New Optical Encoders with Higher Sensitivity

NASA offers companies the opportunity to jointly develop and license these technologies.

Developed at NASA Goddard Space Flight Center, these linear and rotary encoders use a CCD array to detect the relative and absolute position of an object by reading a microlithographic scale on the object. Optical encoders perform precision measurement of angular and linear position and speed for a variety of applications. This invention won the NASA Government Invention of the Year Award for 1999.

Benefits

- ***Higher sensitivity:*** Goddard's linear encoder can resolve to 0.01 micron, while the rotary encoder can resolve to 0.02 arc second.
- ***Longer travel reading:*** Goddard's absolute linear encoder can measure travel in excess of 3 meters with 0.1 micron sensitivity.
- ***Lower cost:*** Goddard's encoders are inexpensive to manufacture.
- ***Better measurements:*** By detecting the absolute as well as relative position of the object, Goddard's encoders function even when the object is stationary or after a power interruption.
- ***Damage tolerant:*** The design of this encoding system is far less susceptible to scale damage or contamination than conventional absolute encoders.
- ***Small:*** The encoder design is very compact for the level of resolution provided.
- ***Versatile:*** Goddard's encoders are suitable for a wide variety of travel and resolution requirements.

Commercial Applications

- Aerospace and aviation
- Computer-aided machining
- Inspection equipment
- Linear positioning mechanisms
- Machine tools and robotics
- Medical imaging
- Profilometers and other instruments
- Semiconductor manufacturing
- Surveying and telescopes

National Aeronautics and Space Administration

The Technology

Optical encoders measure the linear or angular position of an object by optically detecting marks on a scale affixed to the object. Incremental encoders simply detect the relative motion of the object, not its absolute position. Although absolute linear optical encoders are available, they do not offer very high resolution (i.e., sensitivity). Furthermore, with conventional absolute linear encoders, the moving object is limited to 4 millimeters of travel at the highest practical resolution. Finally, if the scale on the object is damaged, most optical encoders yield "dead spots," no longer providing complete and accurate information.

Researchers at NASA Goddard Space Flight Center have developed new absolute and incremental linear and rotary optical encoders that address many of the limitations of current encoder technology. Goddard's linear encoder uses a microlithographically patterned scale and a charge-coupled device (CCD) array. A light source projects the scale's pattern onto the CCD array, and the image information is digitized and analyzed by an image processor. Pattern recognition algorithms are used to determine the relative and absolute position of the object.

Goddard's optical encoders offer many advantages over other absolute encoders. Goddard's absolute linear encoder has a resolution of 0.01 micron and is capable of encoding motion over 400 millimeters. Alternatively, at 0.1 micron resolution, the encoder's range can be extended to 3 meters and beyond. The rotary encoder's resolution is 0.02 arc second for a 125-millimeter diameter code disk. But these performance levels are not the only benefits. The manufacturing costs for Goddard's encoders is significantly lower than for conventional encoders, and they are smaller in size than other encoders with comparable resolution. In addition, because of the novel encoding method, the microlithographic scale pattern is far less susceptible to damage and contamination than are conventional encoder scale patterns.

Partnership Opportunities

This technology is part of NASA's technology transfer program. This program seeks to stimulate commercial use of NASA-developed technology. A patent has been issued for this technology (U.S. Patent 5,965,879), and working prototypes have been built. Goddard seeks companies interested in further developing these optical encoders for use in aviation, robotics, manufacturing, medical, and other applications. NASA is flexible in its agreements, and opportunities exist for licensing on an exclusive, nonexclusive, and exclusive field-of-use basis.

For More Information

If you would like more information about this technology or about NASA's technology transfer program, please contact:

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More information about working with the NASA Goddard Technology Commercialization Office is available online.

http://techtransfer.gsfc.nasa.gov

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