METHOD FOR ACTIVE SENSOR SIGNAL OPTIMIZATION

Background

Alignment of any optical device can be very challenging and can require high precision equipment to maximize optical performance. Reflections of light from every surface complicate the alignment as it is not easy to distinguish the reflection from each surface simultaneously. Since ideal behavior from piece parts is rare and every assembly behaves uniquely, each assembly must be individually aligned to optimize performance.

This technology was developed while analyzing an assembly process involving the precise orientation of a fiber optic focuser and a polymer window. The performance of the focuser/window assembly was directly related to the clocking location between the two devices. For optimum performance, the difference (delta) between the first surface back reflection and the second surface reflection of the polymer window needed to be maximized. Once the clocking position, with maximum signal delta, was determined, it needed to be precisely held, as the signal delta can be sensitive to tenths of a degree of rotation.

A method did not exist where the first surface and second surface reflections could be measured simultaneously, so the clocking and measurements were previously completed in multiple steps. This process, however, did not always provide favorable results, as the clocking position where the first surface reflection was minimized did not always coincide with the maximum reflection of the second surface; resulting in an underperforming and unacceptable assembly.

Description

There are two main aspects to this invention: the process of utilizing COTS equipment in a new manner and the design and use of a holding/clocking fixture to allow the process to be repeatable. In the aforementioned example, a fiber optic focuser holding and clocking set-up and optical backscatter reflectometer (OBR) were utilized to accomplish maximum signal delta between the first and second surface reflections of an optic and/or window. A fiber optic focuser was placed in the fiber holding fixture and was face coupled to the polymer window which was held stationary in the rotational fixture. Data was collected with the OBR and the delta between the first and second reflections of the window was calculated.

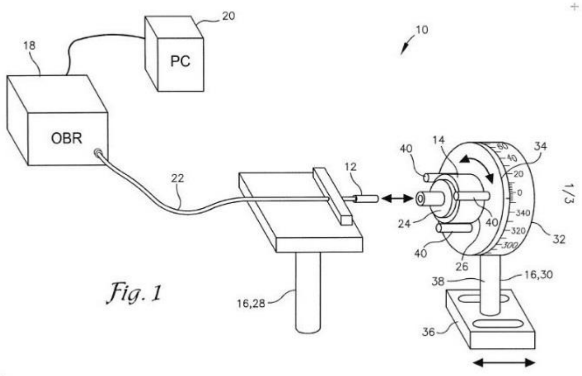

Fig. 1

The fiber-to-window coupling was maintained as the window was rotated while the reflection delta was collected along the rotational path of the window. The degree of rotation for each delta calculation was not critical, but it has been found that 45 degrees was a good compromise of time and data when determining where to begin fine tuning rotations. Fine tuning rotations were completed in reducing increments until the maximum reflected signal delta was obtained. The fiber was then staked to the window at the point of greatest reflected signal delta. The focuser/window assembly was removed from the holding fixture and the final performance of the assembly was characterized.

The OBR allows for the reflections from each of the optics surfaces to be visualized while the rotational fixture allows for the precision needed to maximize the reflected signal delta.

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Advantages

The use of this technology to measure, clock, and assemble in one fixture has been shown to increase manufacturing yield by 15% when compared to marking the optimum alignment orientation prior to assembly. However, the most significant improvement was in performance. When this technology was used the average signal return was increased by 450% when compared to assemblies manufactured without using the technology. The technology will allow for full automation of the assembly process leading to additional performance improvements as well as cost savings. Full automation will take the human factor out of the manufacturing process reducing flow time and potential errors. Full automation is possible because the reflection measurements can be taken simultaneously and within any step of the manufacturing process.

Applications

This technology can be applied in various fields for diverse purposes including the following

- Explosives testing research (oil, mining, demolition, munitions, etc…) for optimization of the sensors used during the testing conducted on products
- Optical based sensor manufacturing for increased performance and yield of product, along with the potential cost reduction through process automation
- Optical assembly production for quality monitoring during the assembly process to help identify potential issues and reduce scrap of final assemblies by early detection
- Research institutions and universities for quicker development of sensors and production of higher quality sensors to aid in the maturity of research topics

Intellectual Property Status

This technology is patent pending under US Patent application number 14/845,131, filed 09/03/2015.

Keyword List

Active Alignment, Sensor Manufacturing, Optical Sensor, Optical Backscatter Reflectometer (OBR), In-Process Testing

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