Low Cost and High Resolution Optical Distance Sensor with a Large Dynamic Range

This invention provides means and methods for the creation of an optical distance sensor comprised of a laser, hybrid (digital and analog) lens for ideal distance range and resolution, and an optical imager to measure target path length. The invention also makes use of a beam splitter to allow for remote sensing of object distance, motion displacement, 3D structure and spatial profile.

Distance sensors are employed for a variety of applications, including non-destructive testing in industry, virtual reality, quality control of parts and tools, architecture, civil engineering and testing of large to microsized structures. Over the years these sensors have utilized various technologies, such as: ultrasonics, microwave radar using radio frequency energy and laser radar using modulated optical energy. One of the commercial applications of laser distance sensors is the measurement of liquid levels in tanks, vats and storage units. Optical distance sensors are the preferred method for liquid level measurements because the lasers employed have high power, low divergence, ultra-short pulse widths and small far-field spots due to small wavelength size. Distance measurements can be conducted over long distances with high spatial resolution of three dimensional structures or surfaces. The limitations of optical distance sensors are due to the pulse width (distance resolution), pulse frequency (maximum distance range), the electronics that control the laser pulses and the components which process the data. Optical distance sensors typically have a specific distance range they can measure with a certain resolution (dynamic range). To increase this dynamic range usually requires more complex and expensive electronics. This leaves the user with the choice of a low dynamic range optical sensor or an extremely expensive one.

Technical Details

Optical engineers and scientists at UCF have developed a sensor with a large distance dynamic range, high distance measuring, high spatial resolution and low cost. This device makes use of a hybrid lens (comprised of both a digital and analog lens) for an ideal range of distance measurements as well as fine distance resolution. Target path length is measured either directly (specular reflection) or indirectly (scattered light). The design allows for remote sensing of object distances, motion displacement, three dimensional structure and spatial profile. These sensors could be used to measure liquid levels in a gas-liquid interface and would also make excellent pressure/displacement/stress sensors by measuring object motion via non-contact optical sensors. These sensors could also be used to monitor the quality and lifetime of skyscrapers, bridges, aircraft, and ships in the fields of civil engineering, architecture and industrial design. Yet another application of these distance sensors would be in the area of defense/military for the location of friendly or hostile targets.

Benefits

- Accurately measures distance over a wide range (centimeter to kilometer scale)
- Low cost, high distance resolution sensor
- Remote sensing of object distance, motion displacement, 3D structure and spatial profile

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Couples with a variety of different lasers and optics to give a wider range of applications

**Applications**

- Optical distance sensor
- Pressure/stress sensor
- Building/civil engineering
- Defense
- Petroleum industries

**Technology #31603**

- US Patent 8,107,056 B1

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