Intel ® oneAPI Rendering Toolkit

Intel® Open Volume Kernel Library

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What is Open VKL?

- Highly-optimized volume sampling and traversal kernel library
- “Embree for Volumes”
- Support for latest CPUs and ISAs (e.g. Intel® AVX-512)
- Windows*, macOS* 10.x, Linux* support
- API for easy integration into applications
- Open Source under Apache* 2.0 license www.openvkl.org

What is Open VKL good for?

- Open VKL provides data structures that store volumetric fields.

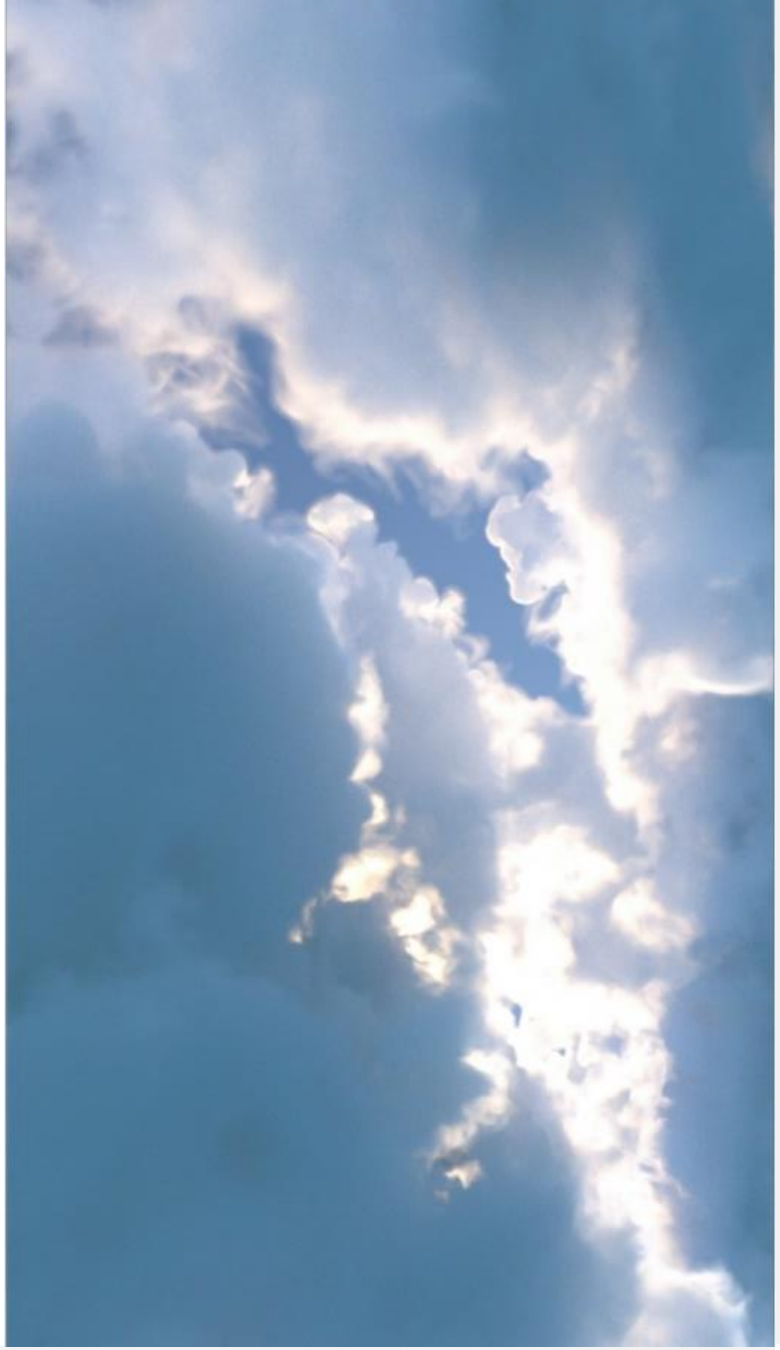
- Open VKL also provides algorithms:

  - point sampling

  - interval iterators

  - hit iterators

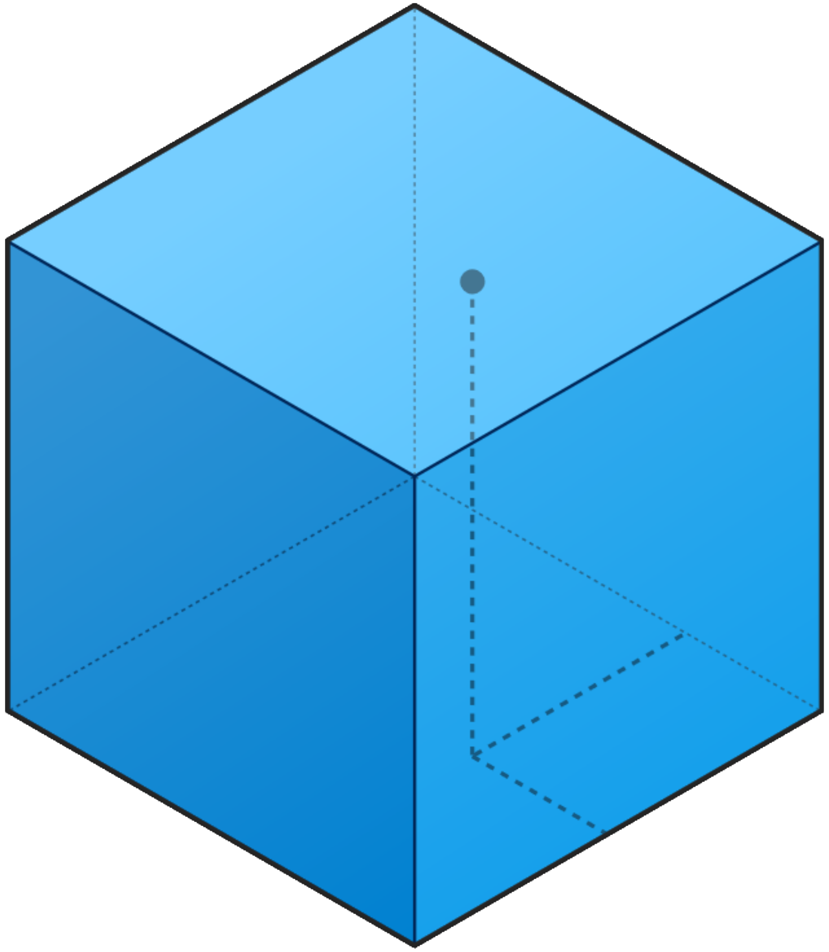
- Scientific visualization & production rendering!



Overview

1. Introduction to Open VKL
2. Installing the library
3. Demo
4. A simple example
5. Wrap up

3D Volumetric Fields



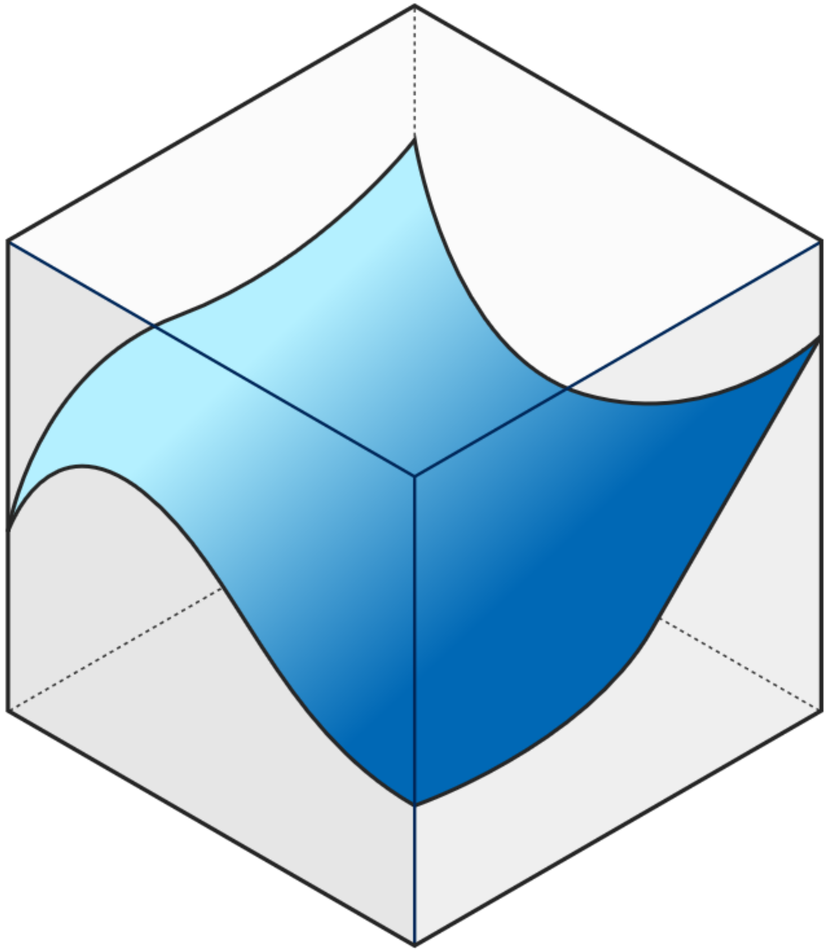
Some quantity that can be measured at a 3D position.

Scalar (density, temperature), vector (velocity)

$$(x_0, y_0, z_0) \mapsto \rho_0$$

Point sampling: **what is the field value** at a position?

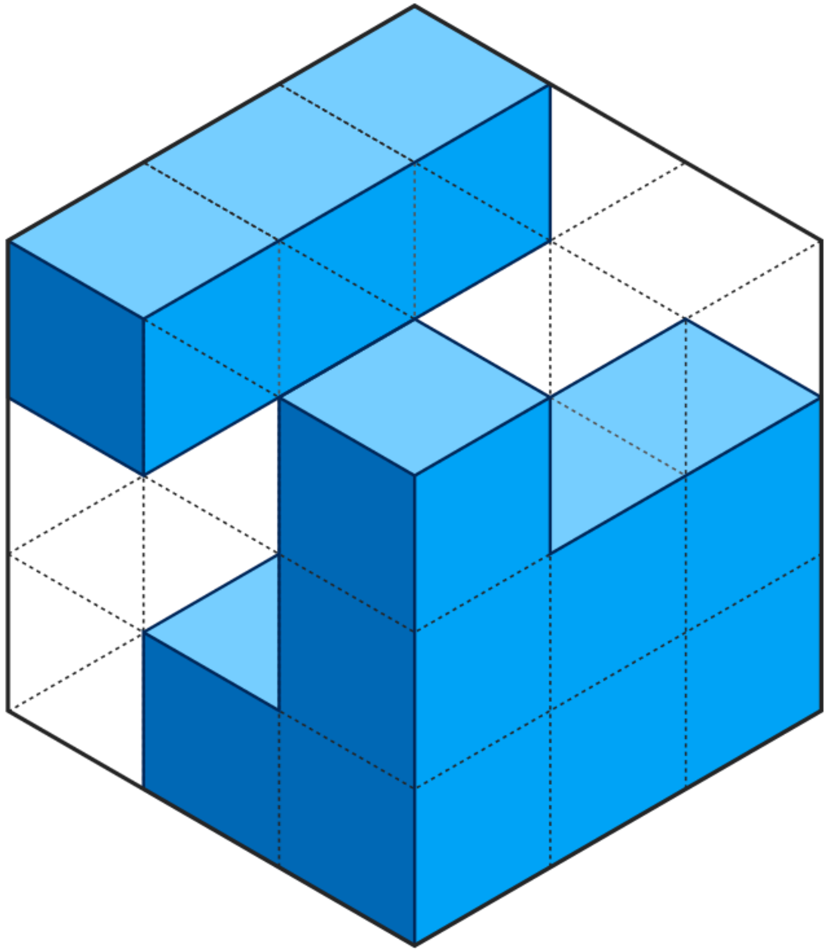
Isosurfaces



Where does the field have a given value?

Open VKL provides **hit iterators** to answer this question!

Discrete Volumetric Data



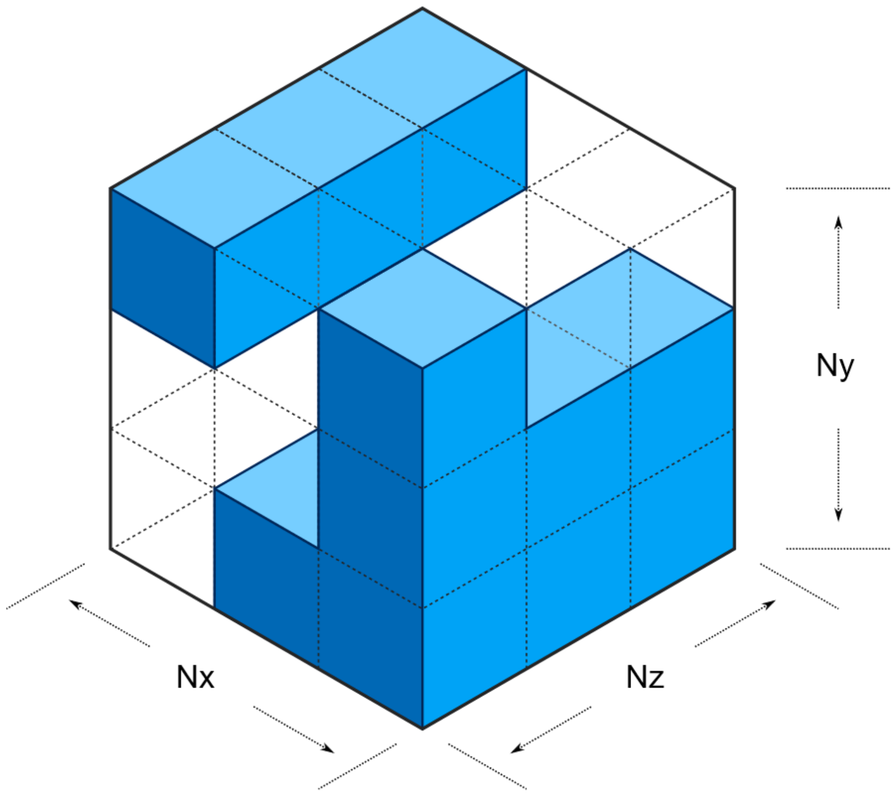
Simulation, content creation: discrete data

Voxels
Meshes (tetrahedron, etc.)
Particles

Use filters to reconstruct continuous field:
Nearest, trilinear, tricubic.

Data Structures in Open VKL

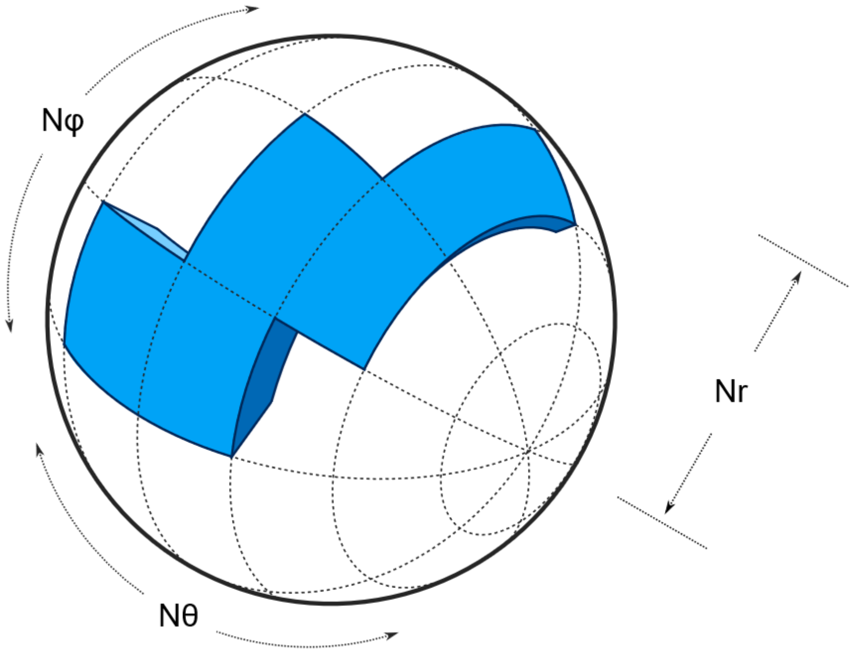
Structured Regular



- Dense 3D array.
- Very fast.
- Good fit for dense data.

Data Structures in Open VKL

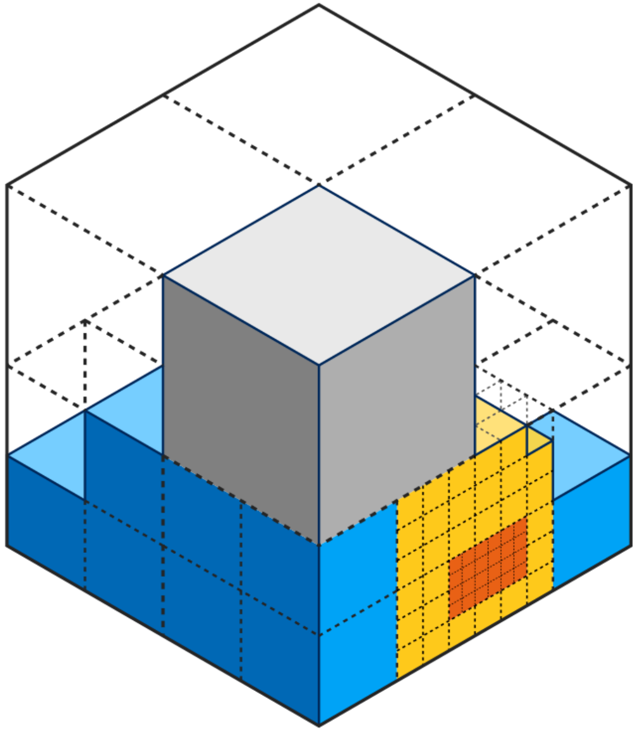
Structured Spherical



- Dense 3D array in spherical domain.
- Very fast.
- Good fit for spherical, dense data.

Data Structures in Open VKL

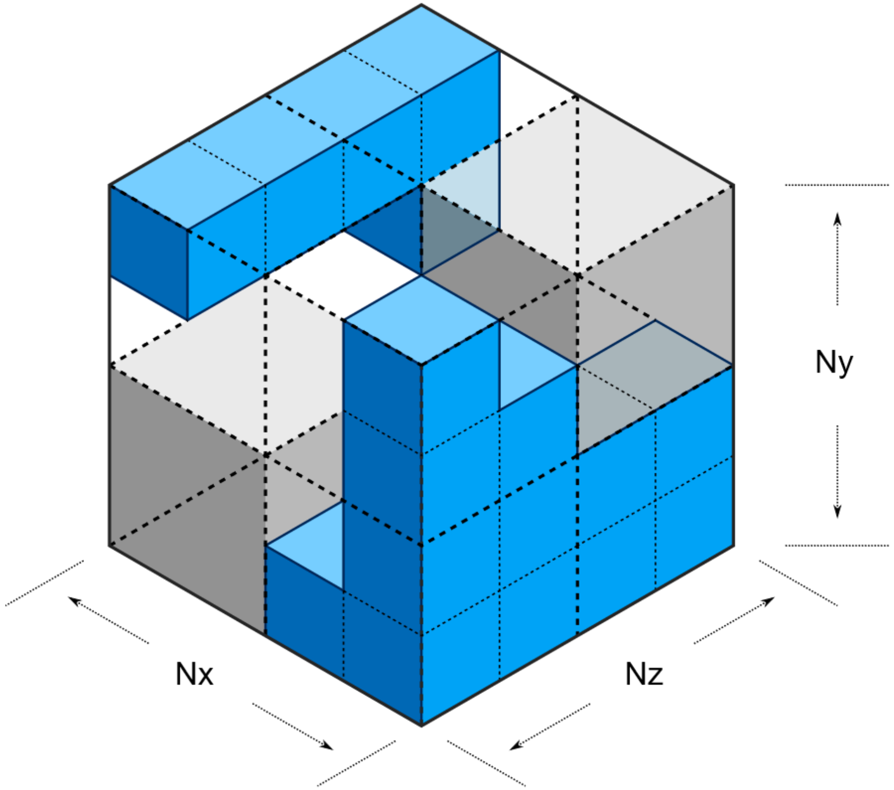
Adaptive Mesh Refinement



- Hierarchical data structure.
- Good for sparse data.
- “Unlimited detail”.
- Slower than regular grids.

Data Structures in Open VKL

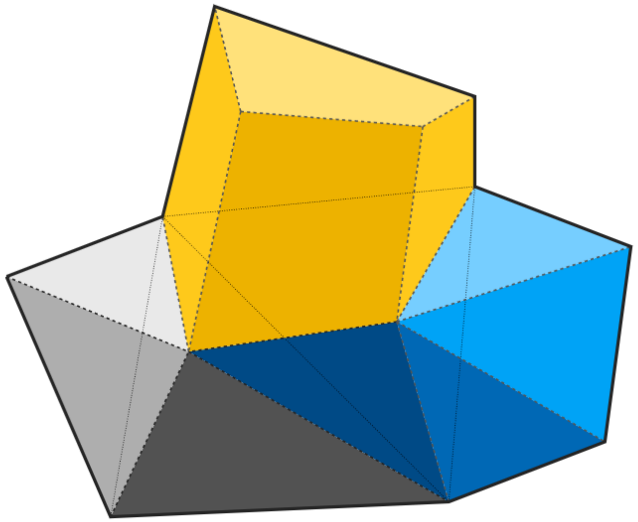
VDB



- Hierarchical data structure.
- Good for sparse data.
- Fixed depth, but huge domain.
- Faster than AMR, slower than regular grids.

Data Structures in Open VKL

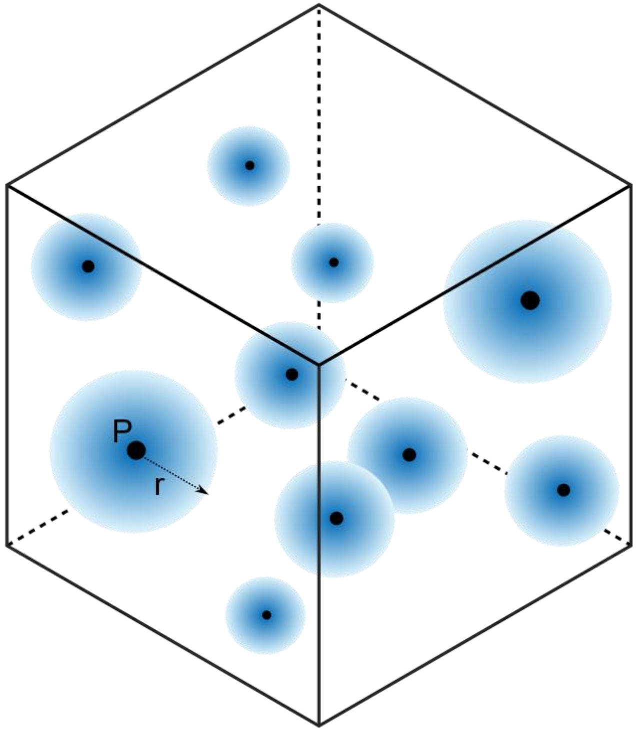
Unstructured



- Very flexible.
- Adapts to surfaces.
- Slower sampling than grid-based structures.

Data Structures in Open VKL

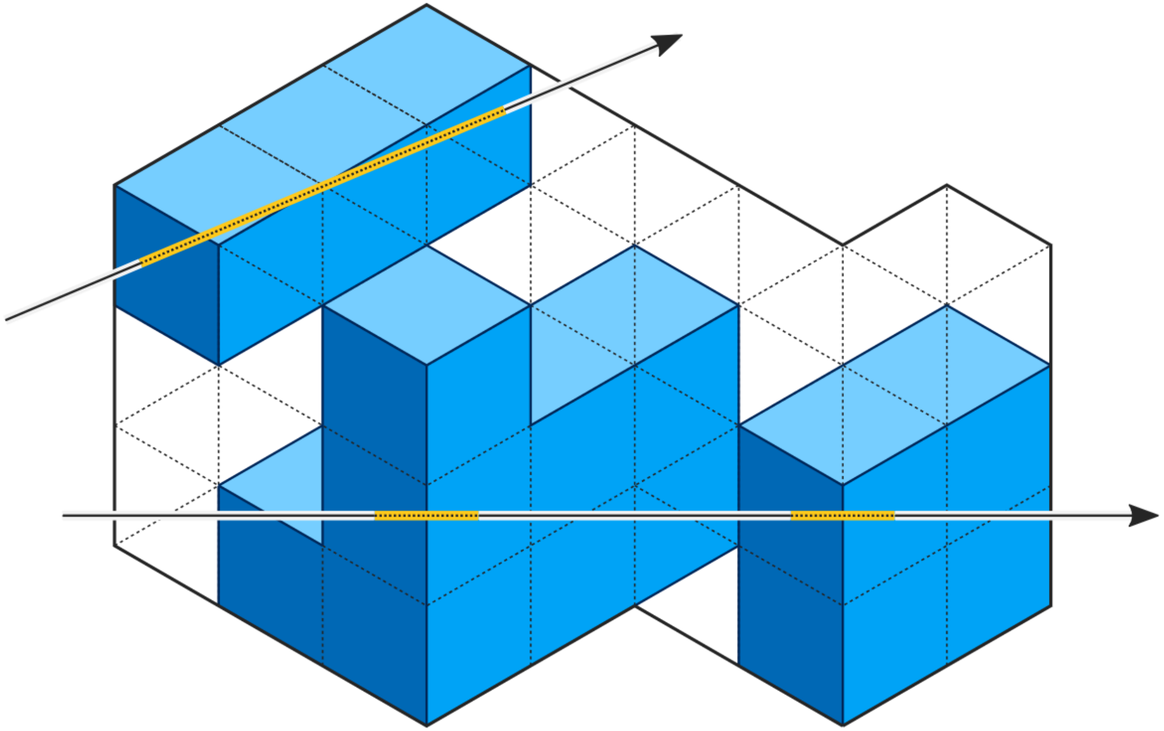
Particle



- Radial basis functions around input particles.
- Handles large data sets.
- Great if a simulation outputs particles.

Iterators

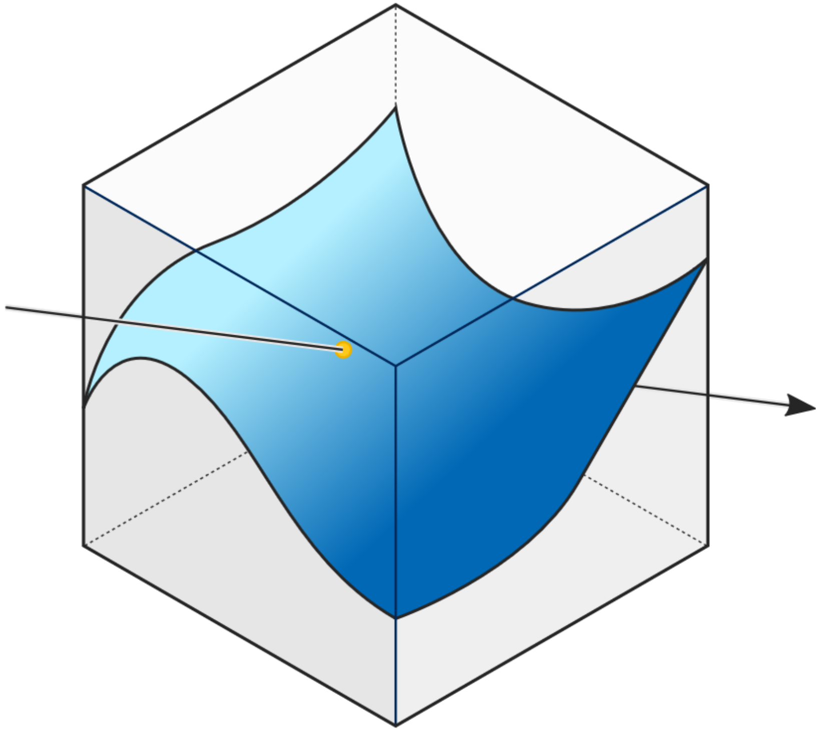
Interval Iterator



- Enumerate meaningful intervals along the ray
- Value range per interval
- Useful for ray marching

Iterators

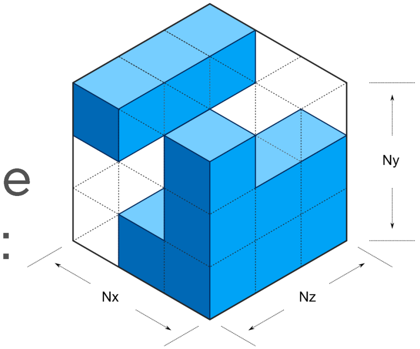
Hit Iterator



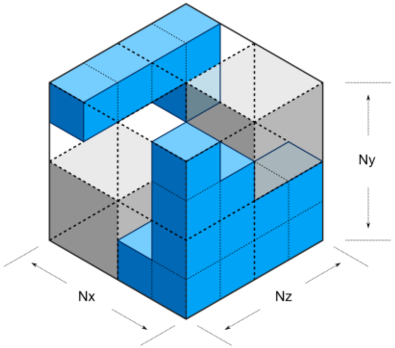
- Intersect isosurfaces.
- Multiple isosurface values can be specified.
- Sample gradient to obtain surface normal.

Recap: Open VKL Features

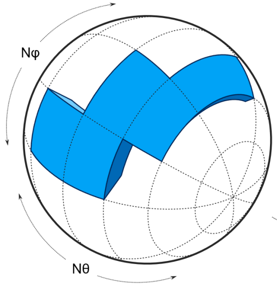
Volume types:



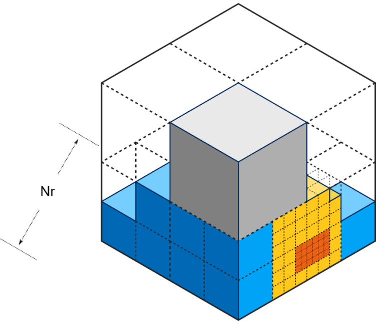
Structured



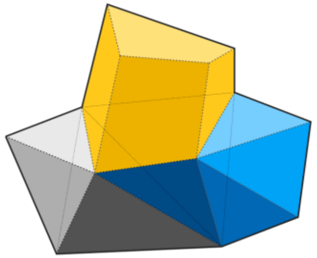
VDB



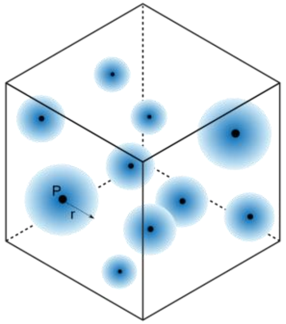
Spherical Structured



Adaptive Mesh Refinement



Unstructured



Particle

APIs:

- Sampling
- Gradient computation
- Ray-based interval iteration
- Implicit Isosurfacing
- Volume Observers

Recap: Open VKL Features

- Direct Support for Motion Blur
  - Optimal Performance with Structured Temporal Data
  - Flexibility and Memory Savings with Unstructured Temporal Data

APIs: Sampling | Gradient computation | Ray-based interval iteration | Implicit Isosurfacing | Volume Observers

Building Open VKL

- Get the latest source code from https://github.com/openvkl/openvkl/releases
- We recommend using our **cmake superbuild**.

```
$ tar -xf openvkl-0.13.0.tar.gz
$ mkdir build
$ cd build
$ cmake ../openvkl-0.13.0/superbuild
$ make -j
```

- The superbuild downloads all relevant dependencies and installs them to `build/install`.
- Use `-DCMAKE_INSTALL_PREFIX=/path/to/install/prefix` to install into a custom location.

Too Busy to Build?

- We provide binaries on our GitHub* release page: https://github.com/openvkl/openvkl/releases

- There are also oneAPI packages for many package managers.

- Develop in the Cloud: https://devcloud.intel.com

Hands On: Demo

A quick look at the vklExamples application.

Hands On: Minimal Example

Basic API concepts, initialization, structured regular volumes.

What to do next?

- Check out the Open VKL source: https://www.openvkl.org
- Try the superbuild.
- Play with our examples.

Please reach out if you have any questions!

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