Analytical Instrumentation, Methods & Materials

High Accuracy Angle Measuring Device for Industrial, Medical, Scientific or Recreational Use

WiSys: T130018US02

Inventors: Dennis Mikkelson

WiSys Technology Foundation is seeking a strategic partner to further develop, manufacture, market, and distribute a high accuracy rotary (angle) encoder. This device has the advantages of high single-reading accuracy (±0.1 arc seconds) and high average reading sensitivity (0.001 arc seconds), low production cost, compact design, and low power consumption. Possible applications include but are not limited to astronomical telescope mounts, land surveillance tools, industrial inspection and calibration, machine tools, medical devices, as well as robotics.

Overview

The ability to measure movement of rotating components with high accuracy is crucial in many applications, including astronomical telescope mounts, field surveillance tools, industrial inspection and calibration, machine tools, medical devices, robotics, and others. The devices used to measure the angles over which rotating components move are called rotary position encoders, and the North American market for these encoders is greater than $500 million. One sub-type, an absolute encoder, is desirable because of its ability to determine present position angle, even if the device has been turned off and on again or moved while powered off. However, a strong limitation to using these encoders is cost. For example, one commercially available system has an advertised accuracy of ±0.4 arc seconds, but it costs approximately $20,000 per system. In addition, encoder systems currently in use for high accuracy angle measurement suffer from large, bulky components, and they often experience measurement errors resulting from mechanical imperfections.

The Invention

A UW-Stout researcher has developed a high-accuracy angle measurement system that addresses the problems inherent to commercially available systems. In this novel device, a high accuracy rotary optical encoder is controlled by a microprocessor. The encoder consists of rotating optical disks and sensors that are precisely formed and placed to read angles with 0.001 arc second sensitivity (average) and better than ±0.1 arc second accuracy (single readings), which is comparable to the accuracy of the high-end commercial encoders currently on the market. This accuracy is maintained with strategies that combat the mechanical sources of error that are known disadvantages of other devices. The system can also be adjusted to compensate for any asymmetrical shifts that may occur. Mechanical sources of error and noise are further minimized by precision placement of disks and sensors, as well as low-friction reference points that keep components centered and level during rotation. In addition, multiple sensor heads eliminate major readout errors and remove the need for recalibration. All of these features and benefits are contained within a design that is both compact and portable. Beyond high accuracy and portability, the cost of this new angle measurement system is substantially lower than a high-end commercial system because it is easily constructed from readily available industrial grade components, bringing the production cost to roughly $2,000. Strikingly, this cost is comparable to the advertised price of other rotary position encoders that are less than one tenth as accurate. Its high accuracy, low cost, and portability make this new angle measurement system a strong option for use in virtually any of the current applications for absolute rotary encoders.

Applications

- Astronomical telescope mounts
- Land surveying

- Industrial inspection and calibration
- Machine tools
- Medical imaging devices like magnetic resonance imaging (MRI) and computerized tomography (CT) machines
- Robotics

Key Benefits

- High single reading accuracy of ±0.1 arc seconds
- High average reading sensitivity of 0.001 arc seconds
- Low production cost
- Compact and portable
- Easily constructed from readily available standard industrial level components
- Low power consumption
- Measurement of angles even while angles are changing
- Excellent inherent accuracy obviates need for calibration in most applications
- Small angular changes can be measured with high accuracy because residual error is a slowly varying function of angle

Stage of Development

Prototypes have been developed and tested for principle of operation, accuracy, and sensitivity. Further refinement through mechanical and electrical engineering would be needed to take this product to market. Additional software development may be needed to interface the device to other equipment depending on desired end-use. Both engineering and development would benefit from industry collaborations

Tech Fields

- Analytical Instrumentation, Methods & Materials : General analytical instrumentation
- Analytical Instrumentation, Methods & Materials : Sensors
- Medical Imaging : MRI

For current licensing status, please contact Jennifer Souter at jennifer@wisys.org or (608) 316-4131