EasyPBR: A Lightweight Physically-Based Renderer

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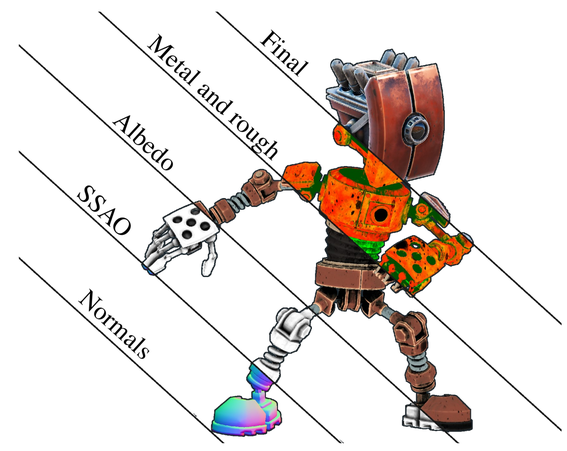
Motivation

- Rendering libraries can produce realistic images but have a steep-learning curve.
- EasyPBR offers high-quality real-time rendering with an easy to use Python and C++ interface.

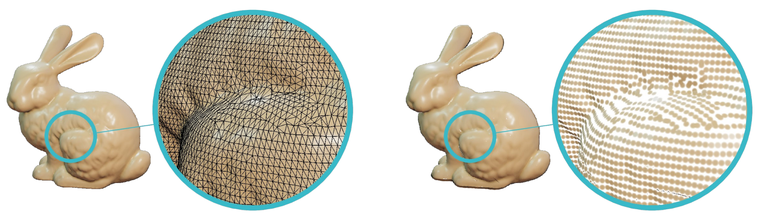
Approach

- Deferred rendering for efficient shading of only visible pixels.
- Image-based-lighting with HDR maps to simulate real-world light.
- Physically-based materials.
- Easy extension with new effects and shaders.



Renderer

- Surfel rendering with surface splatting through geometry shaders.. Quality comparable with a mesh.



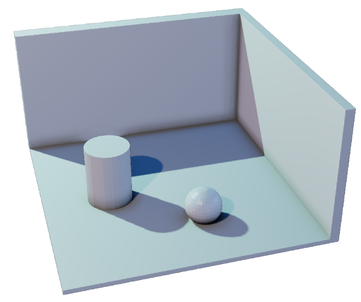
- Point cloud rendering with Eye-dome lighting and Screen-space ambient occlusion offer improved depth perception.

Plain cloud | EDL | EDL + SSAO

- Mesh rendering with color texture and normal mapping.
- Metalness and roughness textures for additional control over the materials.
- Line rendering as a forward rendering pass.

Effects

- Shadows through shadow mapping.
- Percentage Closer Filtering for smoothing



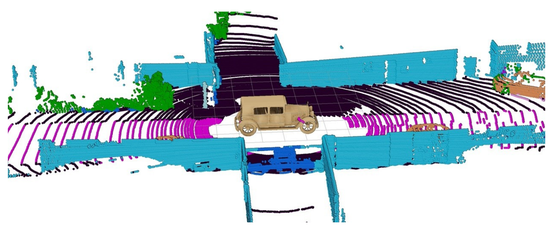
Shadows and SSAO

- Screen-space ambient occlusion using the Normal-orientated Hemisphere method.
- Bloom for simulating color bleed from sun and strong lights.
- Computed at various mip-map levels to achieve a large blur kernel and high speed.

Bloom

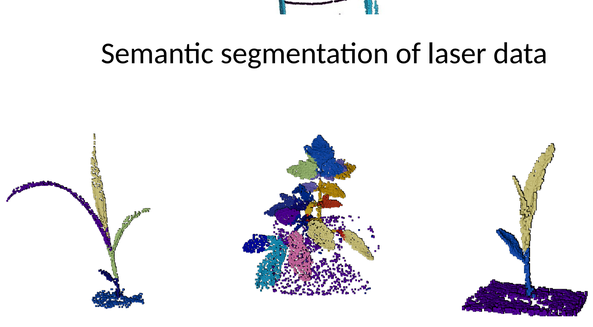
Applications

- Visualizer for 3D deep learning.
- EasyPBR interfaces directly with PyTorch and NumPy.



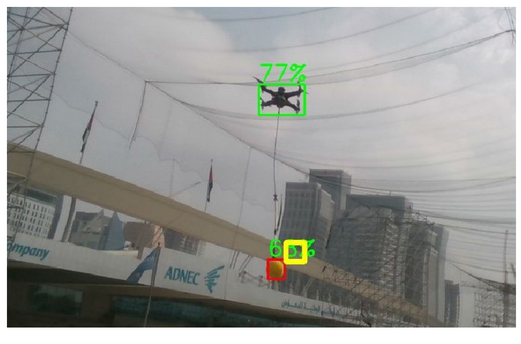
Semantic segmentation of laser data

- Rendering for synthetic data generation.
- Used for training drone detector in robotics competition.



Instance segmentation for plant point cloud

Synthetic image rendered in EasyPBR



Detection on real data using the synthetic training data

Comparison

Marmoset (Marmoset, 2020) | EasyPBR (Ours) | VTK (Schroeder et al., 2000)

	EasyPBR	VTK	Meshlab v2020.09	Meshlab v1.3.2
Goliath	6.2	6.1	6.0	558
Head	1.6	1.6	1.1	1.1

Milliseconds per frame to render various models.
Performance competitive with other renderers.

Acknowledgments

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