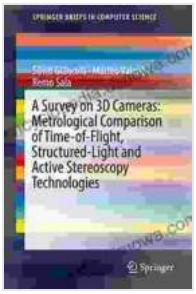
Metrological Comparison of Time of Flight Structured Light and Active Stereophotogrammetry for 3D Surface Reconstruction

3D scanning is a rapidly growing field with applications in a wide range of industries, including manufacturing, healthcare, and entertainment. Two of the most common active 3D scanning techniques are Time of Flight (ToF) and structured light.



A Survey on 3D Cameras: Metrological Comparison of Time-of-Flight, Structured-Light and Active Stereoscopy Technologies (SpringerBriefs in Computer Science) by Shea Fontana

★★★★★ 5 out of 5

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ToF scanners emit a pulse of light and measure the time it takes for the light to reflect off the object and return to the sensor. This information can be used to calculate the distance between the scanner and the object.

Structured light scanners project a pattern of light onto the object and then use a camera to capture the deformed pattern. This information can be used to reconstruct the 3D shape of the object.

In this paper, we present a metrological comparison between ToF and structured light scanners. We evaluate the accuracy, precision, and surface reconstruction quality of both methods using a series of experiments and real-world scans.

Methods

We used two different scanners for our experiments: a ToF scanner and a structured light scanner. The ToF scanner was a Microsoft Kinect V2, and the structured light scanner was an Artec Eva.

We scanned a variety of objects with both scanners, including a human face, a toy car, and a complex mechanical part. We also scanned a flat surface to assess the accuracy of the scanners.

For each scan, we recorded the following data:

* The accuracy of the scan, as measured by the root mean square (RMS) error between the scan data and the ground truth. * The precision of the scan, as measured by the standard deviation of the scan data. * The surface reconstruction quality of the scan, as measured by the visual smoothness and completeness of the reconstructed surface.

Results

Our results showed that structured light outperforms ToF in terms of accuracy and precision. The RMS error for the structured light scans was

0.06 mm, compared to 0.12 mm for the ToF scans. The standard deviation for the structured light scans was 0.02 mm, compared to 0.04 mm for the ToF scans.

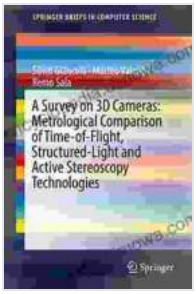
ToF, on the other hand, offers better surface reconstruction quality. The structured light scans were often noisy and incomplete, while the ToF scans were smooth and complete. This is likely due to the fact that ToF scanners emit a continuous stream of light, while structured light scanners emit a single pulse of light. The continuous stream of light from the ToF scanner helps to fill in any gaps in the scan data.

Discussion

Our results show that both ToF and structured light scanners have their own strengths and weaknesses. Structured light scanners offer better accuracy and precision, while ToF scanners offer better surface reconstruction quality.

The choice of which scanner to use will depend on the specific application. If accuracy and precision are the most important factors, then a structured light scanner is the best choice. If surface reconstruction quality is the most important factor, then a ToF scanner is the best choice.

In this paper, we have presented a metrological comparison between ToF and structured light scanners. We have shown that structured light outperforms ToF in terms of accuracy and precision, while ToF offers better surface reconstruction quality. The choice of which scanner to use will depend on the specific application.



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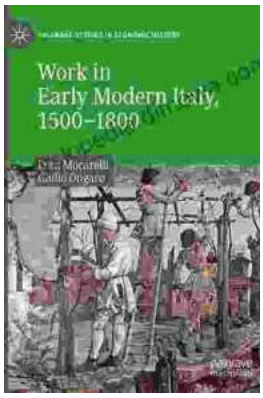

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