Accelerating k^+-buffer using efficient fragment culling

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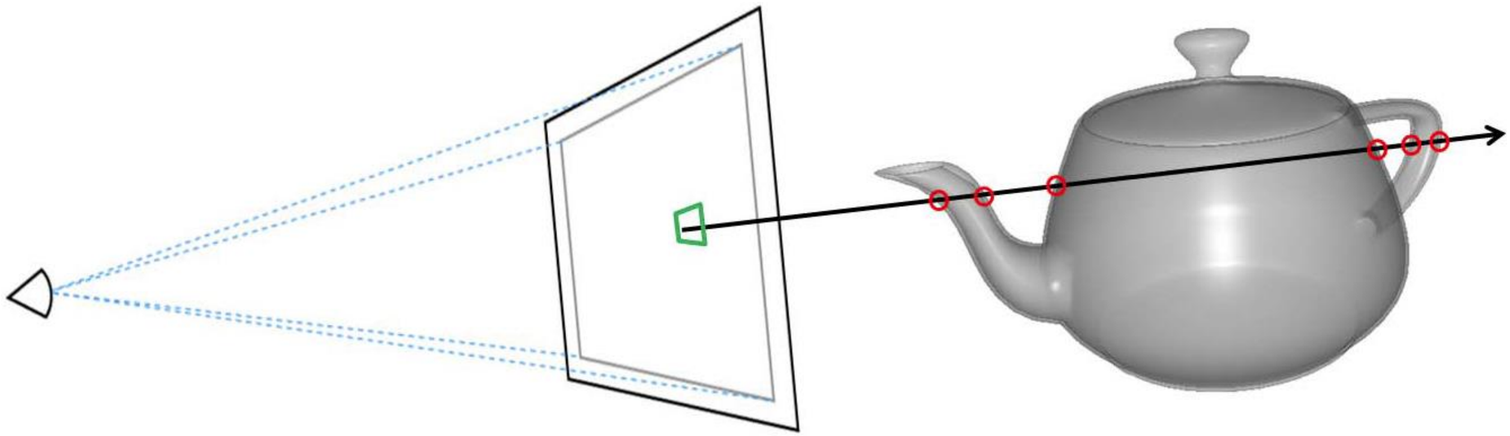
Multi-fragment Visibility Determination

A number of image-based applications require operations on more than one (maybe occluded) fragment per pixel:

- Photorealistic Rendering
  - [global illumination]
  - [order-independent transparency]
  - [shadowing]
- Visualization & Processing
  - [flow], [molecular], [hair], [solid] geometry



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1. A-buffer methods

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- capture [*k*-closest] ones → [reduce] memory & sorting costs
- prior solutions suffer from
  1. [RMW hazards], [geometry pre-sorting], [$k < 32$]
  2. [extra rendering pass], [depth precision conversion]
  3. [unbounded memory]

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  1. [RMW hazards], [geometry pre-sorting], [$k < 32$]
  2. [extra rendering pass], [depth precision conversion]
  3. [unbounded memory]
- k^+-buffer solution (*I3D'14, Vasilakis & Fudos*)
  - [overcomes] all previous limitations
  - [fragment culling] & [pixel synchronization]

Accelerating k^+-buffer

k^+-buffer's fragment culling

- Concurrently [discards] an incoming fragment that is farther from all currently maintained fragments (guided by the [max element]).
- [Limitations]
  1. Depends on the [fragment arrival order].
  2. Requires k^+-buffer to [be initially filled] before starts culling.
  3. Fragment elimination is performed inside the [pixel shader].

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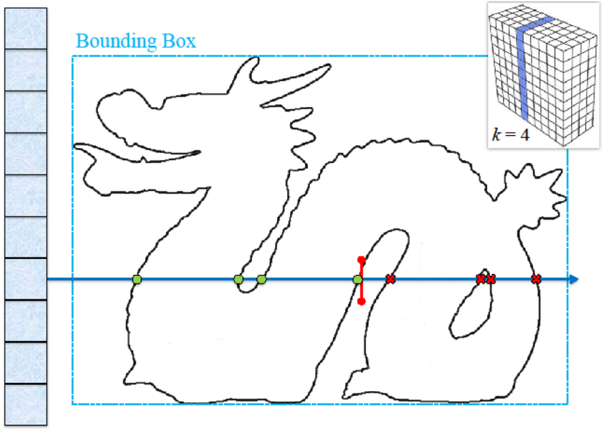
Ideal fragment culling

- Knowing the exact depth of the k-th fragment a priori allows us to insert all fragments with ≤ depth in constant time, discarding the rest (farther ones).



Accelerating k^+-buffer

Our Idea:

- Approximate this value via *fragment occupancy maps* !!!