Multi-Resolution Depth-of-Field Rendering

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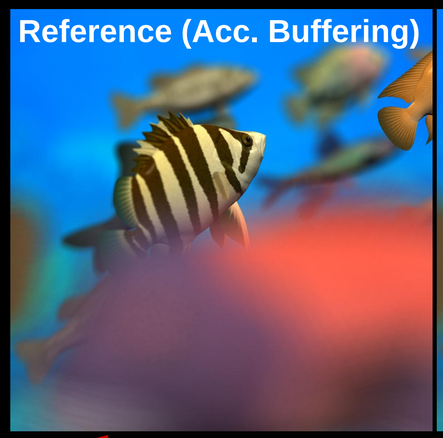
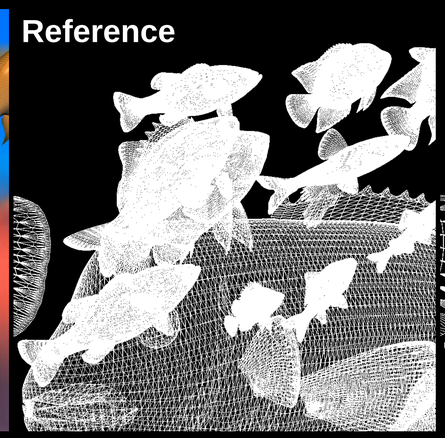
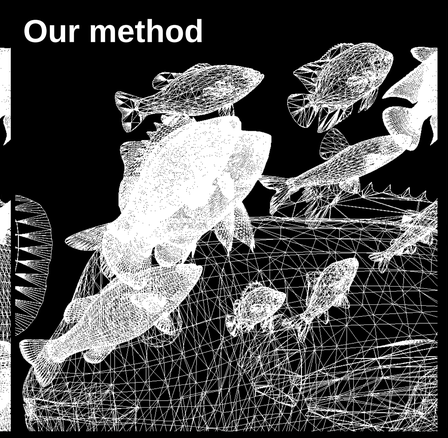






Motivation

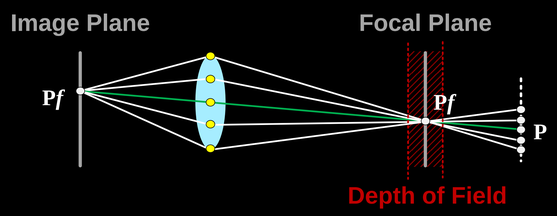
Fine geometric details of out-of-focus (blurred) objects are hardly visible and are aside from a user's attention. Hence, we can improve rendering performance by using lower-detail representations for highly blurred objects.

Challenges

Improving performance without spatiotemporal quality loss
- — Choice of a good LOD metric based on degree of blur
- — Avoiding temporal popping from discrete LODs

Problem

Depth of Field (DOF)?
A distance range in which photographic capture yields acceptable sharp imagery.



Previous Approaches

Object-based: Accurate but slow
- — Distributed ray tracing [Cook 1984]
- — Accumulation buffering [Haeberli 1990]

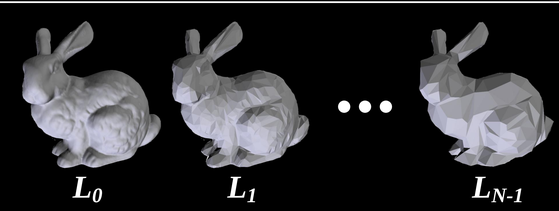
Image-based: Fast but with artifacts
- — Filtering or mipmapping

Hybrid: Balanced quality/performance
- — [Lee et al. 2010]

Our Approach

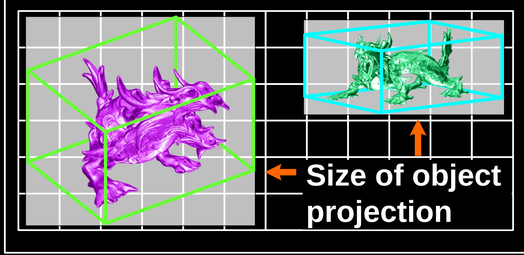
We propose a new **LOD management scheme for DOF rendering**, which is useful for object-based approaches including the accumulation buffering. We use higher details for in-focus objects, and low details for out-of-focus objects. Discrete LOD scheme is adopted, yet temporal popping is avoided using sampling-space blending.

Given 3D models, we generate their discrete LOD representations, applying successive simplification at a step of half size.



Real-time performance: DOF Rendering Based on Multi-Resolution Models

The LOD of an object is proportional to the degree of blur and the reciprocal of its projection size.



LOD of object:

$$L \propto \frac{R}{S}$$

L: Level of detail
R: Degree of blur (CoC radius)
S: Size of object projection / Number of polygons

Removing temporal popping artifacts: Blending of Two Discrete-Level Models

We use two different discrete levels adjacent to the model's LOD, instead of a single integer level that obviously leads to the popping.

L = 2.80
64 samples

Results

The speed-up of our method against the reference reached up to 10 for the fish scene (1.7M polygons and 67 objects); the quality loss is marginal. Also, our method often outperformed the state-of-the-art hybrid approach [Lee et al. 2010], while maintaining better qualities.