attempt to compensate for transmission error by modifying gear teeth. This is done traditionally by a rough "rule of thumb" or more recently under the guidance of an analytical code. In order for a designer to have confidence in a code, the code must be validated through experiment.

NASA Glenn Research Center contracted with the Design Unit of the University of Newcastle in England for a system to measure the transmission error of spur and helical test gears in the NASA Gear Noise Rig. The new system measures transmission error optically by means of light beams directed by lenses and prisms through gratings mounted on the gear shafts. The amount of light that passes through both gratings is directly proportional to the transmission error of the gears. A photodetector circuit converts the light to an analog electrical signal.

To increase accuracy and reduce "noise" due to transverse vibration, there are parallel light paths at the top and bottom of the gears. The two signals are subtracted via differential amplifiers in the electronics package. The output of the system is 40 mV/mm, giving a resolution in the time domain of better than 0.1 mm, and discrimination in the frequency domain of better than 0.01 mm.

The new system will be used to validate gear analytical codes and to investigate mechanisms that produce vibration and noise in parallel axis gears.

Bibliography

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Find out more from Glenn's Mechanical Components Branch (http://www.grc.nasa.gov/WWW/5900/5950/)

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