Effect of Ground Reflectance on Shadow-Based NLOS Drone Tracking Using Synthetic Outdoor Rendering

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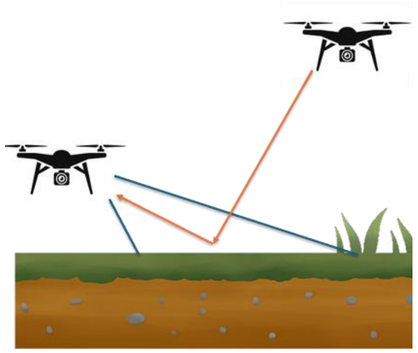
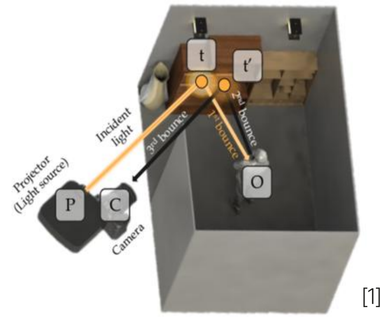
Research Question

How do the various reflectance properties of the ground plane affect accuracy of the passive NLOS localization techniques based on shadows on the ground?



Motivation

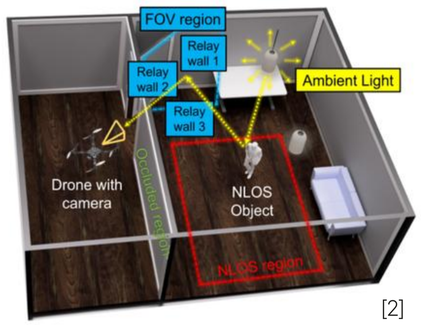
- Traditional sensing (e.g., GPS) fails in complex environments
- Shadows provide indirect information about hidden objects
- Goal: use ground shadows to infer drone position



[1]

Related Work

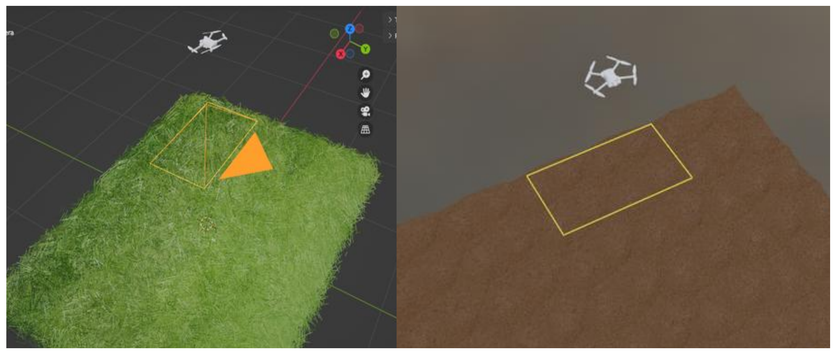
- NLOS uses relay surfaces and indirect light paths
- Prior work uses controlled illumination setups
- Our work extends to outdoor scenes and materials



[2]

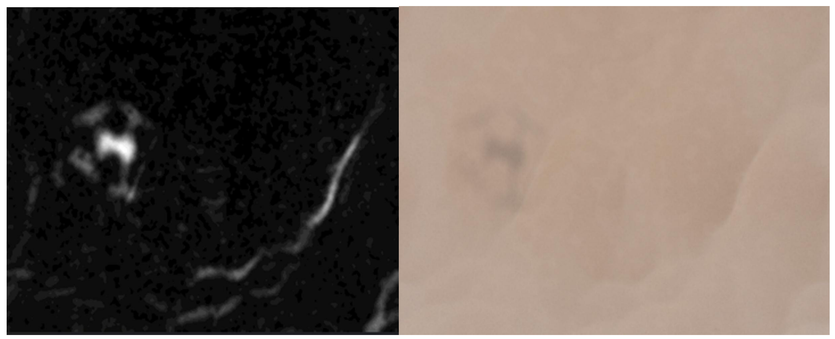
Approach

- Simulate outdoor scenes in Blender (grass, sand, plain)
- Model sunlight and shadows from aerial objects
- Generate synthetic images and analyze shadow patterns



Difference Image

- Image subtraction used to visualize changes in shadow patterns



Results

- Surface texture affects shadow clarity and visibility
- More uniform surfaces produce clearer shadow signals
- Dataset size: 1,500 sequences (~6,000 labeled frames)
- Compute: Generated on SOL NVIDIA H100 GPU
- Resolution: 518 × 518 pixels
- Render time: ~4–5 minutes per frame (256 samples)
- Scalability: Pipeline can generate 10k–20k+ frames by increasing sequences

Next Steps

- Apply machine learning models to predict drone position from shadow data
- Expand dataset with additional environments and lighting conditions
- Improve shadow extraction methods for complex textures

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seq_6_0005.json	1.11 kB	2/5/2026 4:47:30 PM

References

[[1]] S. Kannapiran et al., PathFinder: Attention-Driven Dynamic Non-Line-of-Sight Tracking with a Mobile Robot, IEEE, 2023

[2] S. Chandran et al., Learning-Based Spotlight Position Optimization for Non-Line-of-Sight Human Localization and Posture Classification, WACV, 2024

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