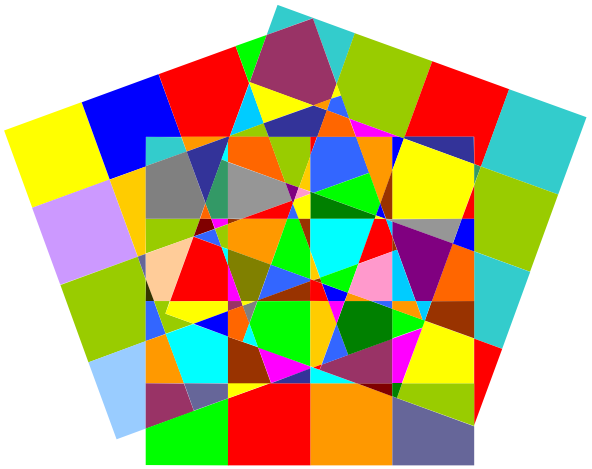
IEEE Visualization 2007

A Flexible Multi-Volume Shader Framework for Arbitrarily Intersecting Multi-Resolution Datasets



John Plate, Fraunhofer IAIS

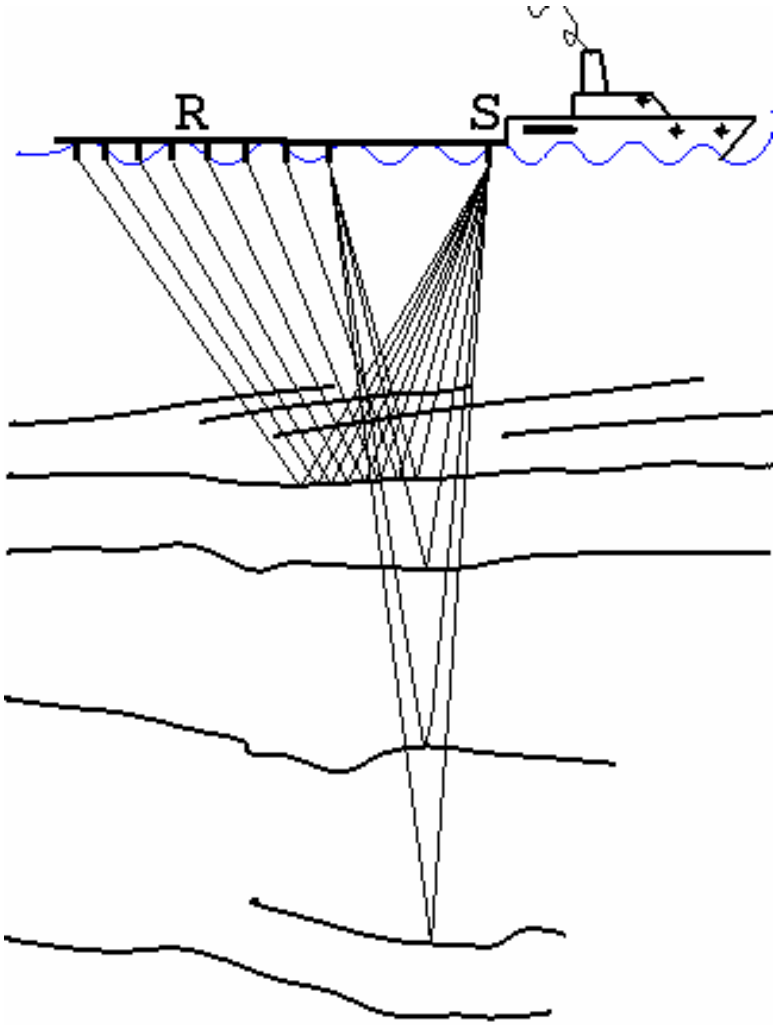
Thorsten Holtkaemper, Fraunhofer IAIS

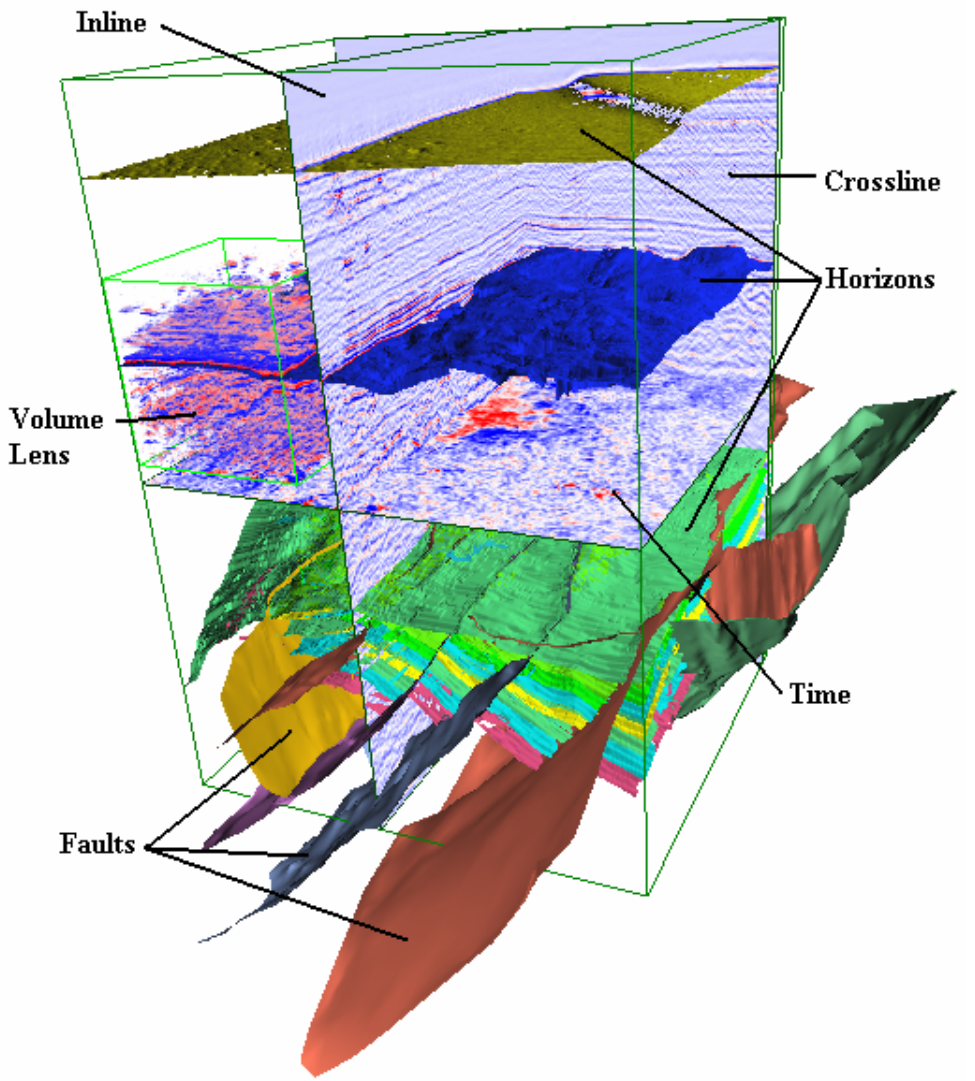
Bernd Froehlich, Bauhaus-Universität Weimar

Fraunhofer Institut Intelligente Analyse- und Informationssysteme

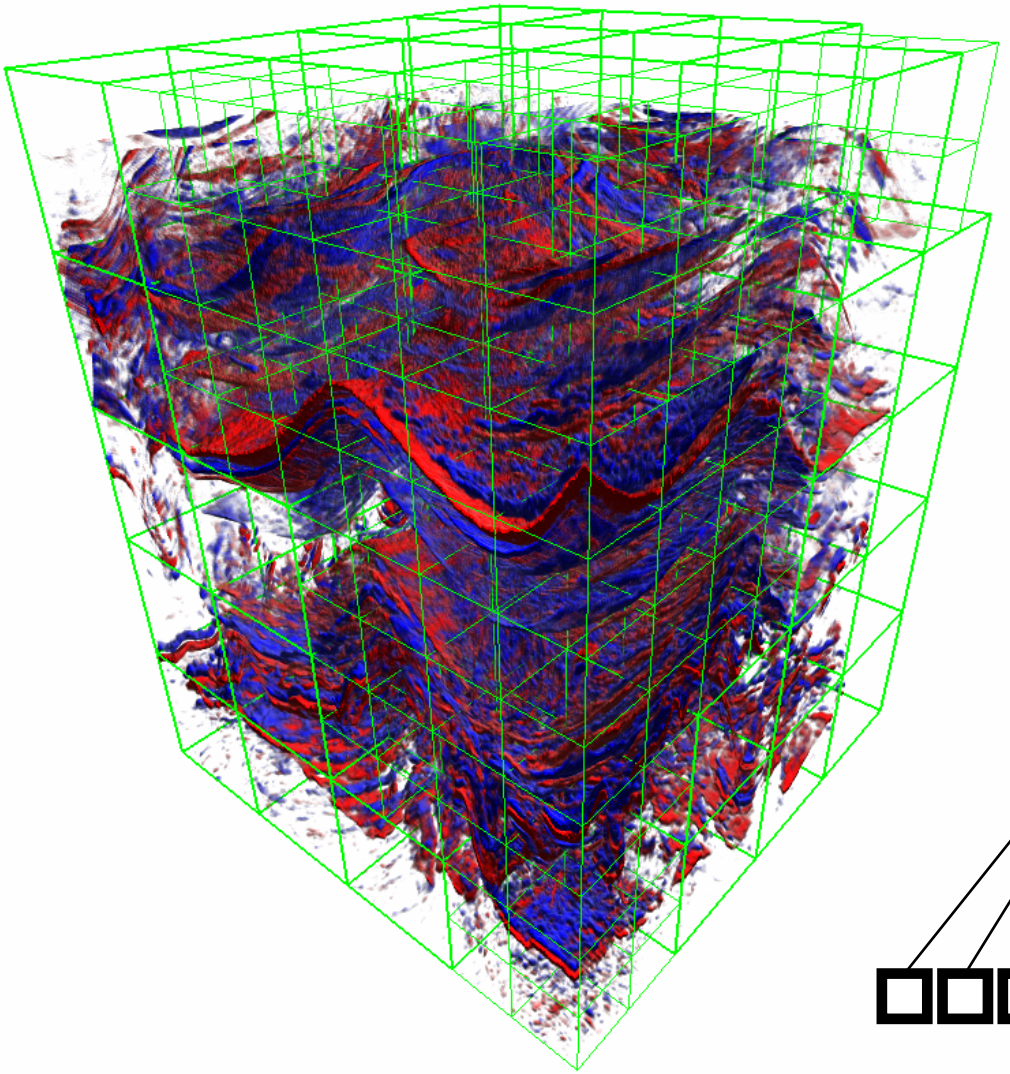
Bauhaus-Universität Weimar

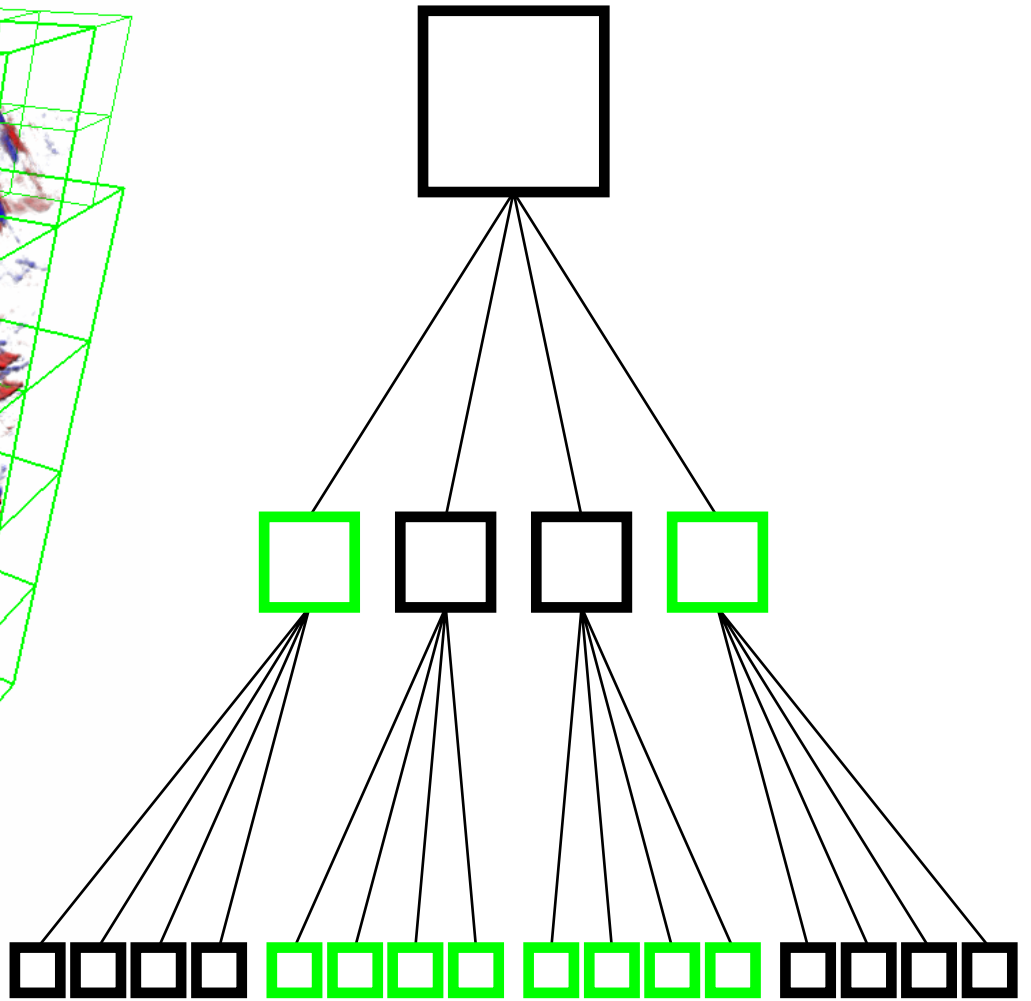
Visualization in the Oil & Gas Industry





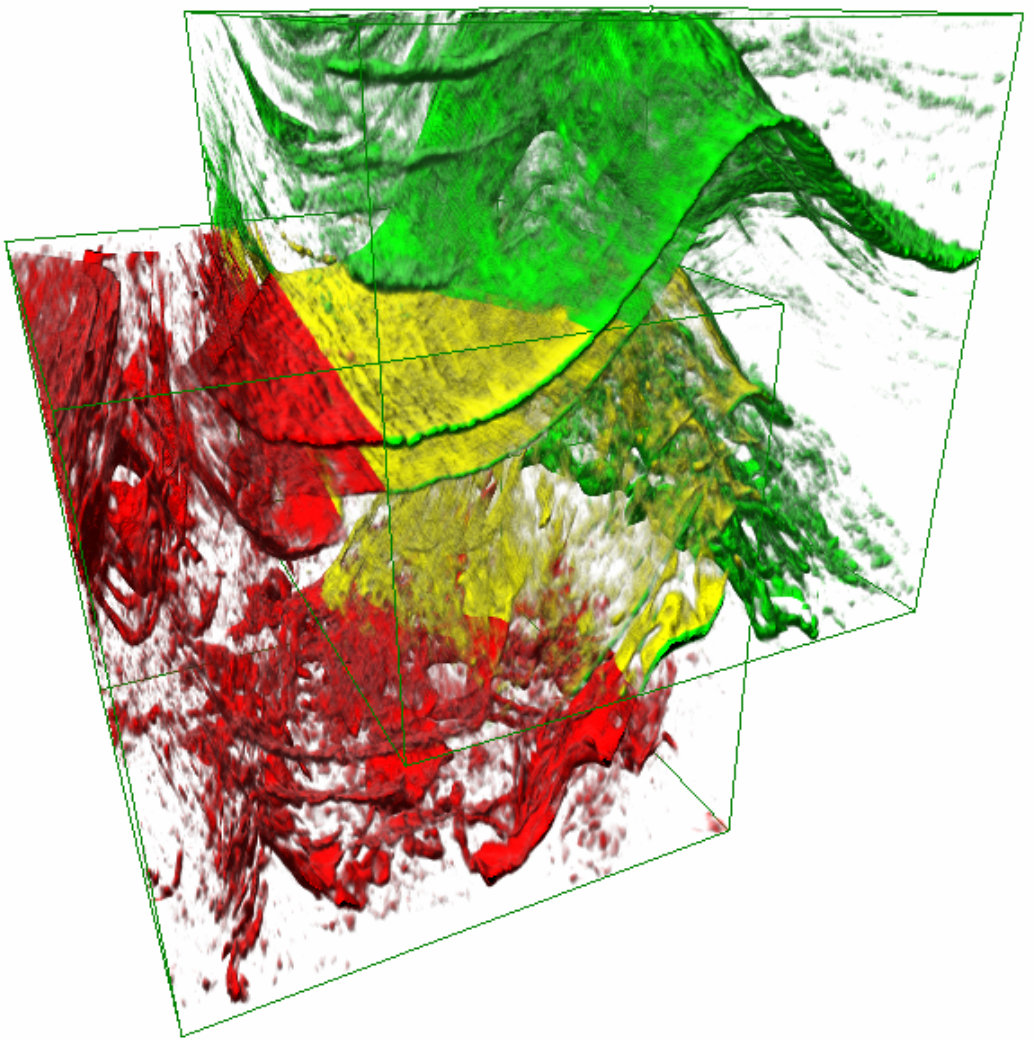
Octreemizer™: Out-of-core Multi-Resolution Volume Rendering





Multi-Volume Data

- Arbitrarily overlapping volume data
  - Temporal snapshots
  - Multi-gigabyte volumes
  - Multiple attributes
  - Clip volumes
- Resampling sometimes not desirable
  - Dynamic scenes
  - Only partial overlapping
  - Pre-processing time
  - Numerical inaccuracies
  - Different resolutions



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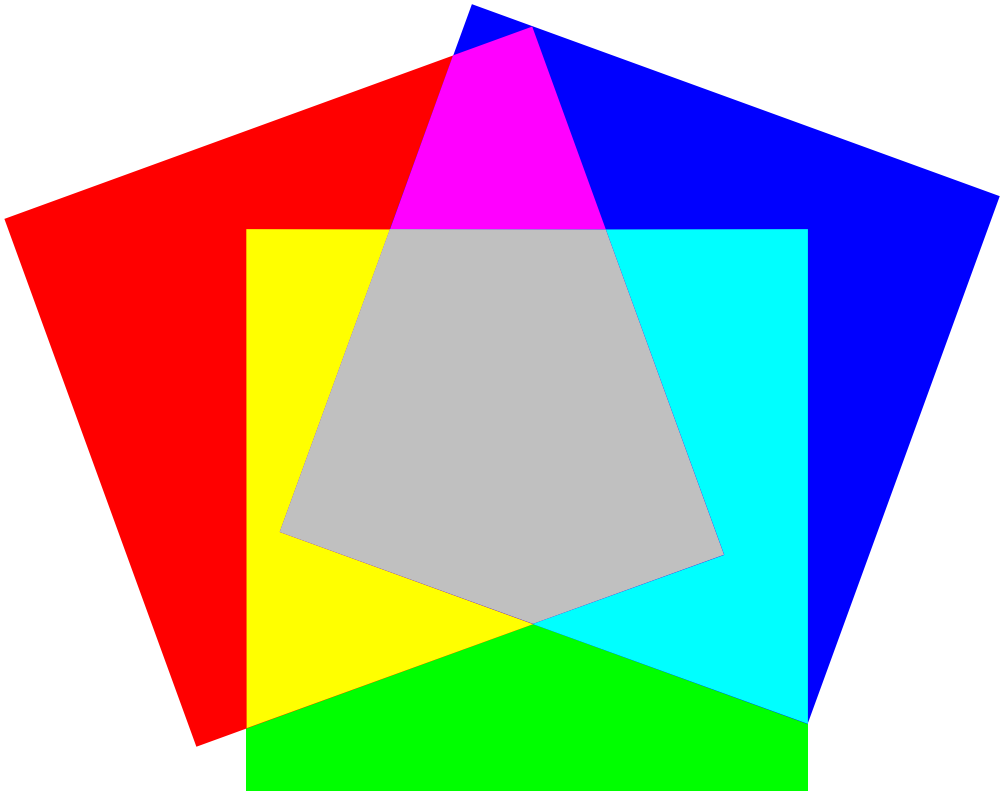
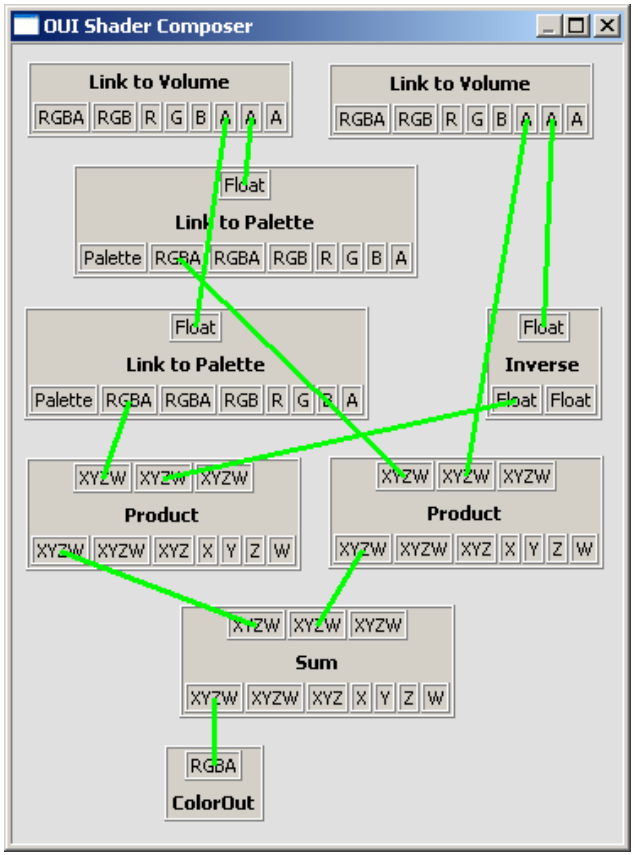
Overview

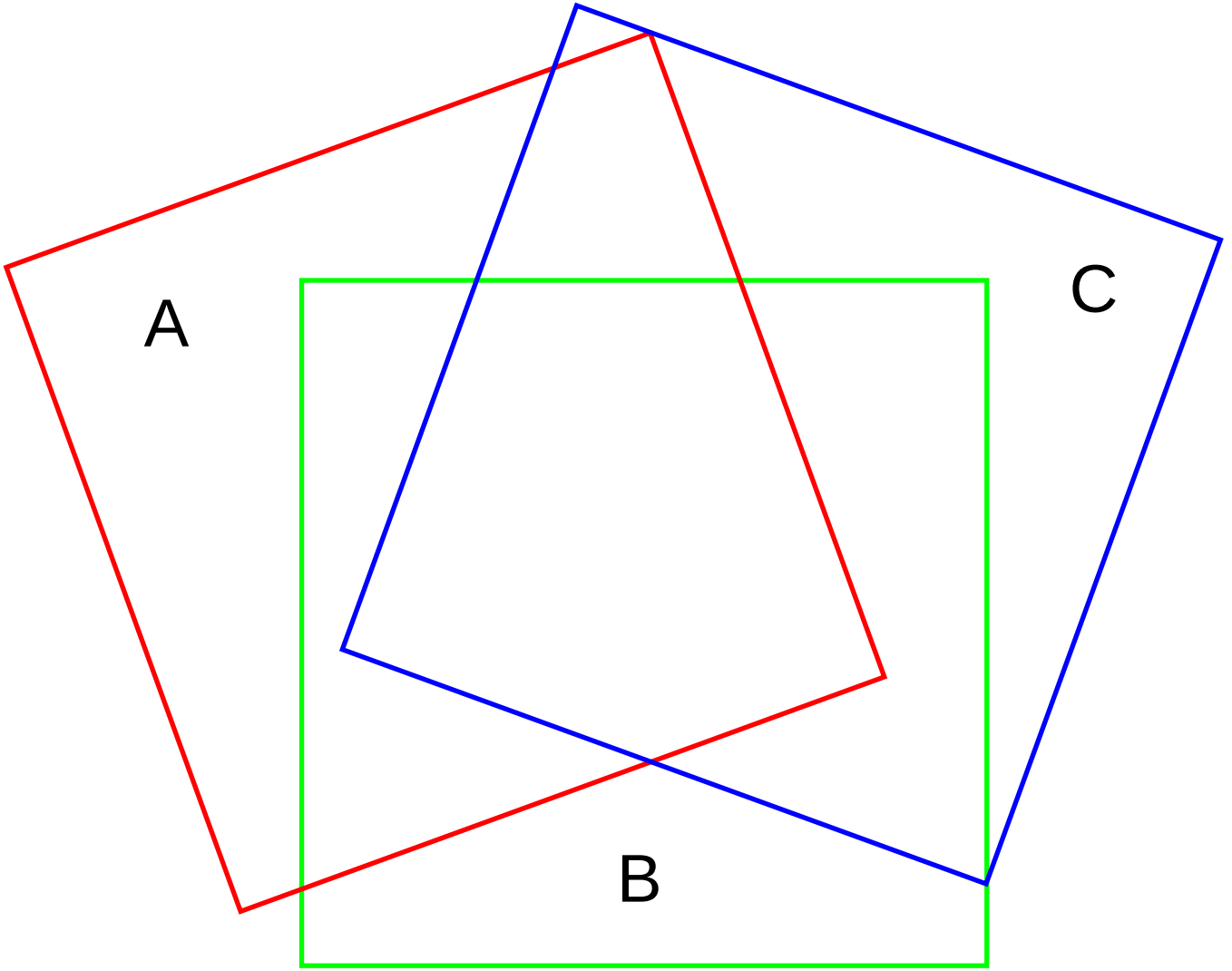
- Geometry Pipeline
  - Identify regions with different sets of volumes
  - Create proxy geometry for volume rendering



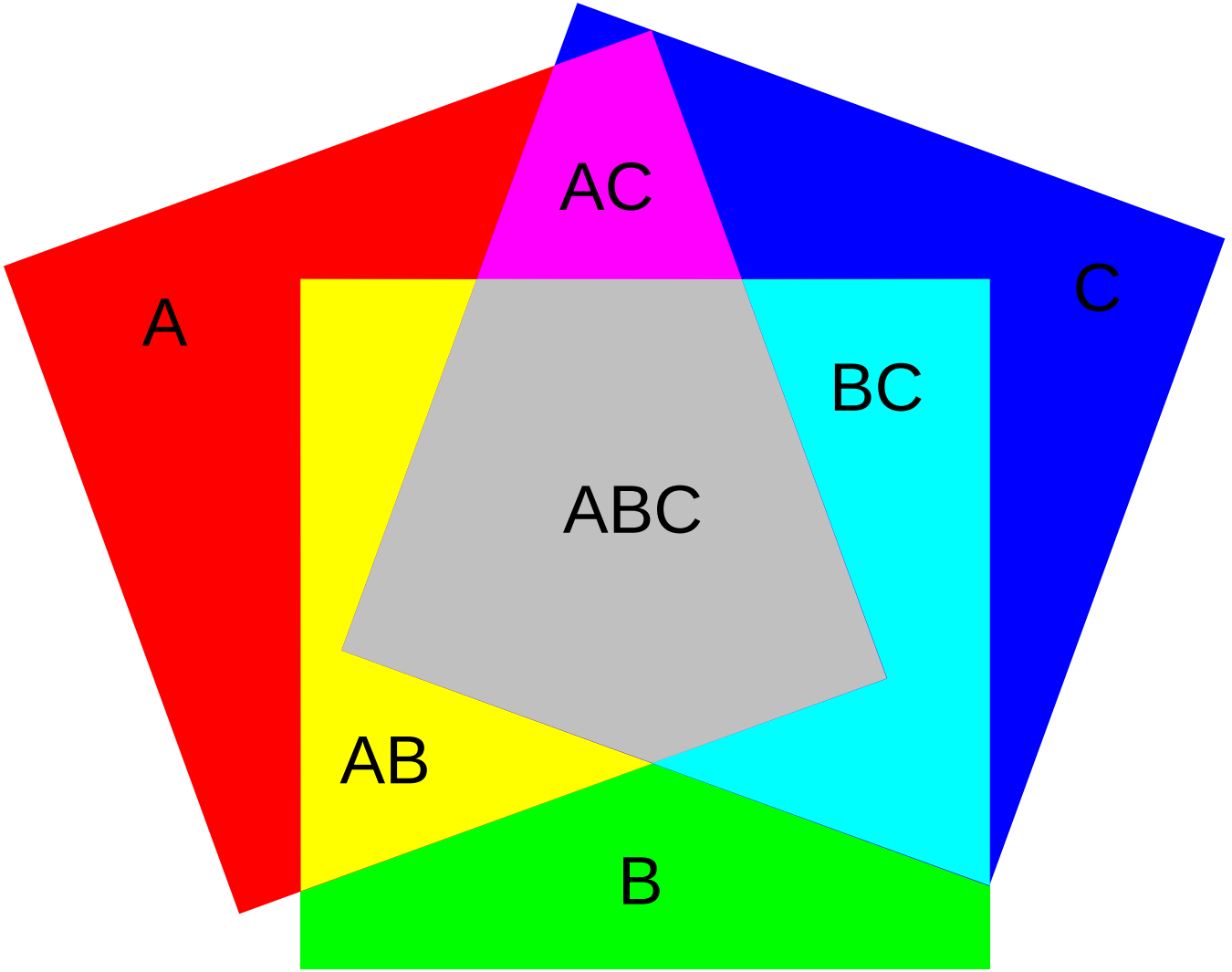
- Interactive Shader Composer
  - Define compositing technique



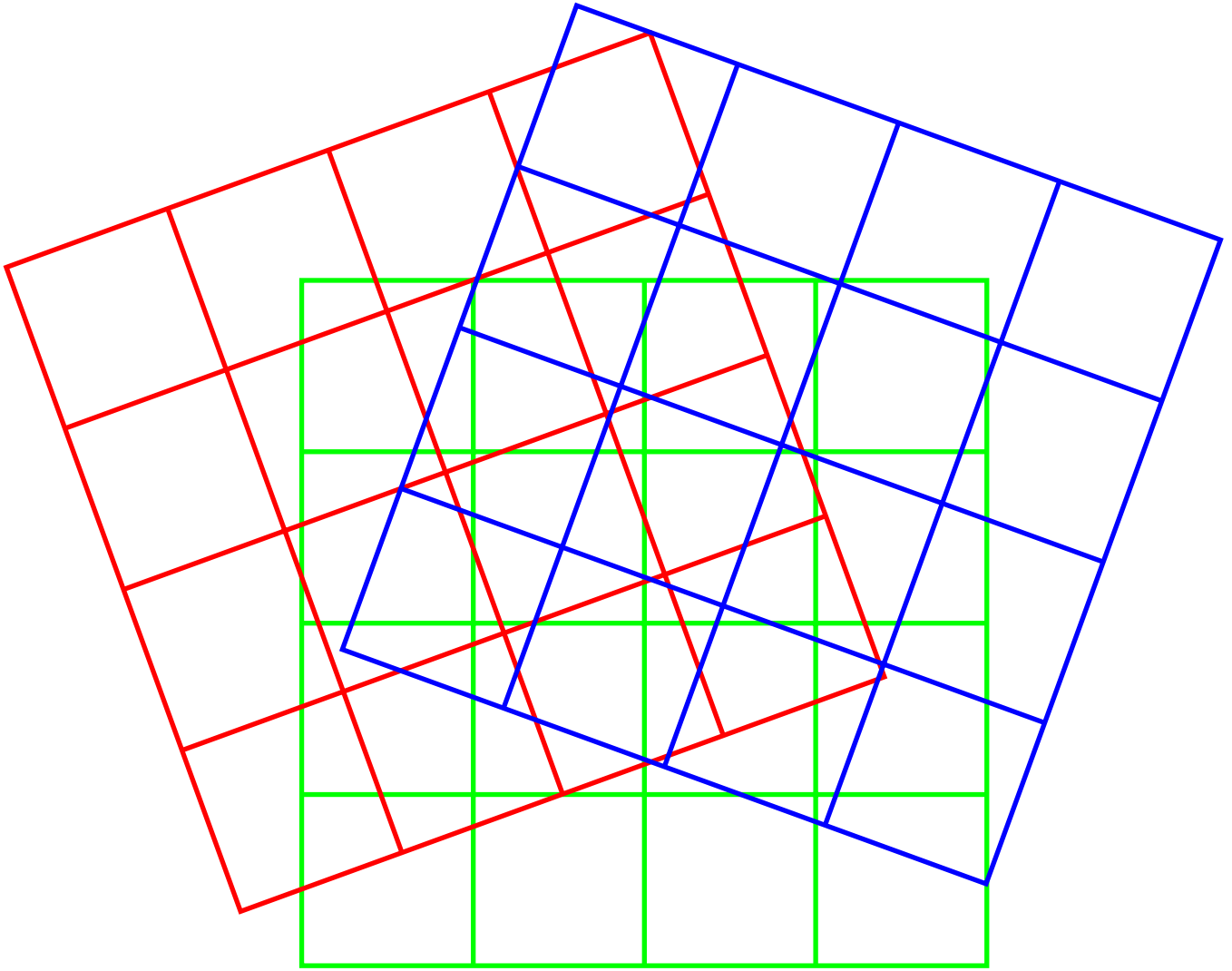
Overlapping Volumes



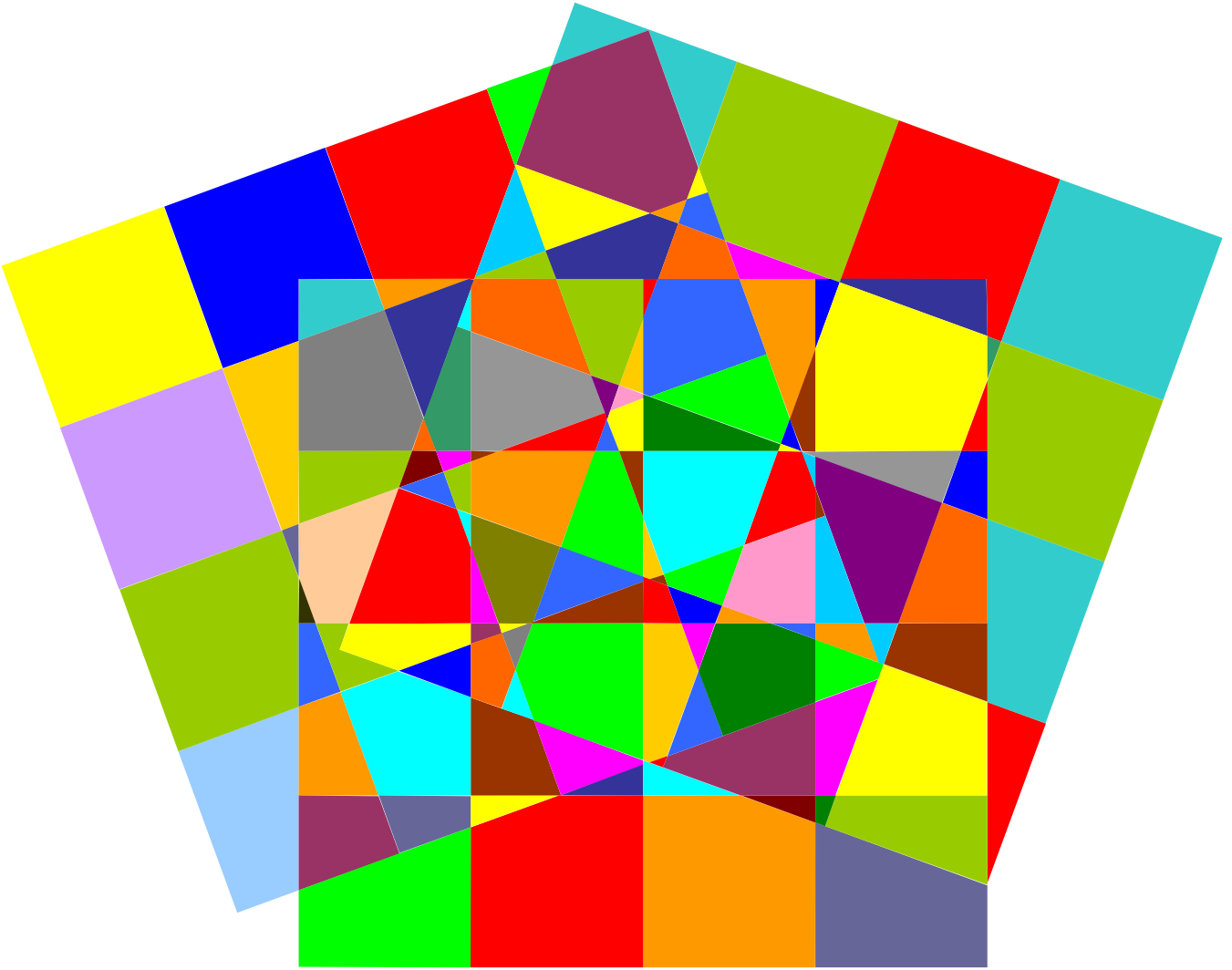
Different Sets of Overlapping Volumes



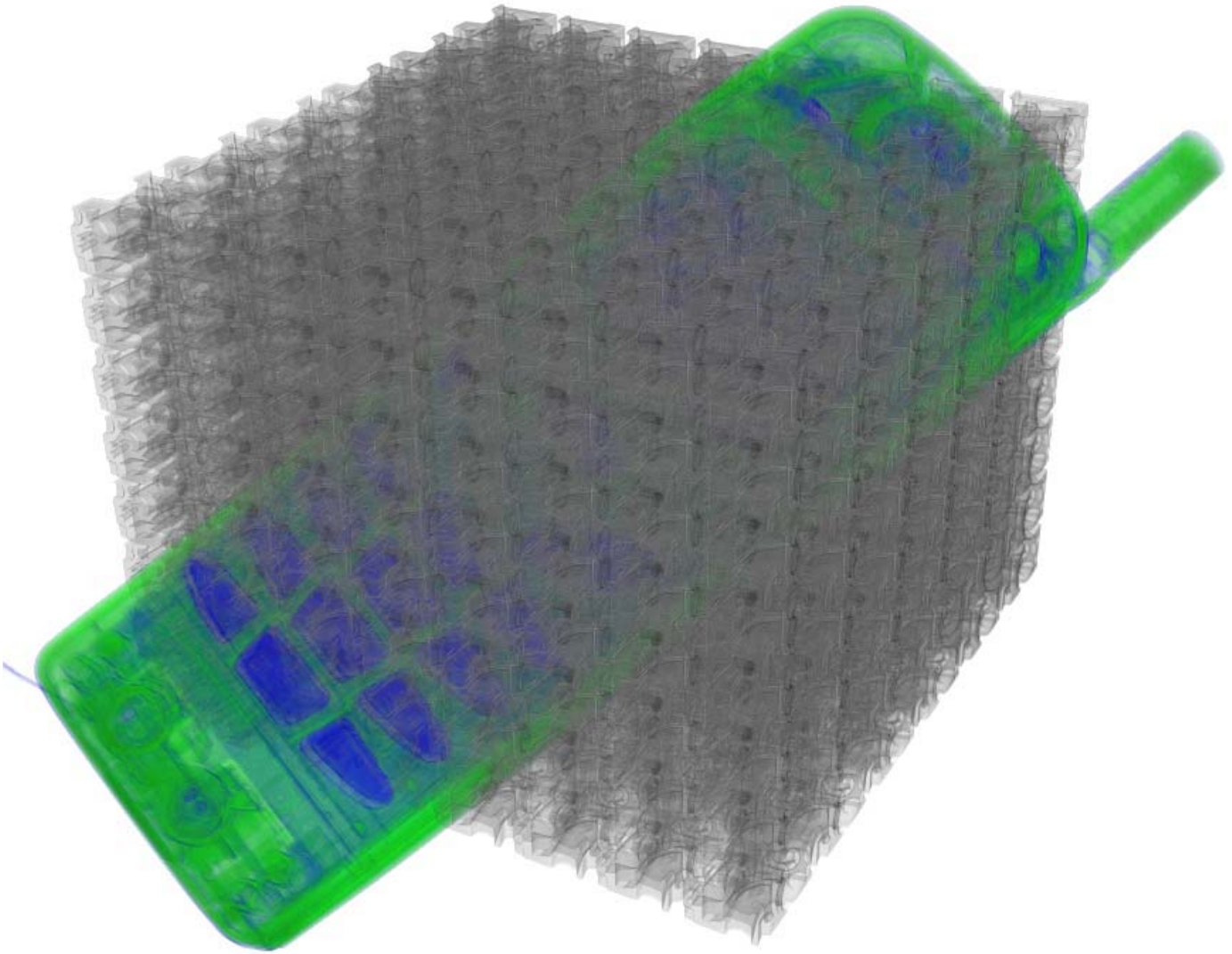
Overlapping Multi-Resolution Volumes



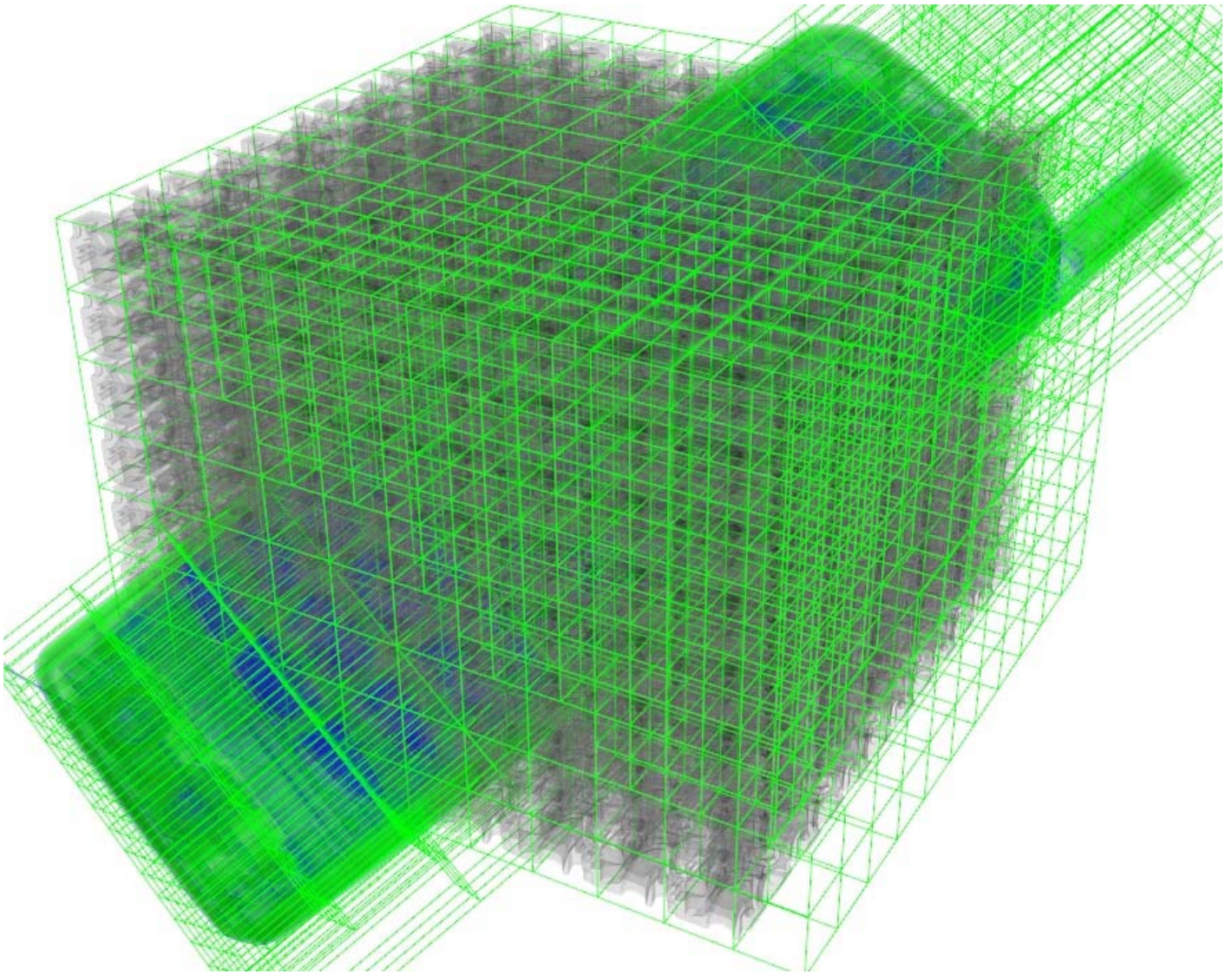
Different Sets of Overlapping Bricks



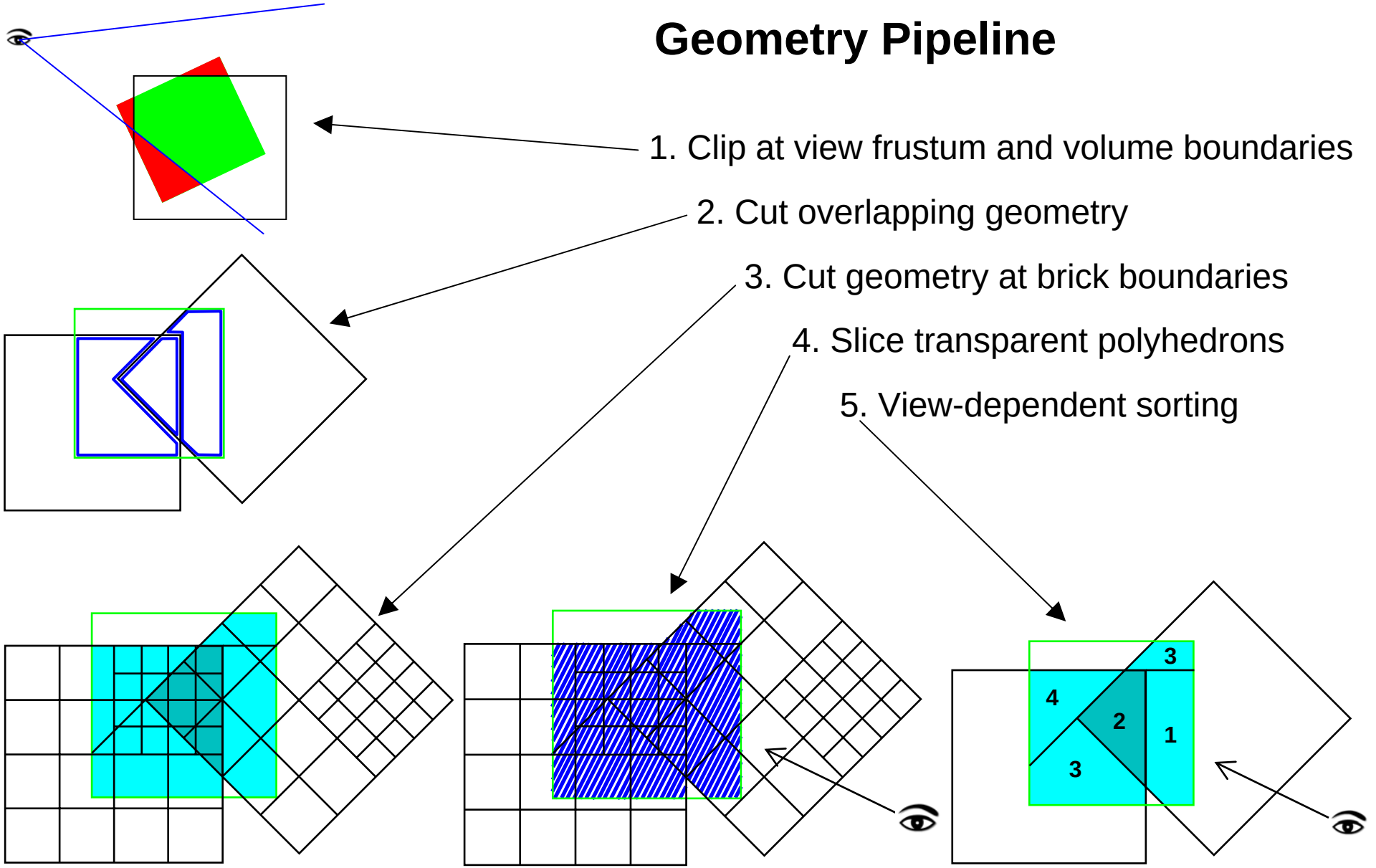
Overlapping Volumes



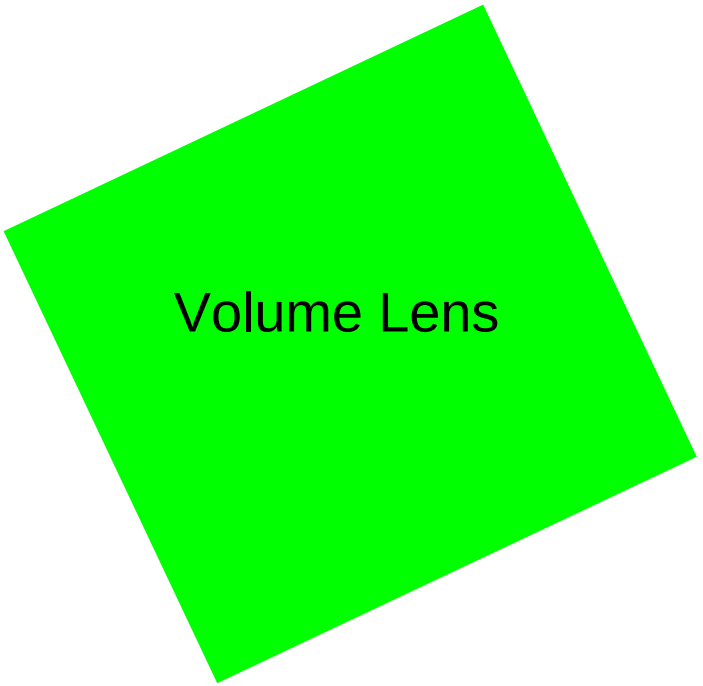
Overlapping Multi-Resolution Volumes



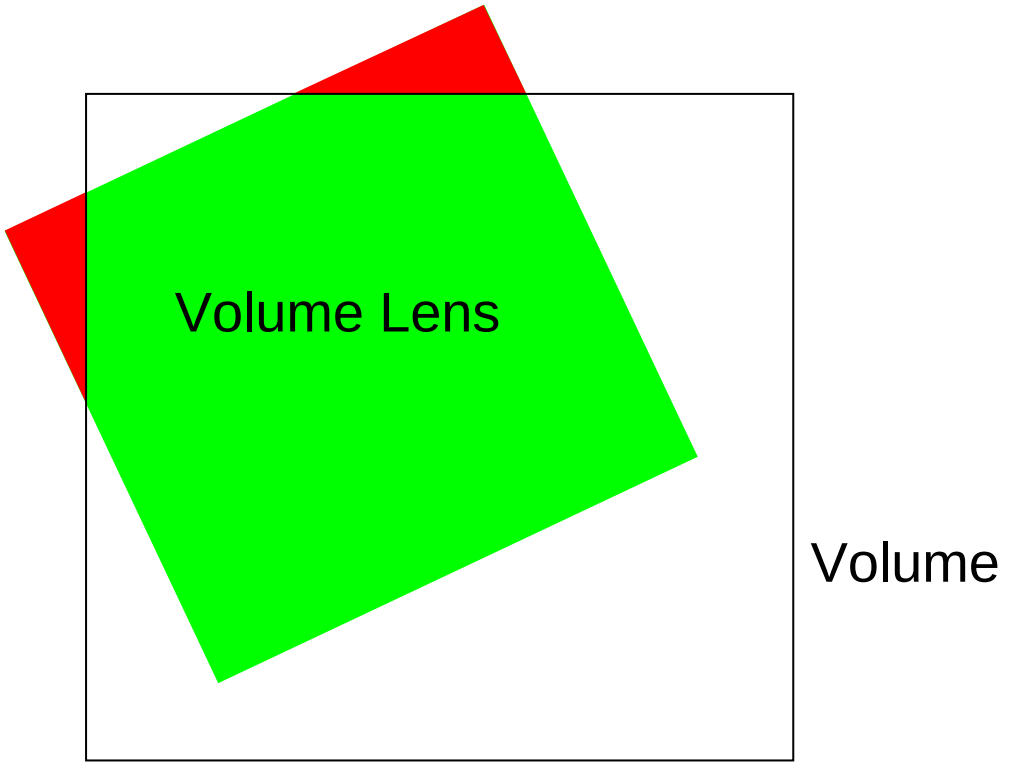
Geometry Pipeline



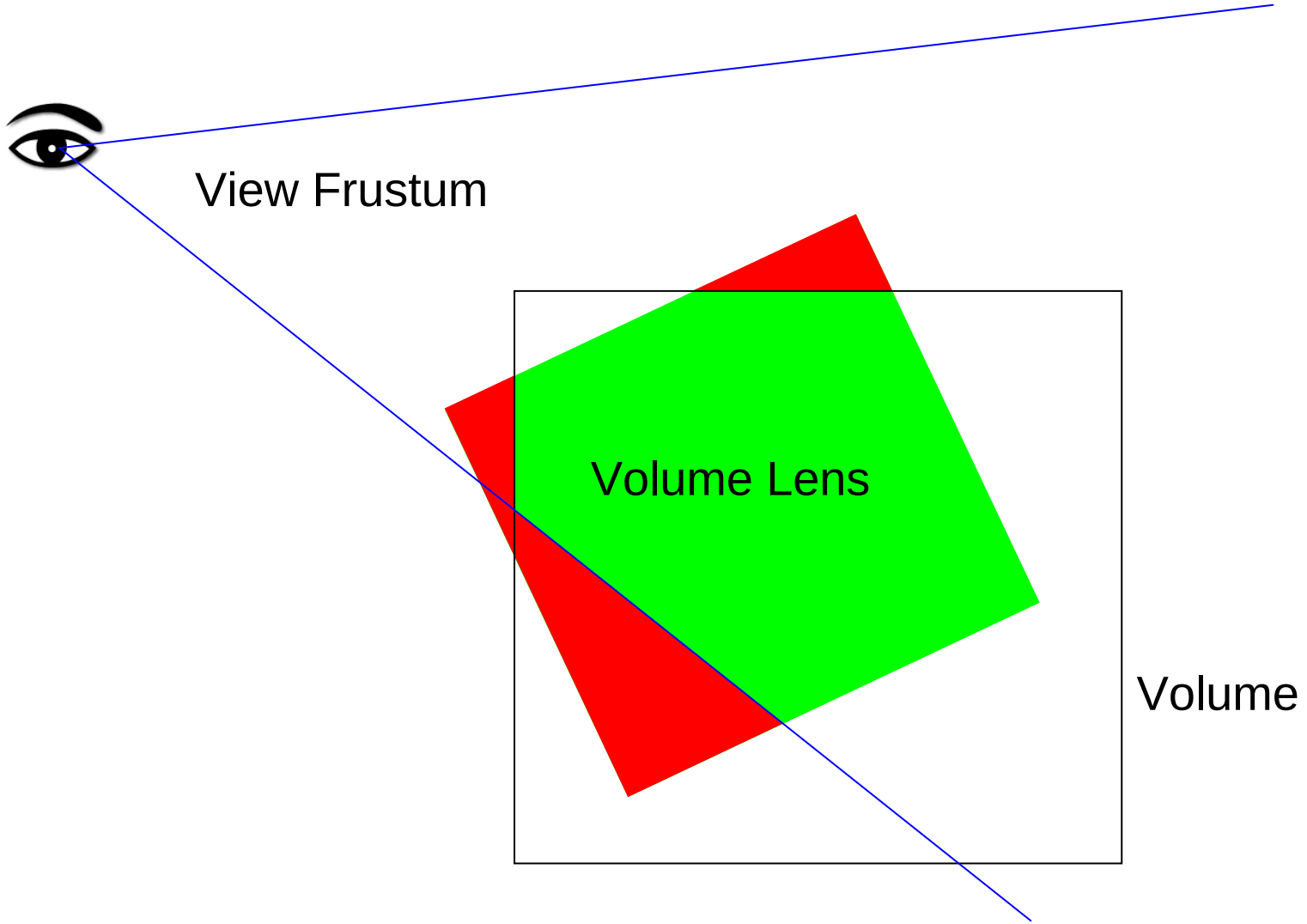
Clip at Volume Boundaries



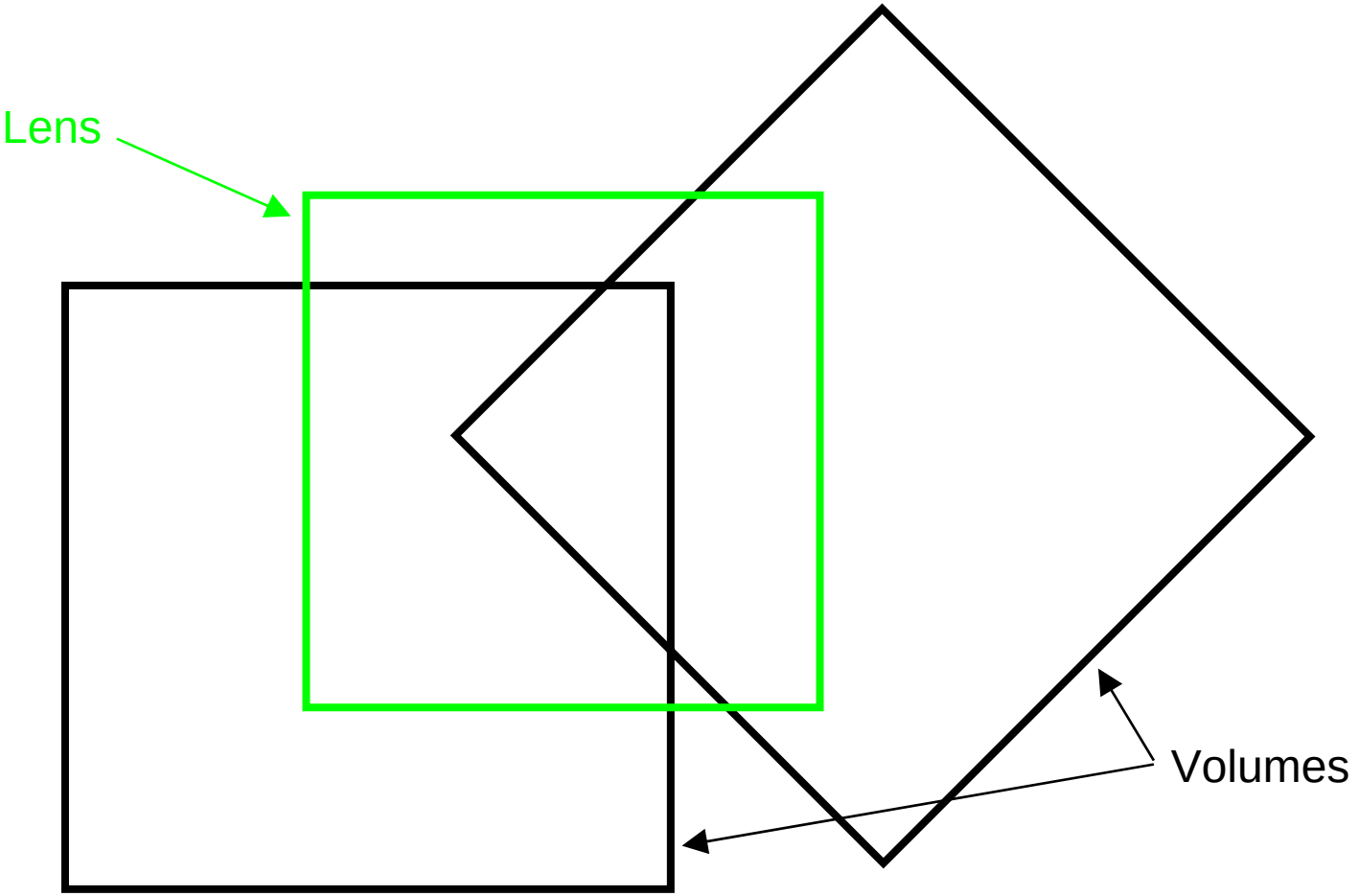
Clip at Volume Boundaries



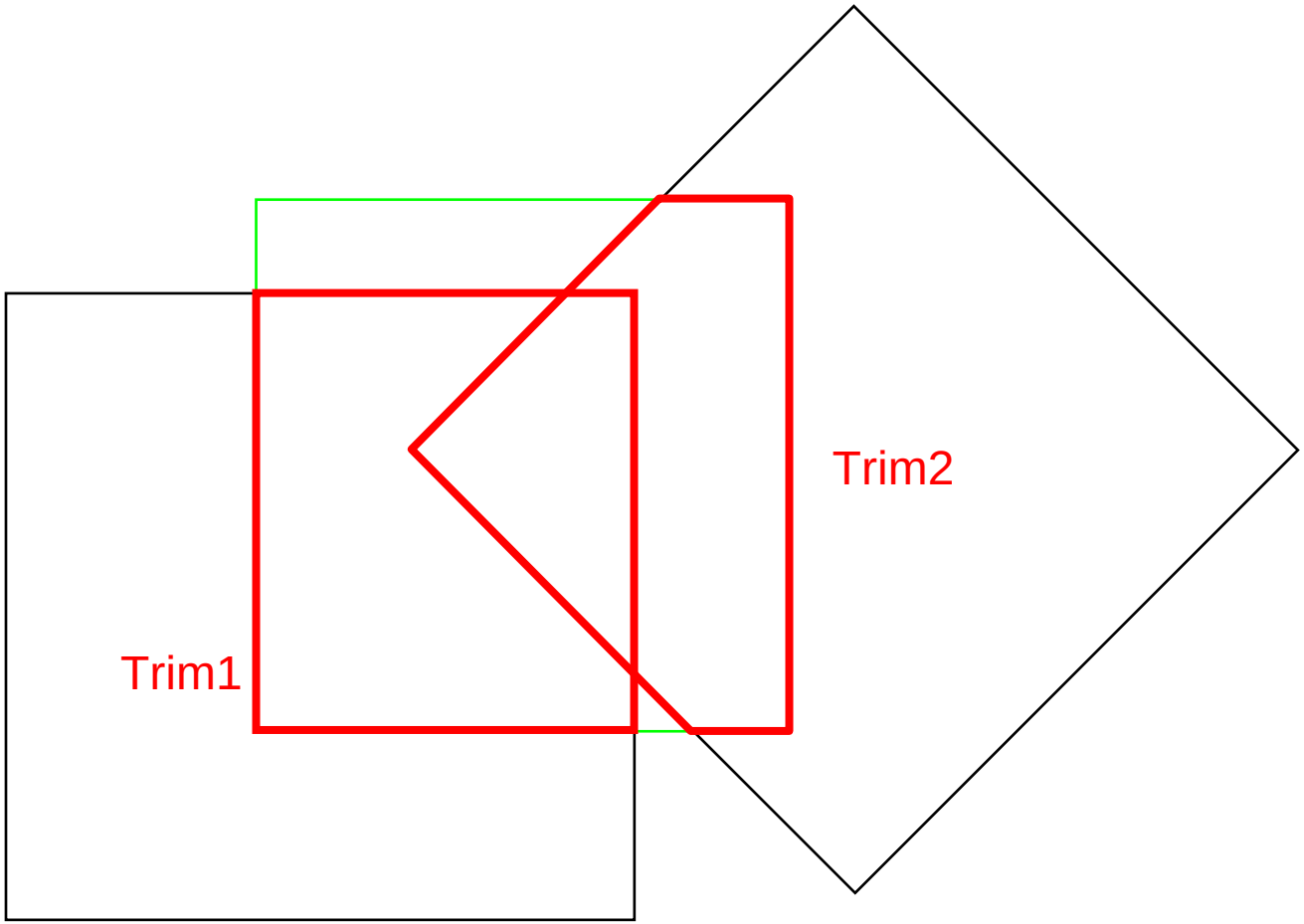
Clip at View Frustum



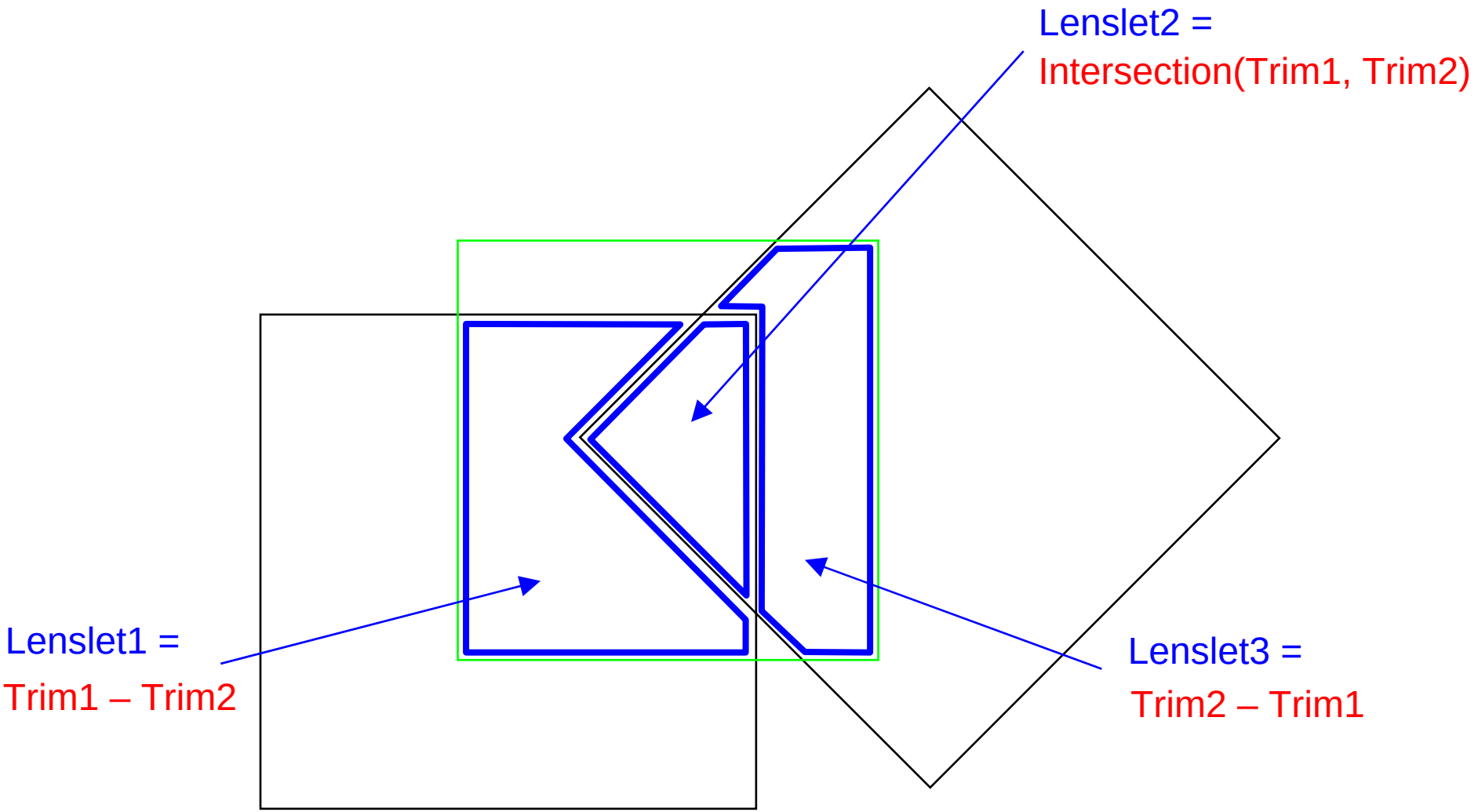
Lens in Two Overlapping Volumes



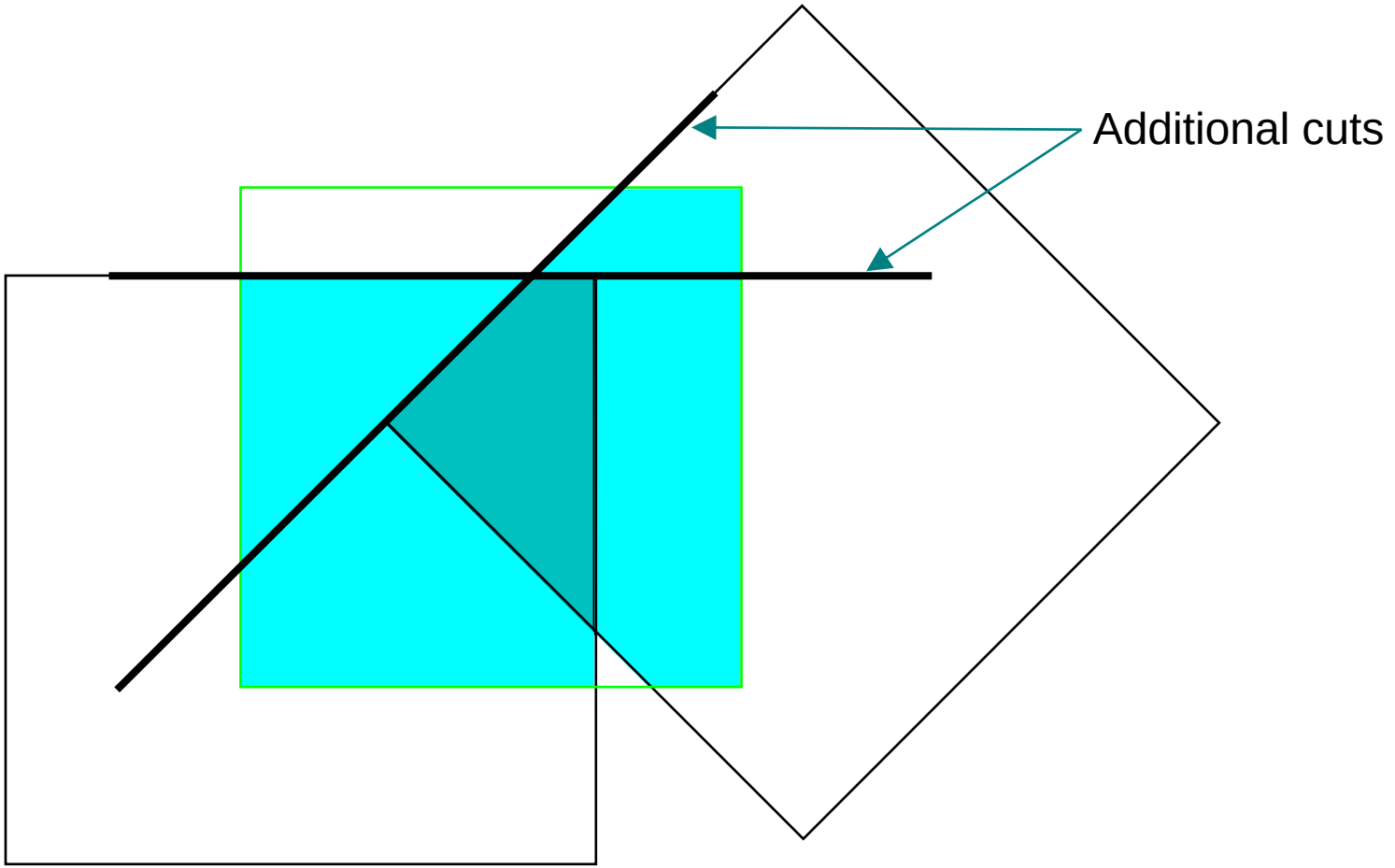
Trimmed Lenses



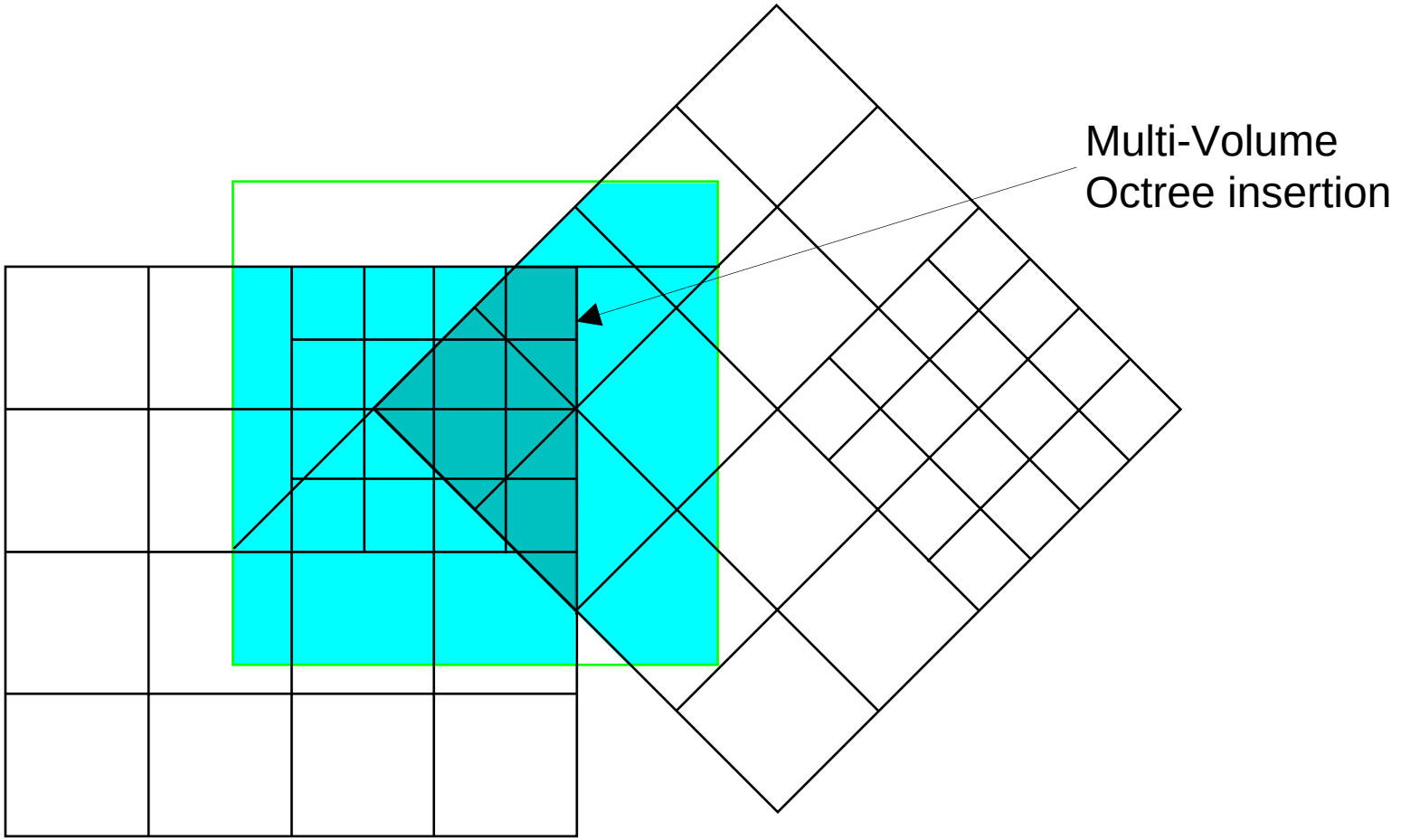
Lenslets


Lenslet2 =
Intersection(Trim1, Trim2)
Lenslet1 =
Trim1 – Trim2
Lenslet3 =
Trim2 – Trim1

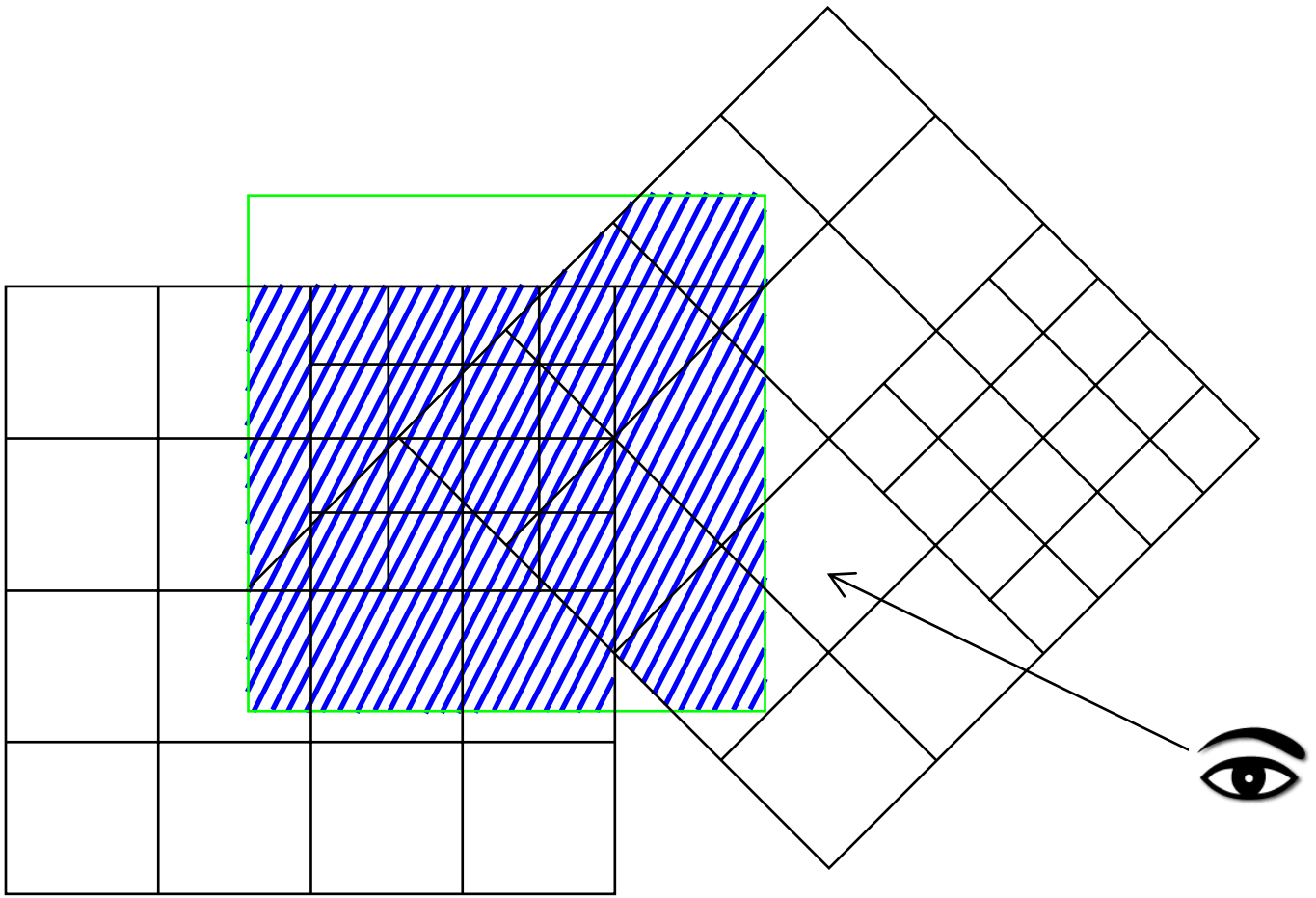
Convex Lenslets



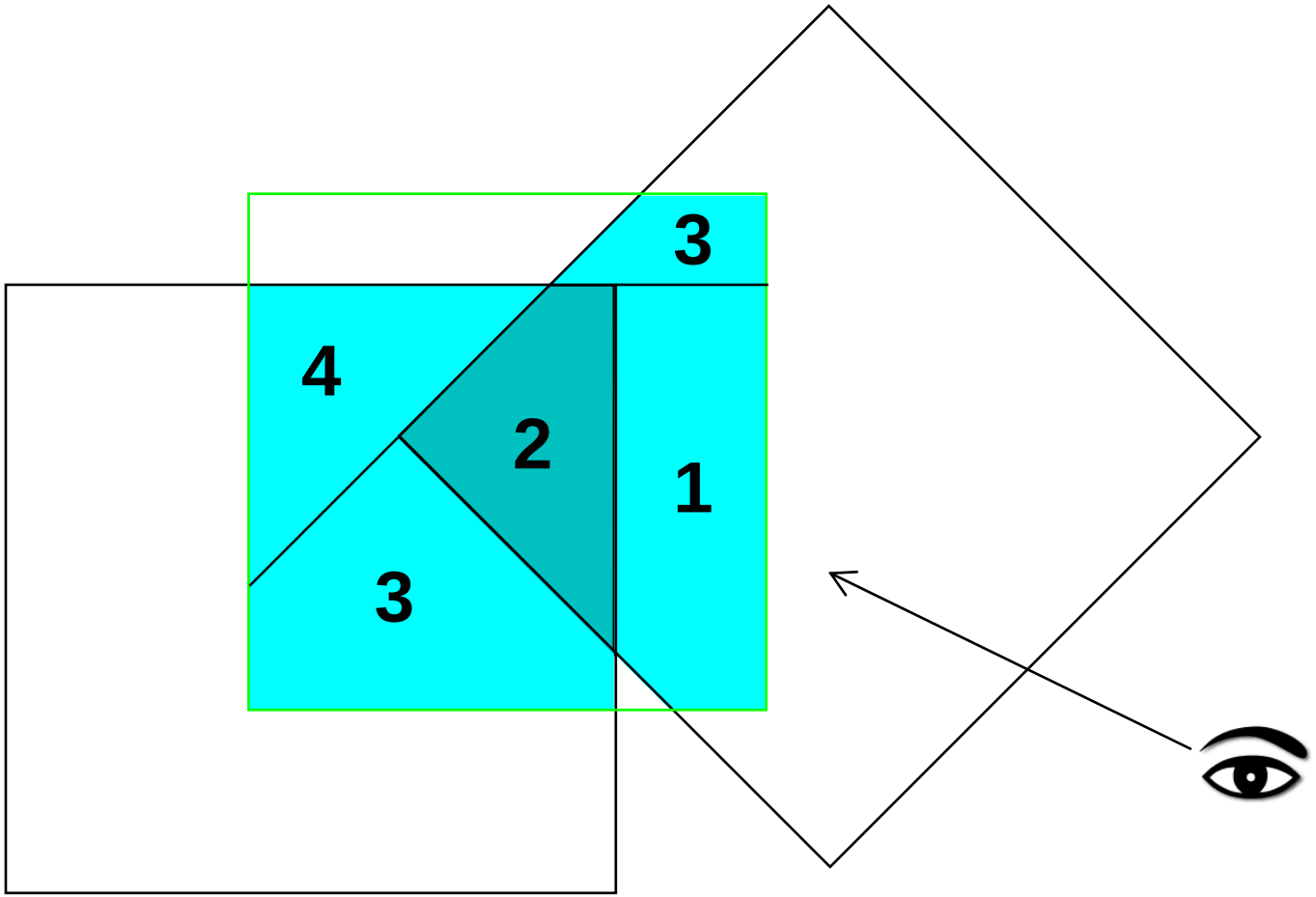
Lens Fragments: Bricked Lenslets



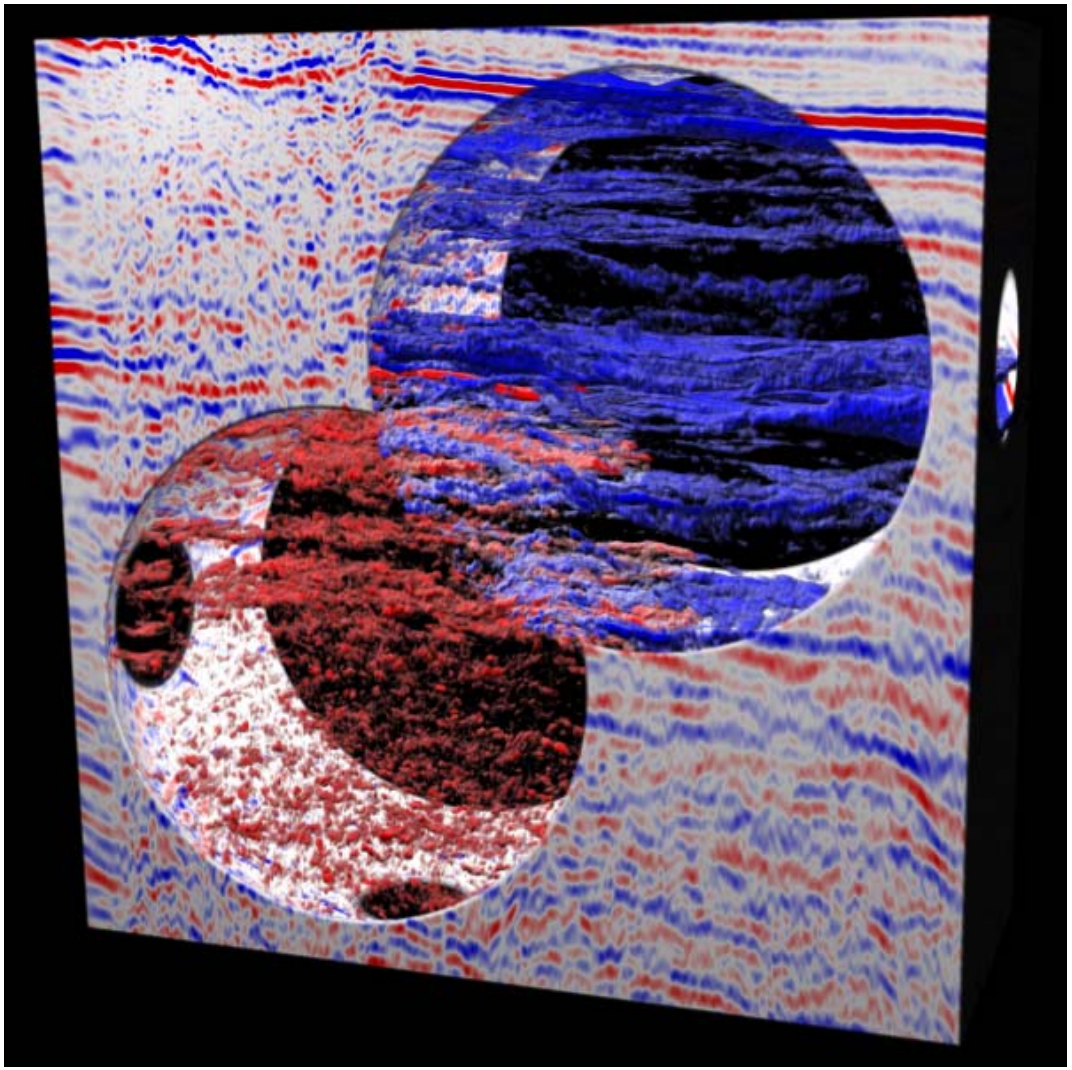
Sliced Lens Fragments

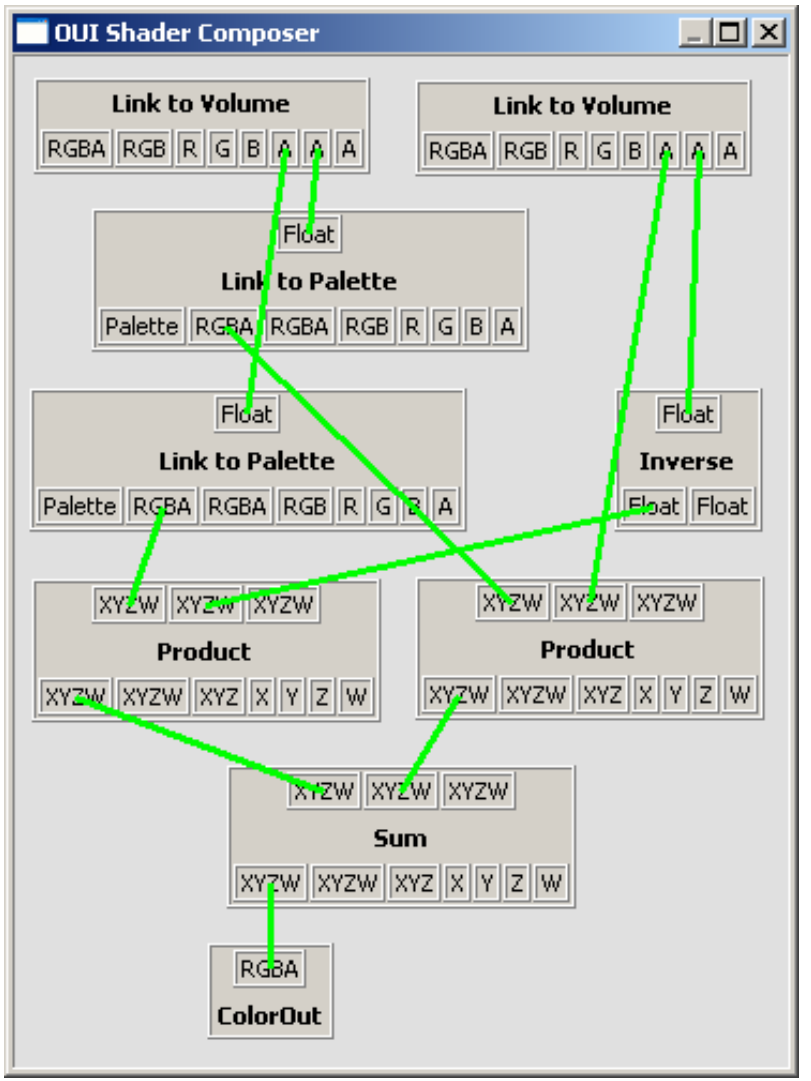


View-Dependent Sorting



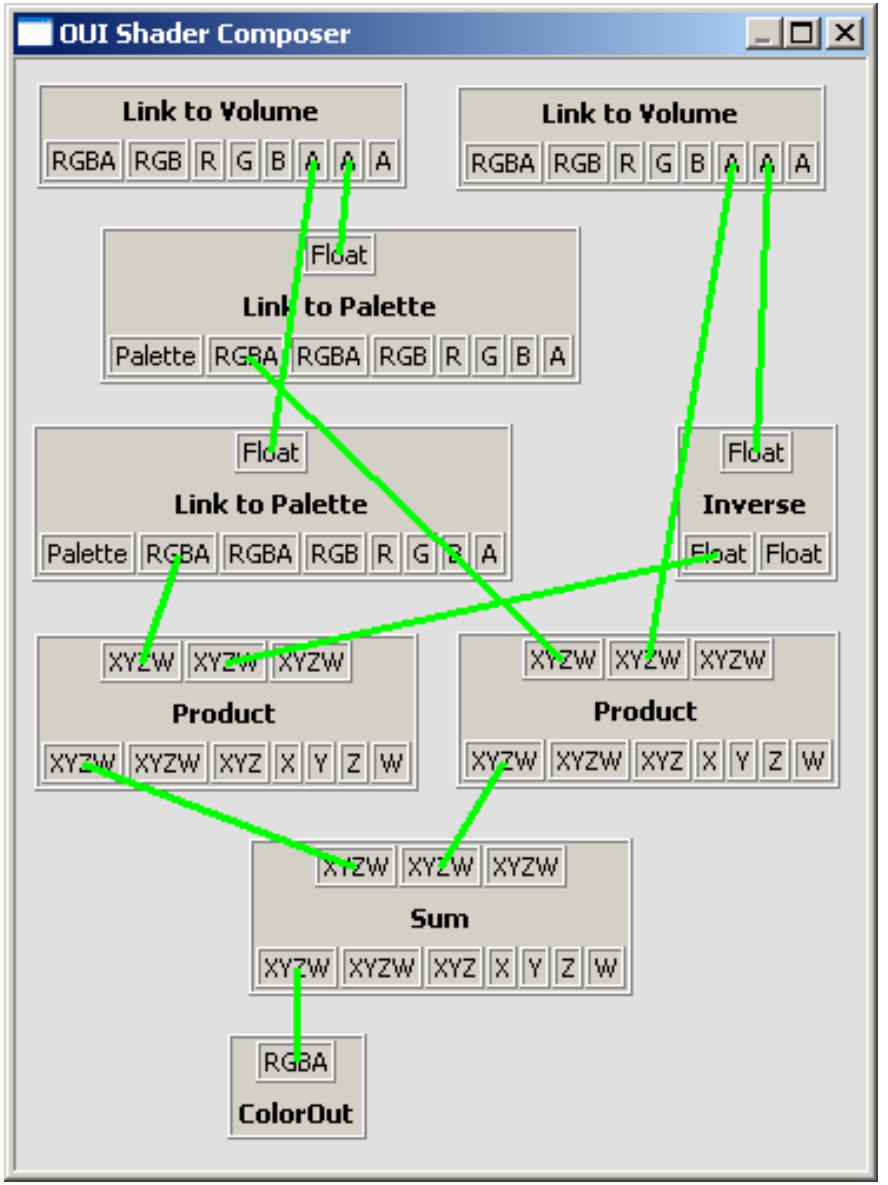
Interactive Shader Composer





Interactive Shader Composer

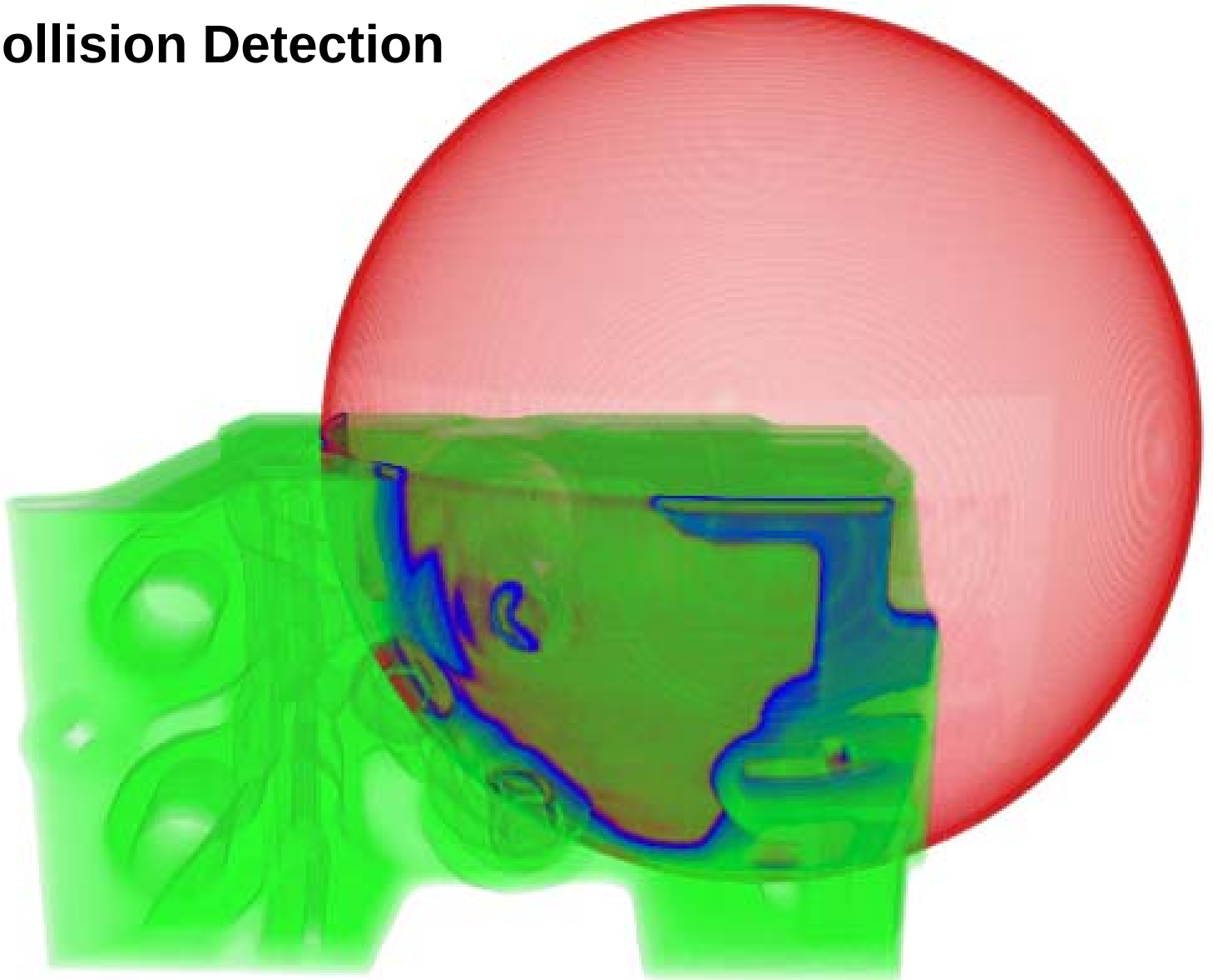
- Unlimited number of volumes (current hardware supports up to 16 textures)
- Interactive data flow definition with field connections
- Single- and multi-component fields
- Dynamic field type check
- Dynamic data flow validation (red and green lines)
- On-the-fly generation of GPU-based shader programs



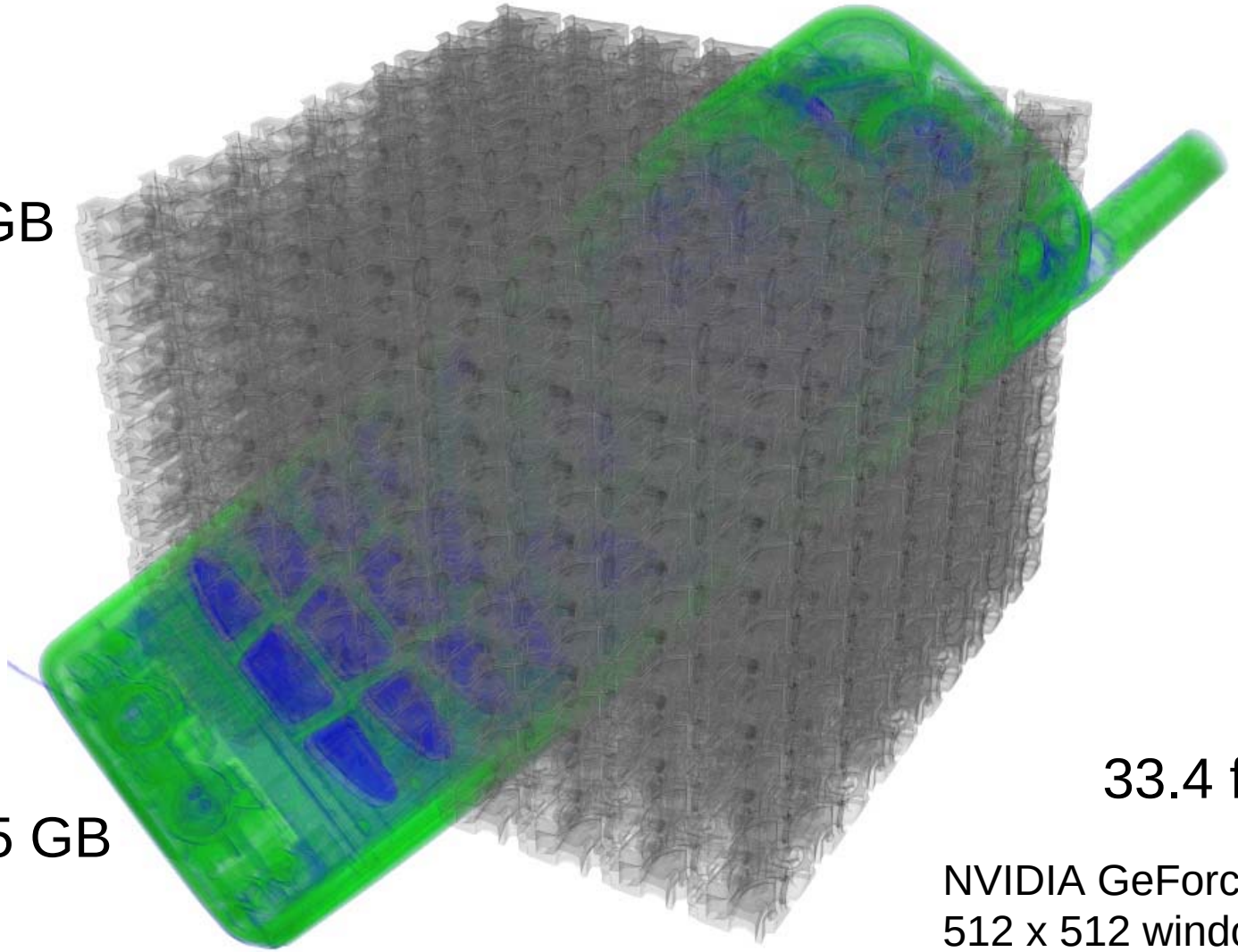
Shader Composer Nodes

- Volumes and geometries (e.g. lens and slice)
- 1D and 2D color palettes
- On-the-fly multi-volume gradients
- Phong lighting with multiple light sources
- Operators
  - Inverse, Negative, Blend, Product, Sum, Minimum, Maximum
- Multi-component combiner / swizzler
- Uncertainty
  - Desaturation, Blur and Deformation
- Waveform signal generator
- Constants

“Visual” Collision Detection



Overlapping Multi-Gigabyte Volumes



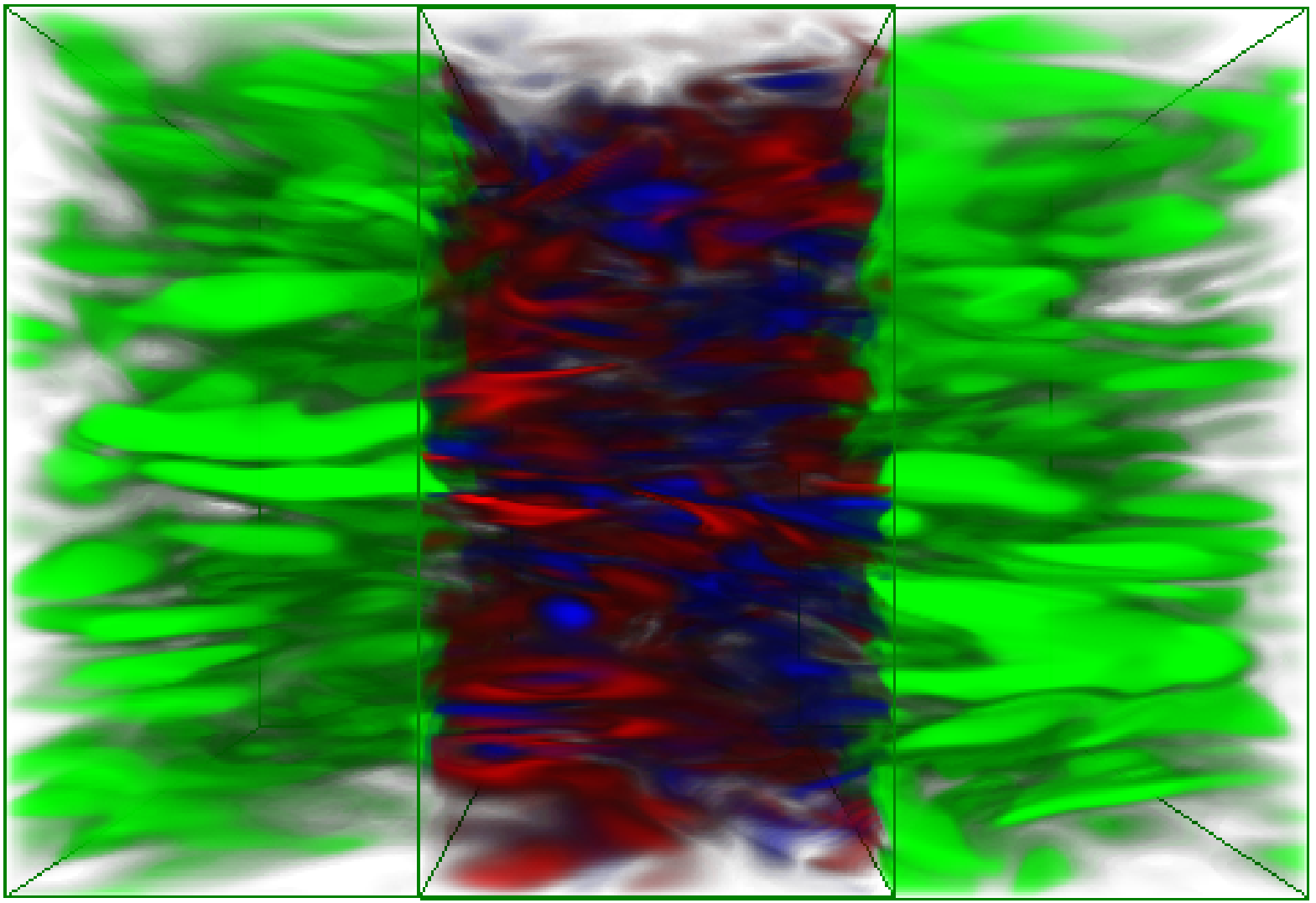
2 GB

4.5 GB

33.4 fps

NVIDIA GeForce 8800 GTX SLI
512 x 512 window size

Difference Visualization



Conclusions and Future Work

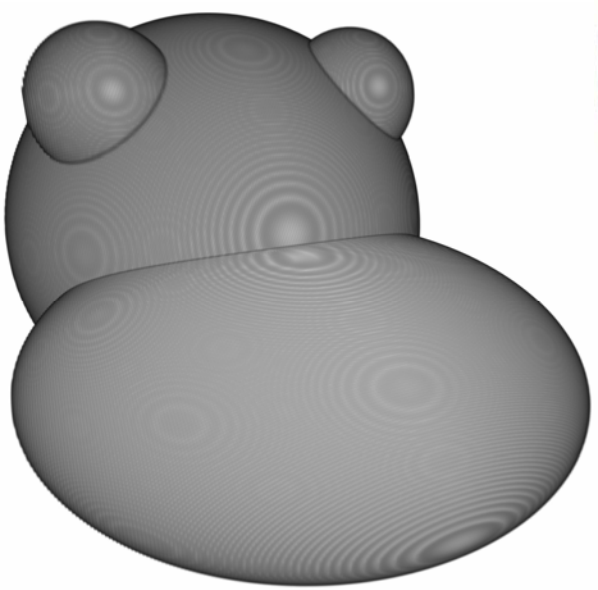
- Flexible multi-volume rendering and shading framework for multi-resolution datasets
- No resampling of the overlapping datasets
- Fast and numerically robust geometry pipeline
- Interactive frame rates only for a few overlapping multi-resolution volumes
- Interactive shader composer
  - Specifies the volume composition and rendering technique
  - Extensible and expressive tool, also for users without programming skills
  - New visualization techniques can be interactively developed and explored
- Future work
  - GPU-based proxy geometry generation
  - Volume ray casting
  - Pre-integration techniques

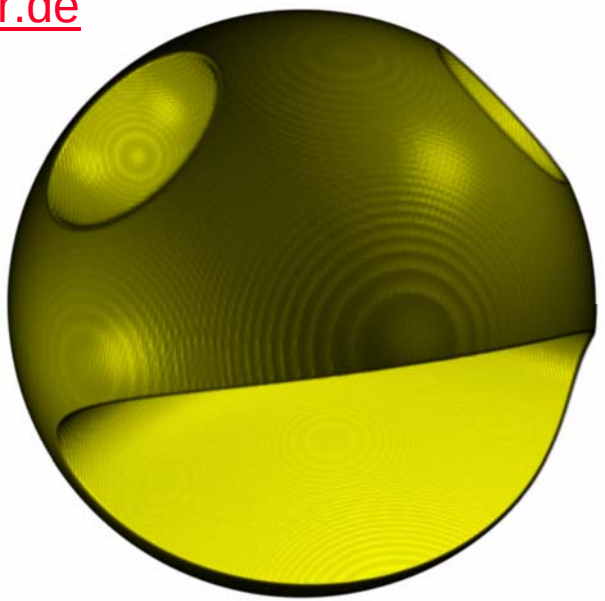
Thank you!

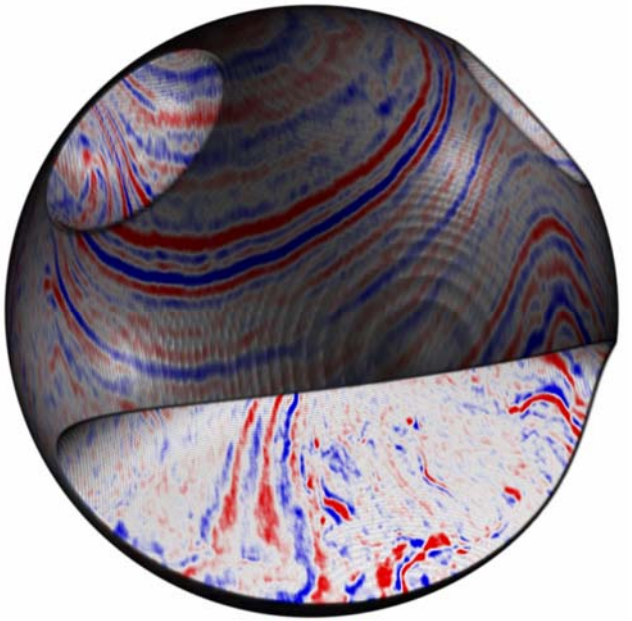
john.plate@iais.fraunhofer.de

thorsten.holtkaemper@iais.fraunhofer.de

bernd.froehlich@uni-weimar.de







Supported by the

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