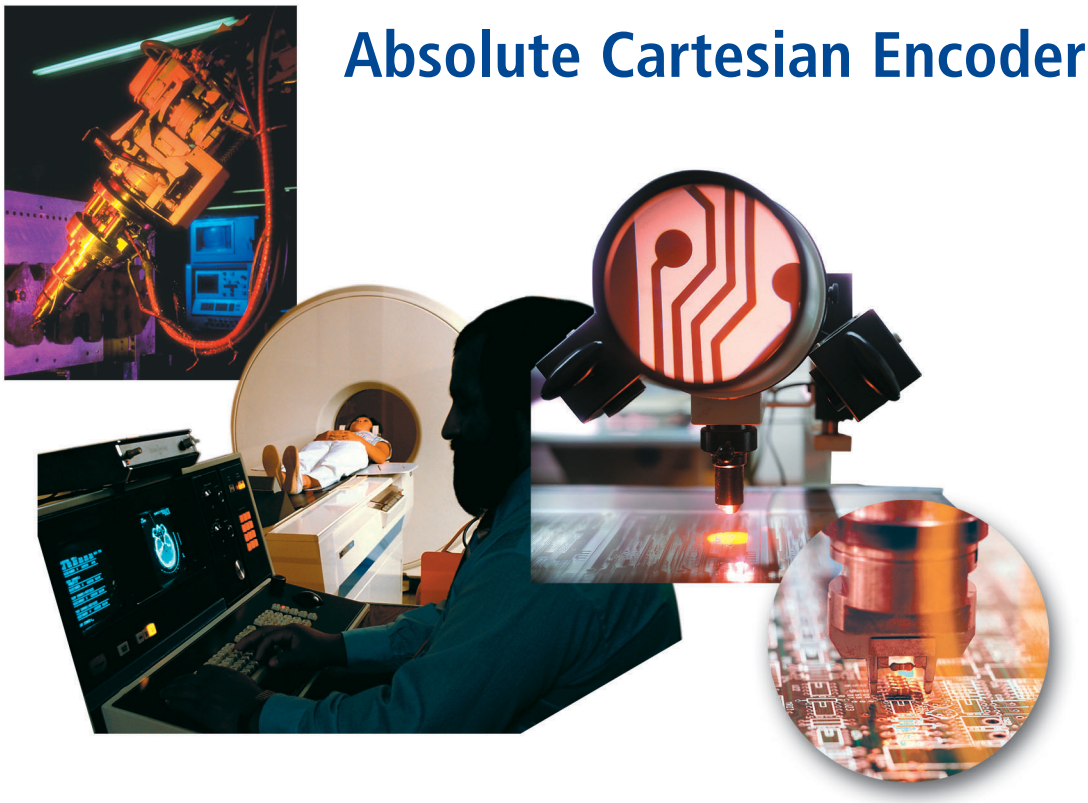
Absolute Cartesian Encoder

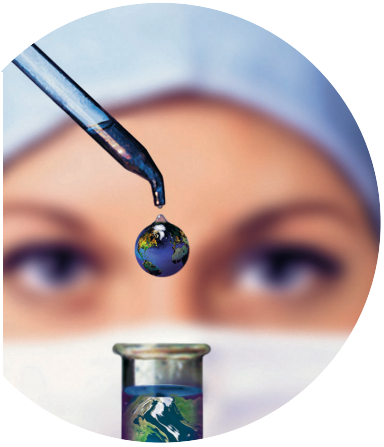


These absolute Cartesian encoders rely on a combination of mature technologies to measure the X-Y planar motion of an object in a true Cartesian coordinate frame with high accuracy and near-perfect orthogonality. Originally developed at NASA Goddard Space Flight Center for the Hubble Space Telescope Project, absolute Cartesian encoders can be used for inspection, manufacturing, and assembly.

Benefits

- Based upon mature technologies: Goddard's absolute Cartesian encoders use a highly accurate microlithographic scale, optical projection, CCD (charge-coupled device) array image detection, and simple image processing.
- Longer travel reading: Goddard's absolute Cartesian encoders can read travel lengths as long as the scale.
- Resolution of 60-70 nm demonstrated for a coarse scale; below 10 nm is obtained using a finer scale.
- Accurate X-Y readings regardless of assembled orthogonality or straightness of travel of stages.
- Absolute X-Y accuracy limited only by accuracy of microlithography.
- Damage tolerant: the design of this encoder is far less susceptible to scale damage or contamination than conventional optical encoders.
- Small: the encoder design is very compact for the level of resolution provided.
- Software upgradeable.

National Aeronautics and Space Administration



The Technology

The NASA absolute Cartesian encoder offers extremely flexible design because the scale features and optical magnification can be chosen to suit the requirements of essentially any application. Traditional X-Y positioning systems with closed-loop feedback encoders consist of two linear translation stages often stacked one atop the other. Newer incremental planar or grid encoders use an optical read head with multiple optical elements that read a chrome-deposited pattern on a glass plate. Laser interferometers with plane mirrors offer the highest accuracy and resolution, but are very expensive.

The absolute Cartesian encoder uses a backlit, microlithographically patterned scale that is attached to the moving object. The scale carries X-Y information that uniquely identifies the horizontal and vertical location of the scale image as seen by a fixed CCD imaging camera, thereby allowing determination of the absolute Cartesian position of the object.

NASA has demonstrated a 5-cm x 5-cm (2-inch x 2-inch) absolute Cartesian encoder with coarse feature separation. Resolution of around 60 to 70 nm has been measured. Travel is not limited to that size. Even greater resolution, below 10 nm, is obtained using a more finely patterned scale, which still does not challenge the state-of-the-art in microlithography.

Measurement speed or conversion rate is a function of the CCD camera frame rate and the image processing software. NASA has demonstrated a 15-Hz measurement rate using a very inexpensive Texas Instruments CCD-based camera. More expensive cameras in conjunction with high-speed frame grabbers will improve measurement speed to well in excess of 1 kHz.

Commercial Opportunities

This technology is part of NASA's technology transfer program. The program seeks to stimulate commercial use of NASA-developed technologies. Goddard has applied for U.S. patents for this technology. NASA invites companies to partner with Goddard to license and jointly develop this technology for commercial applications.

For More Information

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