Efficient Pixel Shader based Ray-tracing Method with Multi-Scale Pyramid Resampling

Correcting GNSS Non-line-of-sight Error with Large-scale Surfaces

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This approach uses pixel shaders to simulate rough signal reflections combined with further refinement. More efficient for large scale complex surfaces.

This method's computational load only grows linearly (not exponentially) with the number of reflections, making it much more efficient.

Tests showed this method can correct satellite pseudorange non-line-of-sight errors without introducing any additional errors.

PCT application filed.

Collaboration opportunities: seeking research or licensing partnership.

Background

In urban environments, the accuracy of global navigation satellite systems (GNSS) like GPS is often compromised by non-line-of-sight (NLOS) errors. These errors occur when satellite signals are obstructed or reflected by buildings and other structures, leading to inaccurate positioning. Traditional methods to correct these errors, such as ray-tracing, simulate how signals interact with the urban landscape. However, these methods are computationally intensive and slow, making them unsuitable for real-time applications.

To address this challenge, researchers at University of Calgary developed a method called Pixel Shader Based Ray-Tracing (PSBRT). This approach leverages advanced graphics processing techniques and efficiently simulates signal reflections. By employing pixel shaders and a refinement process, the PSBRT method significantly reduces computational load with large-scale surfaces without introducing any additional error compared to the state-of-art method, while maintaining high speed (37-117 FPS on a desktop GPU and 25-57 FPS on a smartphone GPU). . This innovation allows for real-time NLOS error correction, enhancing GNSS positioning in complex urban settings.

Competitive Advantages

- Real-time capability
- State-of-art accuracy
- Lower computational load
- Supports any surface shape and orientation

Areas of Application

- Autonomous vehicles
- Urban Navigation Systems
- Augmented Reality (AR)
- Disaster Response and Management

Publication and Resources

- Publication: Zhitao Lyu & Yang Gao. Volume 27, article number 159, (2023). GPS Solutions
- Researcher Profile: Dr. Zhitao Lyu & Dr. Yang Gao
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