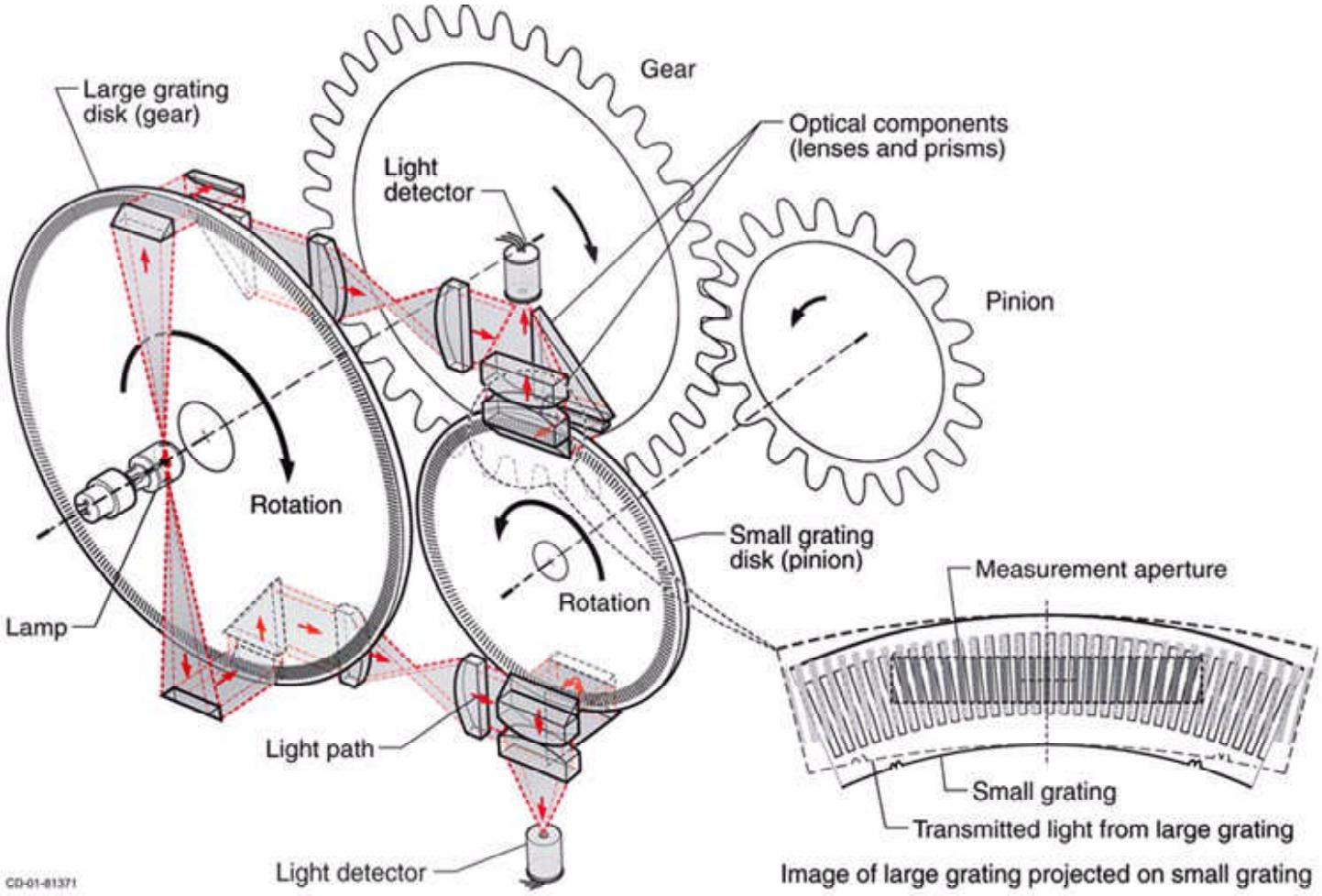
Gear Transmission Error Measurement System Made Operational

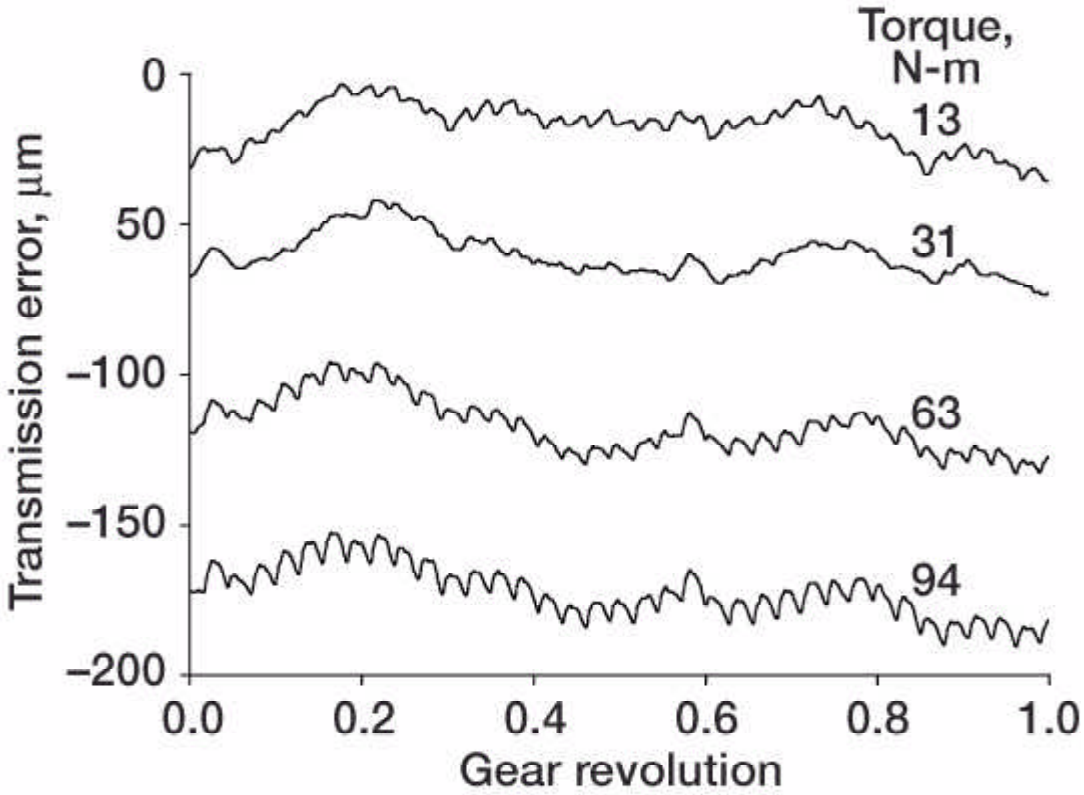


Schematic of the transmission error measurement system indicating the light path through the gratings and other optical components. At right is a representation of the light from one grating projected onto the other grating.

A system directly measuring the transmission error between the meshing spur or helical gears was installed at the NASA Glenn Research Center and made operational in August 2001 (see the preceding illustration). This system employs light beams directed by lenses and prisms through gratings mounted on the two gear shafts. The amount of light that passes through both gratings is directly proportional to the transmission error of the gears. The device is capable of resolution better than 0.1 μm (one thousandth the thickness of a human hair).

The measured transmission error can be displayed in a "map" that shows how the transmission error varies with the gear rotation (see the following graph) or it can be converted to spectra to show the components at the meshing frequencies. Accurate transmission error data will help researchers better understand the mechanisms that cause gear noise and vibration and will lead to

improved analytical codes.



Map plot showing transmission error at four different torque levels. Note that the second trace (31 N-m) is smoother (has less high-frequency variation) than the other traces. Computer codes predict that this torque is approximately the optimum level to produce minimum tooth-to-tooth excitation of the gear system; thus, there is less vibration in the mesh.

The Design Unit at the University of Newcastle in England specifically designed the new system for NASA. It is the only device in the United States that can measure dynamic transmission error at high rotational speeds. The new system will be used to develop new techniques to reduce dynamic transmission error along with the resulting noise and vibration of aeronautical transmissions.

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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