INTRODUCING GVDB SPARSE VOLUMES

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Ken Museth, Dreamworks Animation & SpaceX

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NVIDIA

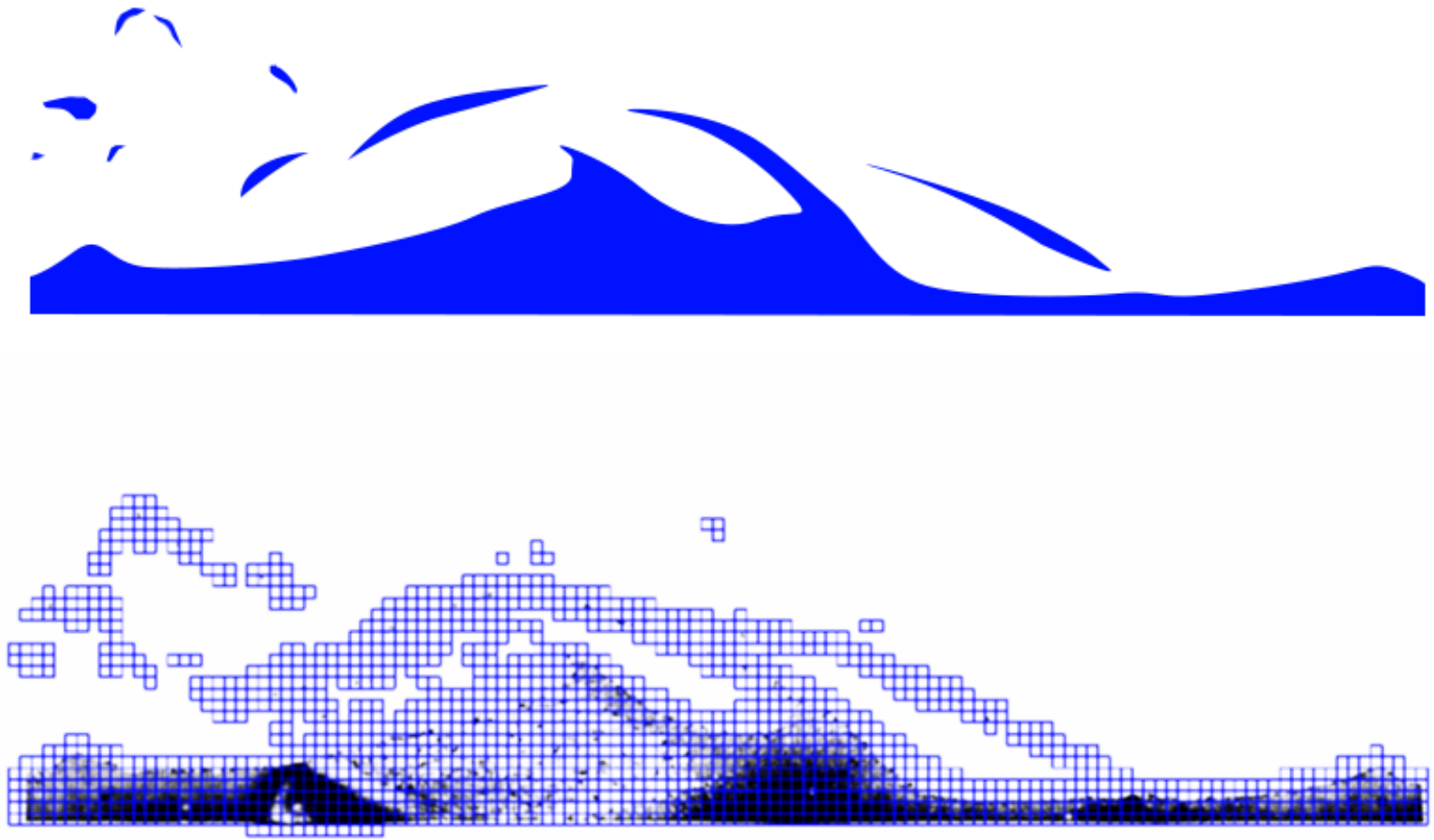
SIMULATION IN MOTION PICTURES

Increasing detail and complexity..

Property of DreamWorks Animation

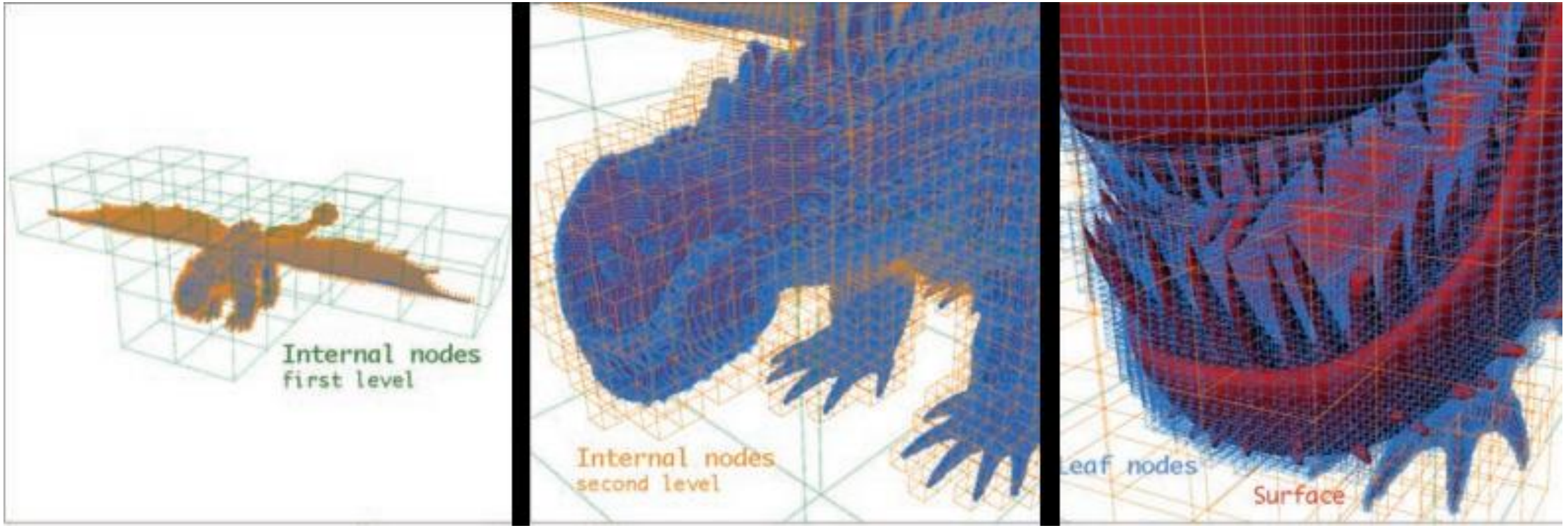
THE SOLUTION: VOXELS

Simulations are easier to perform on voxels



OPENVDB: SPARSE VOLUMES

Ken Museth, Lead Developer of OpenVDB



Ken Museth, VDB: High-resolution sparse volumes with dynamic topology, Transactions on Graphics, 2013

OpenVDB

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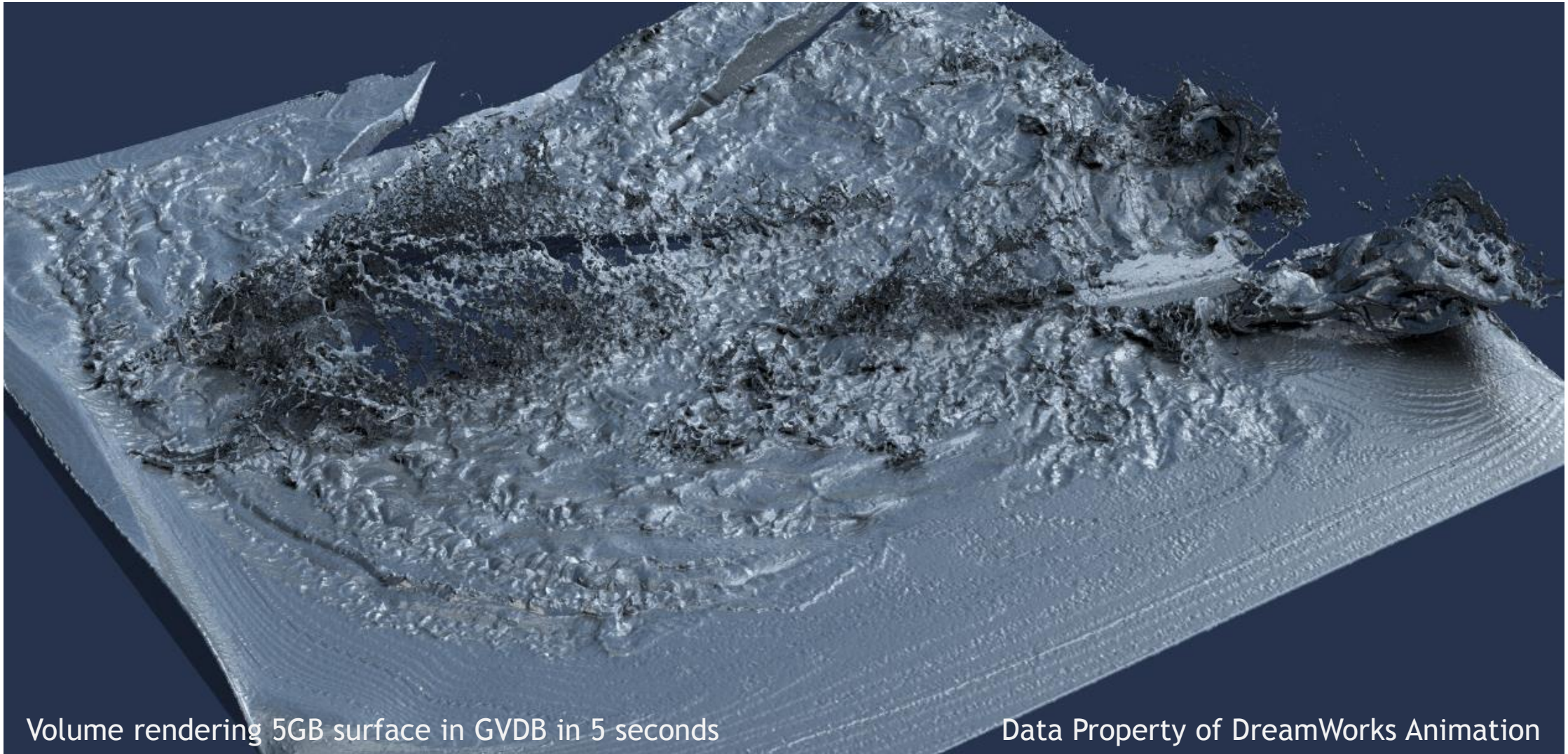
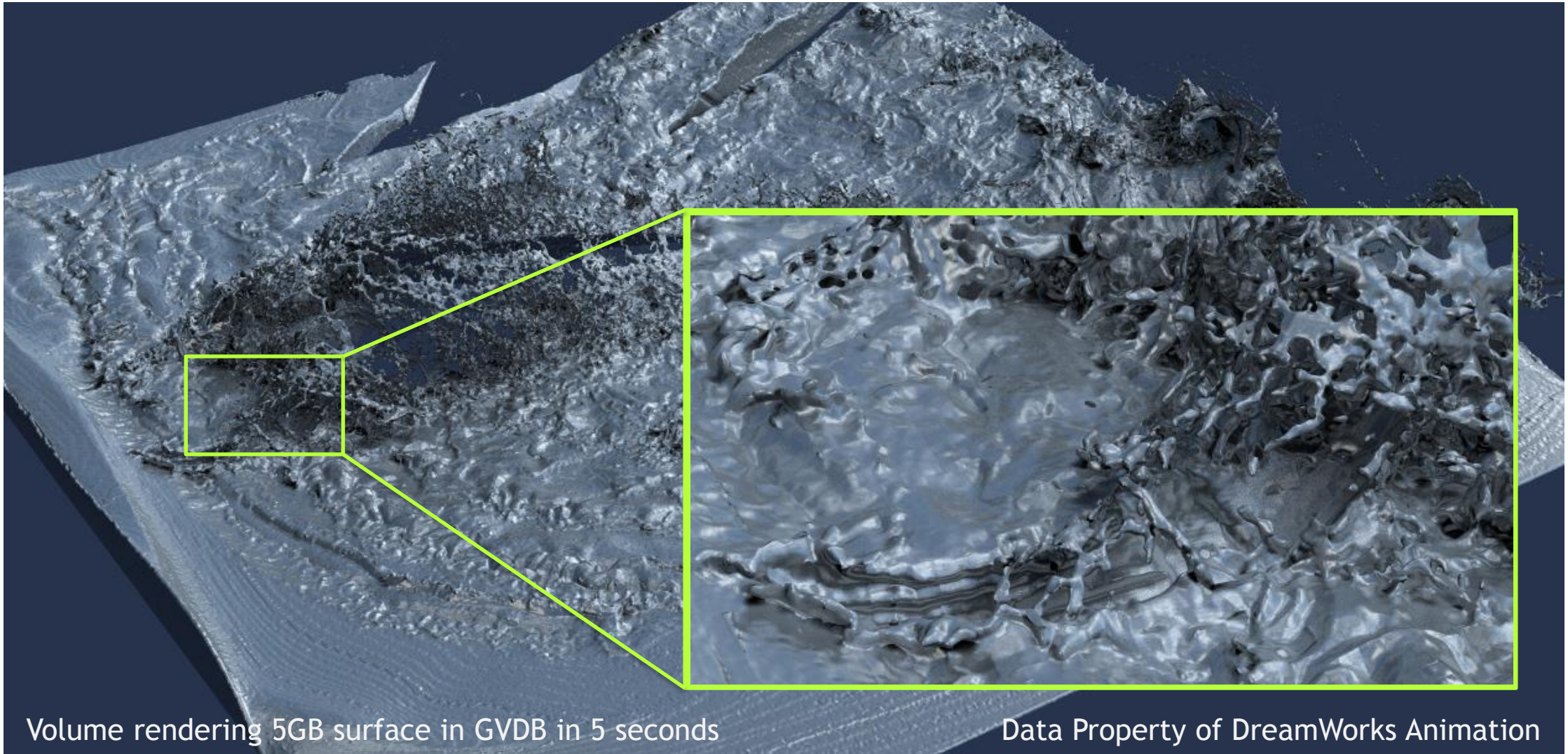


Volume rendering 5GB surface in GVDB in 5 seconds

Data Property of DreamWorks Animation

Introducing
NVIDIA® GVDB Sparse Volumes



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Data Property of DreamWorks Animation

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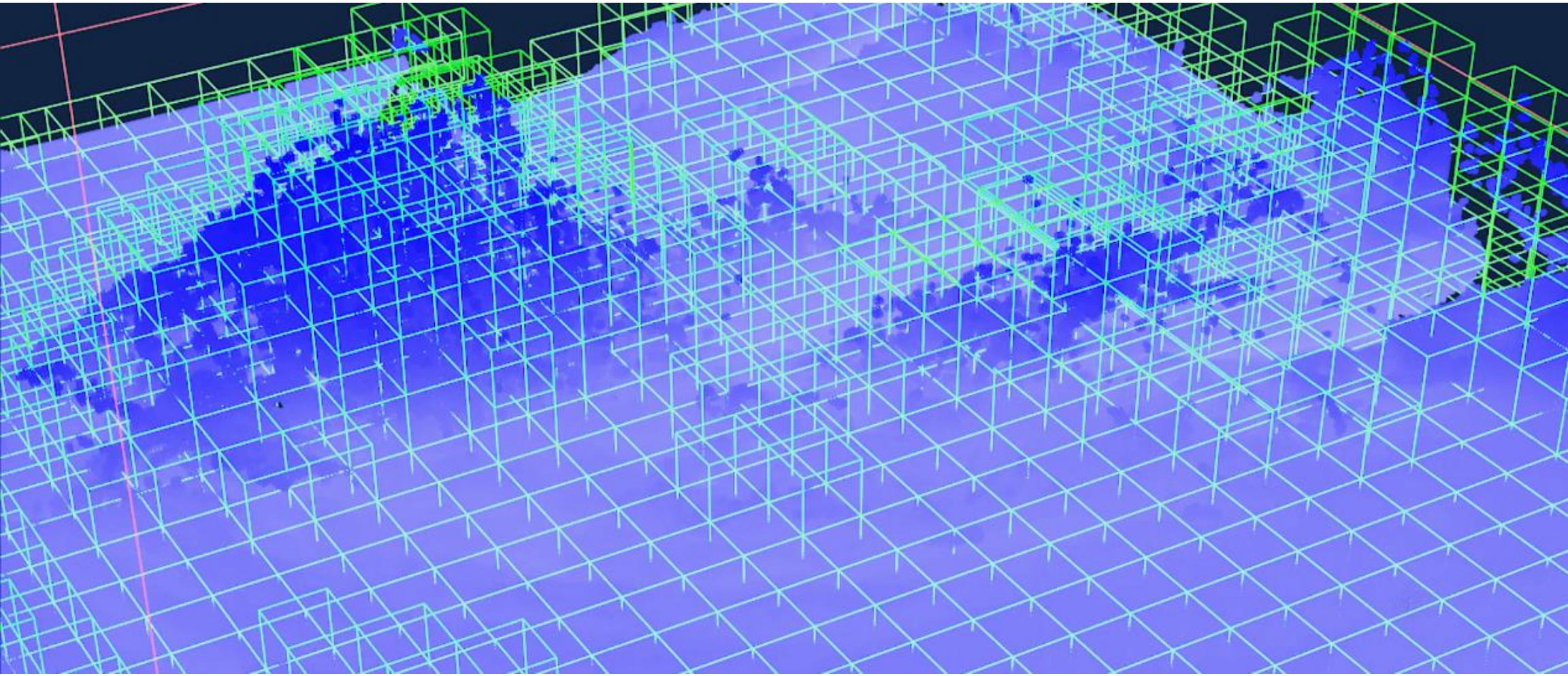

Each Blue Brick is 8^3 = 512 voxels. Total Size: 3344 x 568 x 3384 = 5.5 GB (24 GB dense)

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What is GVDB?

NVIDIA® GVDB is a GPU-based framework for VBD data structures inspired by the award-winning software library OpenVDB used for motion picture visual effects and modelling, with tools to enable full volume *compute operations* and *high quality raytracing*.

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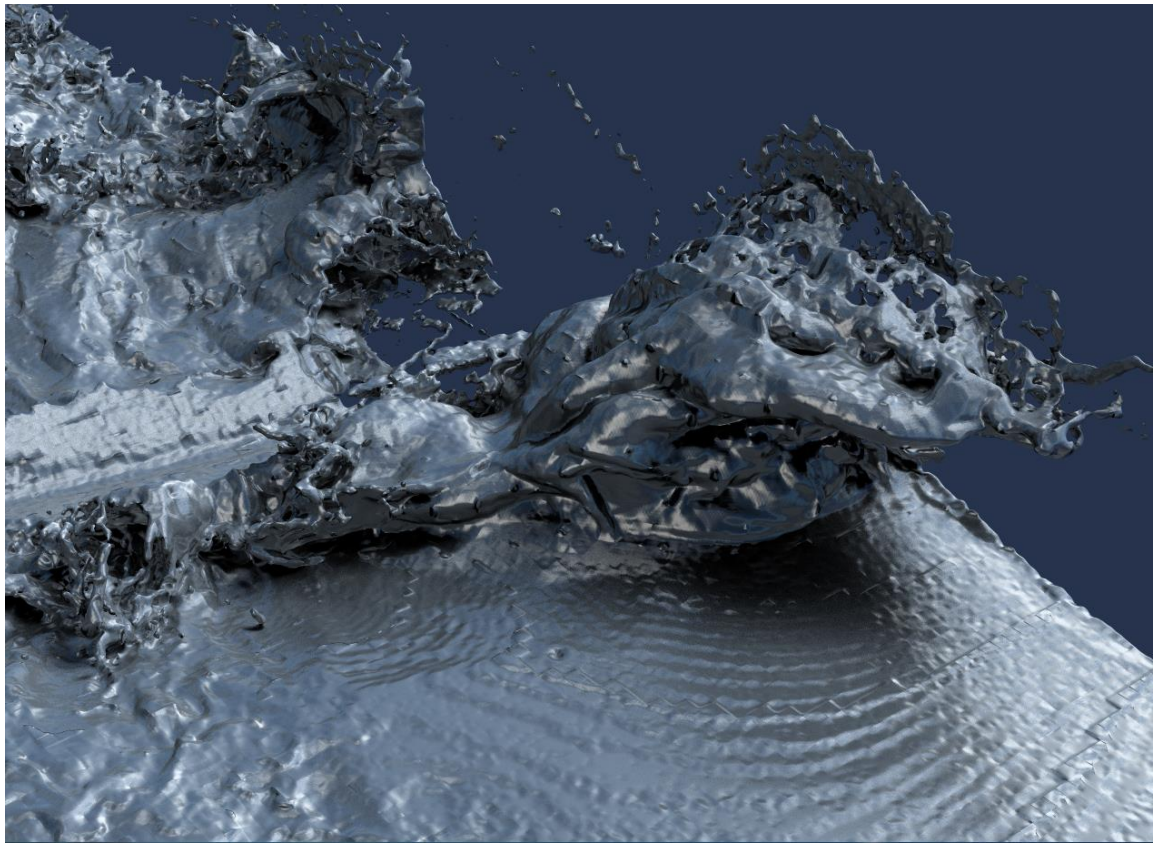
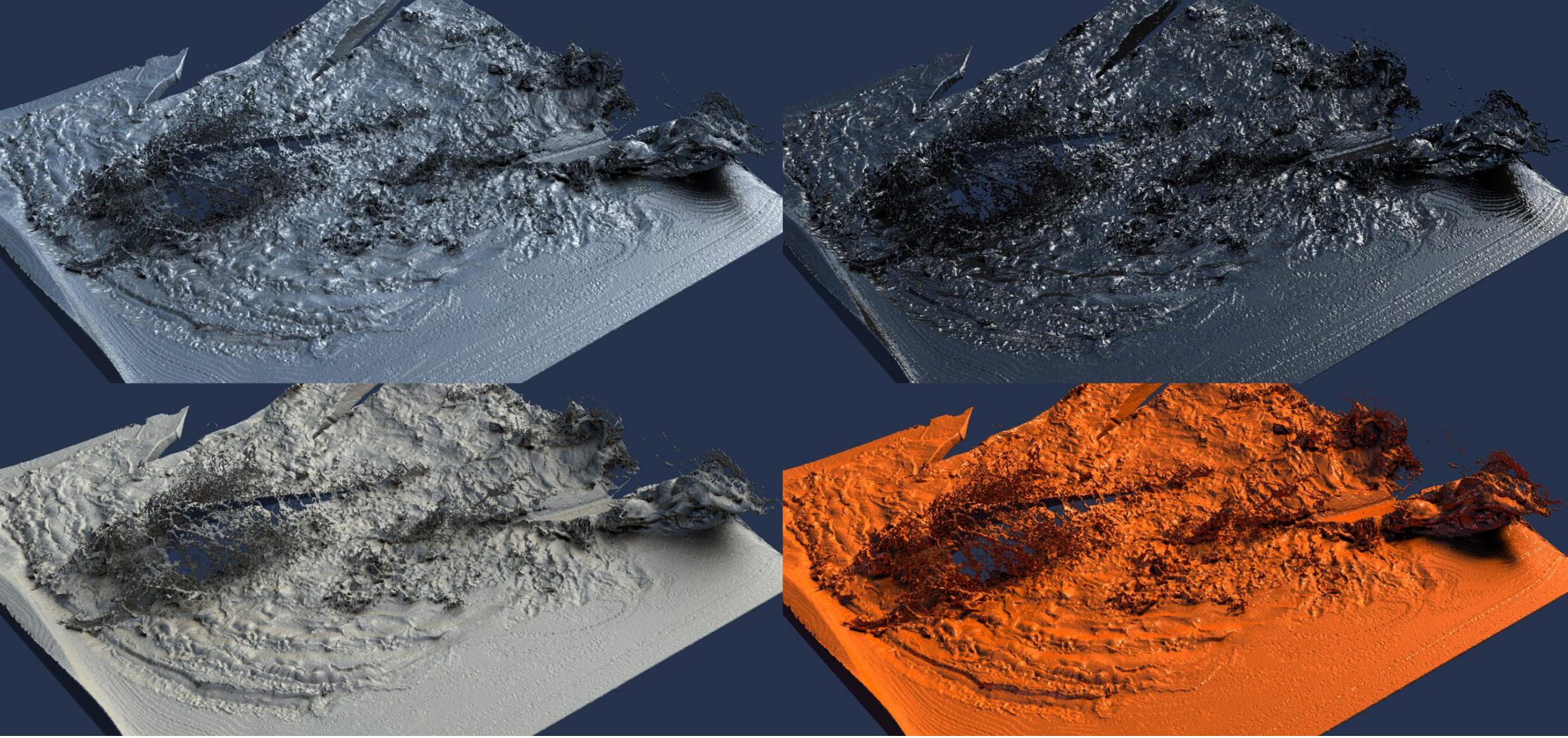


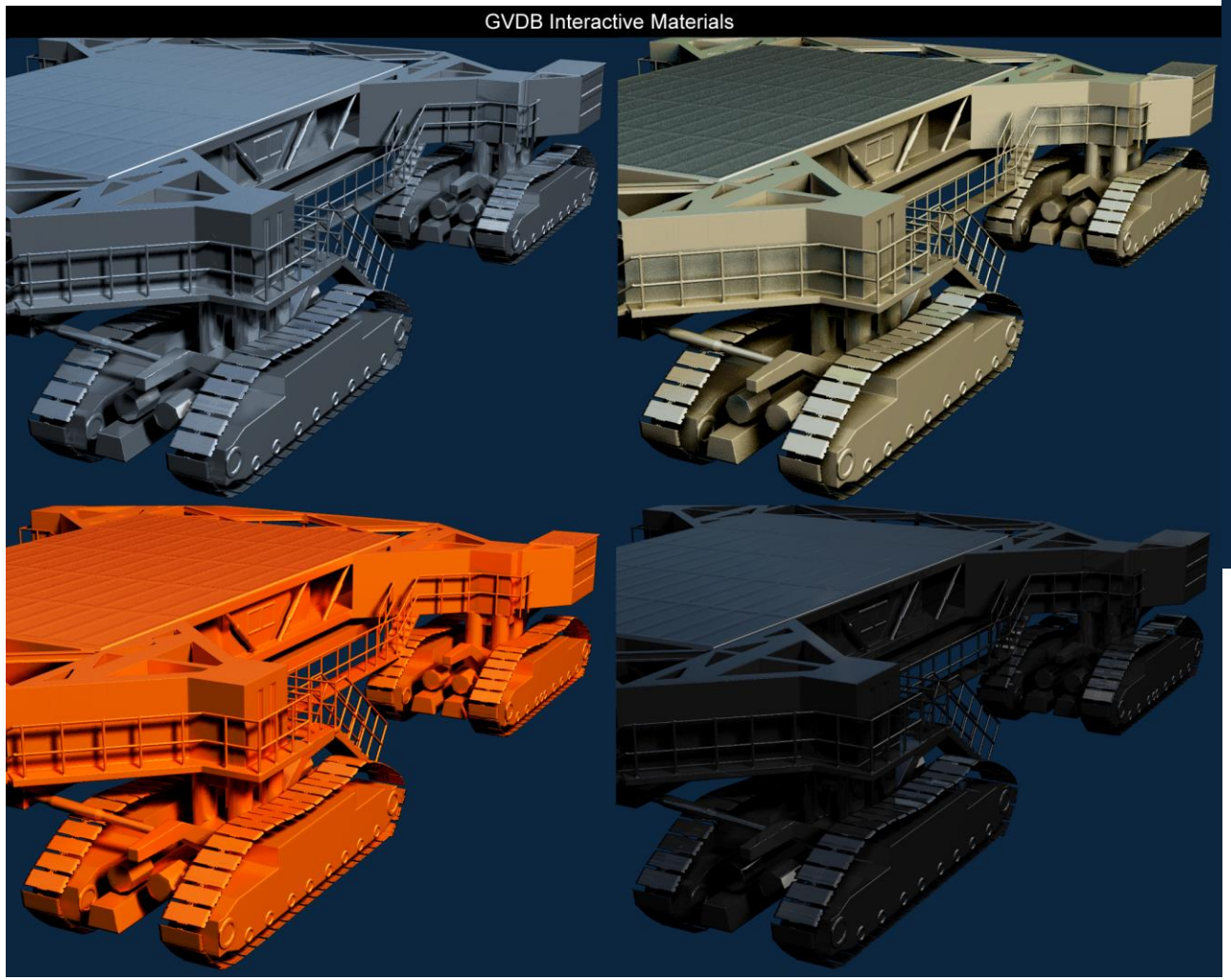
High Quality Raytracing

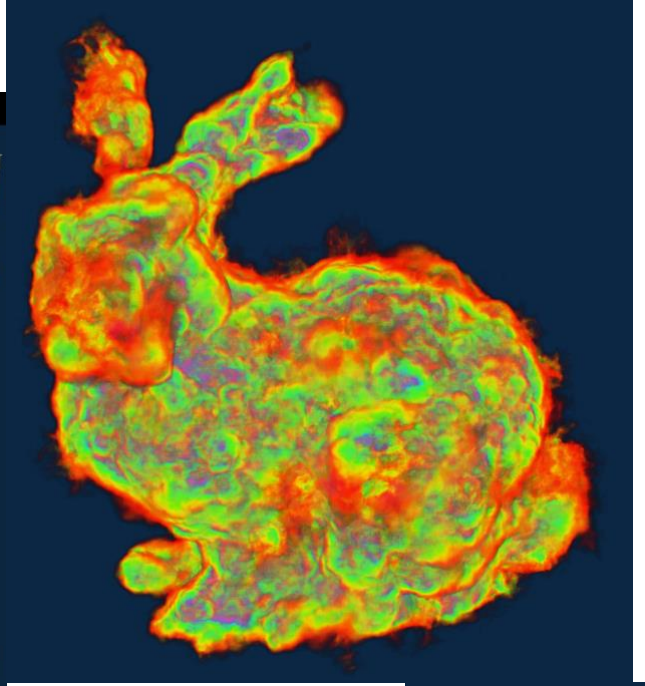
NVIDIA® GVDB integrates with NVIDIA® OptiX to deliver efficient, generalized raytracing of sparse volumes with global illumination.

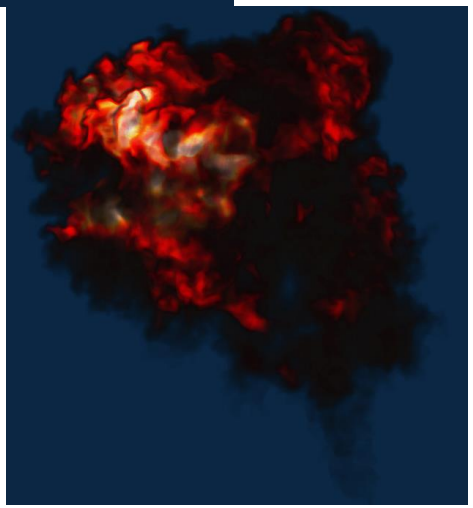
GVDB Raytracing on GPU is 10x-30x faster than CPU rendering



NVIDIA® GVDB WITH NVIDIA® OptiX integration enables *interactive editing of materials and lighting* of volumes.







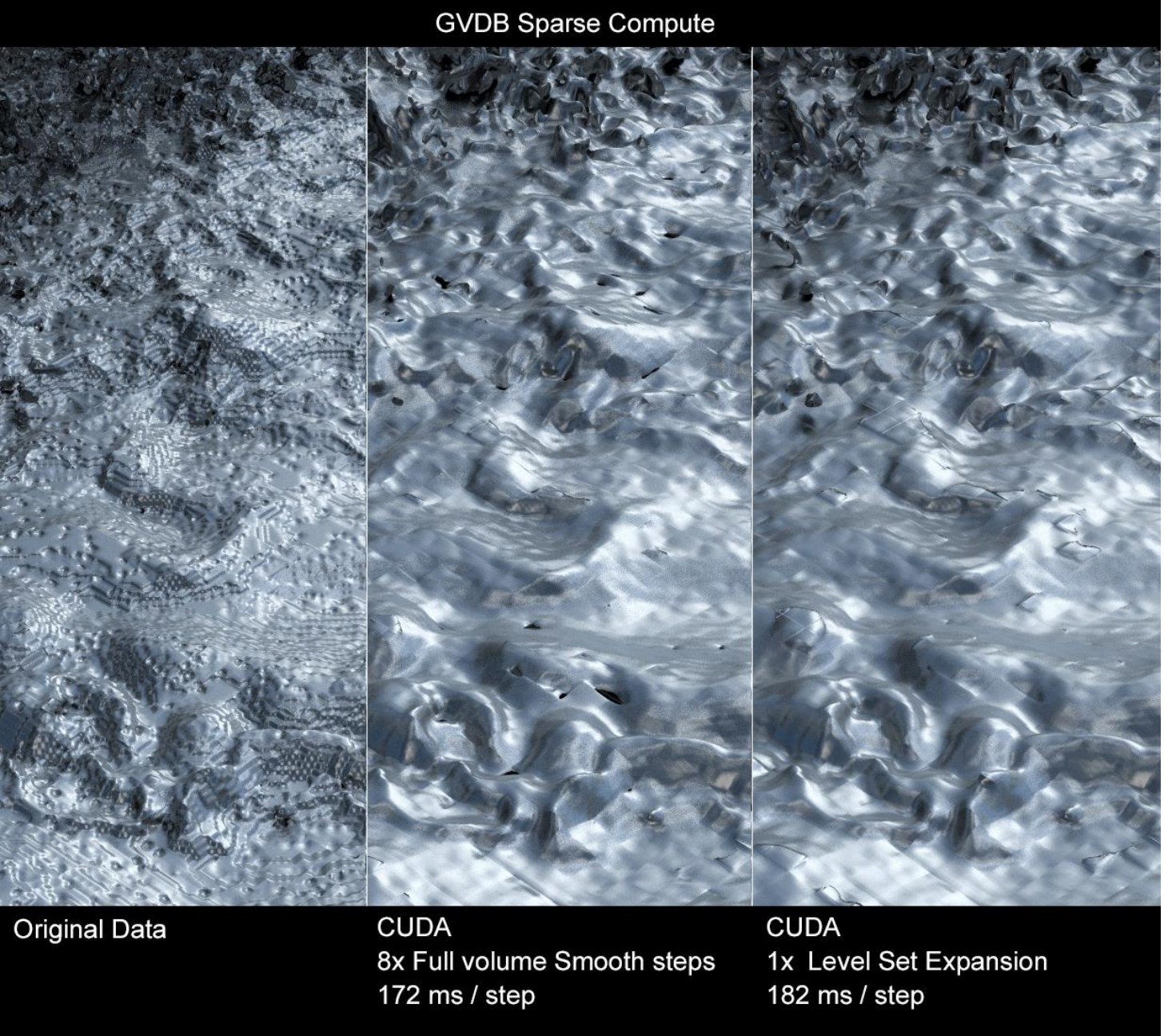
NVIDIA® GVDB direct raytracing of level set surfaces and volumetric data with CUDA kernels.

NVIDIA® GVDB Sparse Volumes

Compatibility with OpenVDB

Features:

- Spatial layout and numerical values identical to OpenVDB
- Uses fast VBX cache format internally, yet able to translate to and from OpenVDB files
- Run-time configuration of VDB topology



NVIDIA® GVDB Sparse Volumes

Compute Operations

Sparse volume compute operations are supported with CUDA using a single kernel launch over *all* bricks.

User-created kernels can easily access neighbors.

NVIDIA® GVDB Sparse Volumes

API Library Usage

Example Host code:

```
gvdb.SetCudaDevice ( devid );   // Optional

gvdb.Initialize ();                    // Start GVDB

gvdb.LoadVBX ( scnpath );       // Load volume

                                       // Screen pixels
gvdb.AddRenderBuf ( 0, w, h, 4 );

cuModuleGetFunction ( &cuRaycastKernel,
cuCustom, “my_raycast_kernel" )

                                       // Custom render
gvdb.RenderKernel ( cuRaycastKernel );

unsigned char* buf = malloc ( w*h*4 );
gvdb.ReadRenderBuf ( 0, buf );

save_png ( “out.png", buf, w, h, 4 );
```

Example Kernel code:

```
#include "cuda_gvdb.cuh“
..
__global__ void raycast_kernel ( uchar4* outBuf )
{
    int x = blockIdx.x * blockDim.x + threadIdx.x;
    int y = blockIdx.y * blockDim.y + threadIdx.y;
    if ( x >= scn.width || y >= scn.height ) return;

    rayMarch ( gvdb.top_lev, 0, scn.campos,
        rdir, hit, norm );        // Trace ray into GVDB

    if ( hit.x != NOHIT ) {
      float3 R= normalize ( reflect3 ( eyedir, norm ) );
      float clr = tex3D ( envmap, R.xy );
    } else {
      clr = make_float3 ( 0.0, 0.0, 0.1 );
    }
    outBuf [ y*scn.width + x ] = make_uchar4(
                clr.x*255, clr.y*255, clr.z*255, 255 );
}
```

NVIDIA® GVDB is focused on motion picture developers.

NVIDIA® GVDB Sparse Volumes

Upcoming Release

API Library with multiple samples

Based on CUDA

Integration with OpenVDB and NVIDIA® OptiX

Open Source with BSD 3-clause License

Available in late September 2016

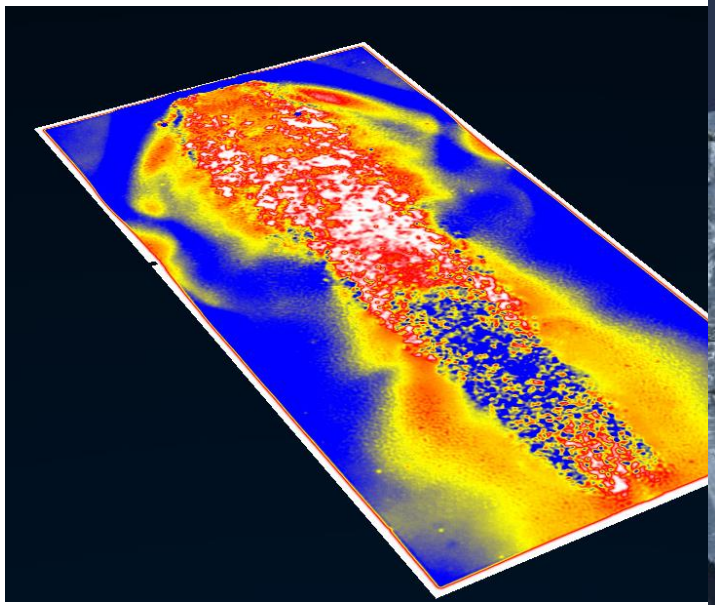
“ *GVDB is a new rendering engine for VDB data, uniquely suited for NVIDIA GPUs and perfectly complements the CPU-based OpenVDB standard while improving on performance. I am excited to take part in the future adoption of GVDB in the open-source community for visual FX*.”

— Dr. Ken Museth, Lead Developer of OpenVDB (DreamWorks Animation & SpaceX)

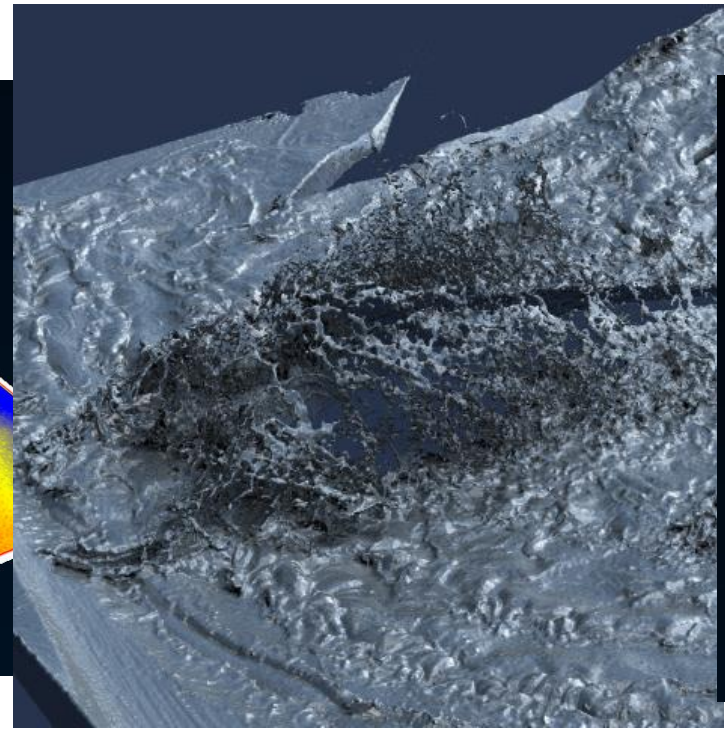
NVIDIA® GVDB Sparse Volumes

Application Areas

Scientific Visualization

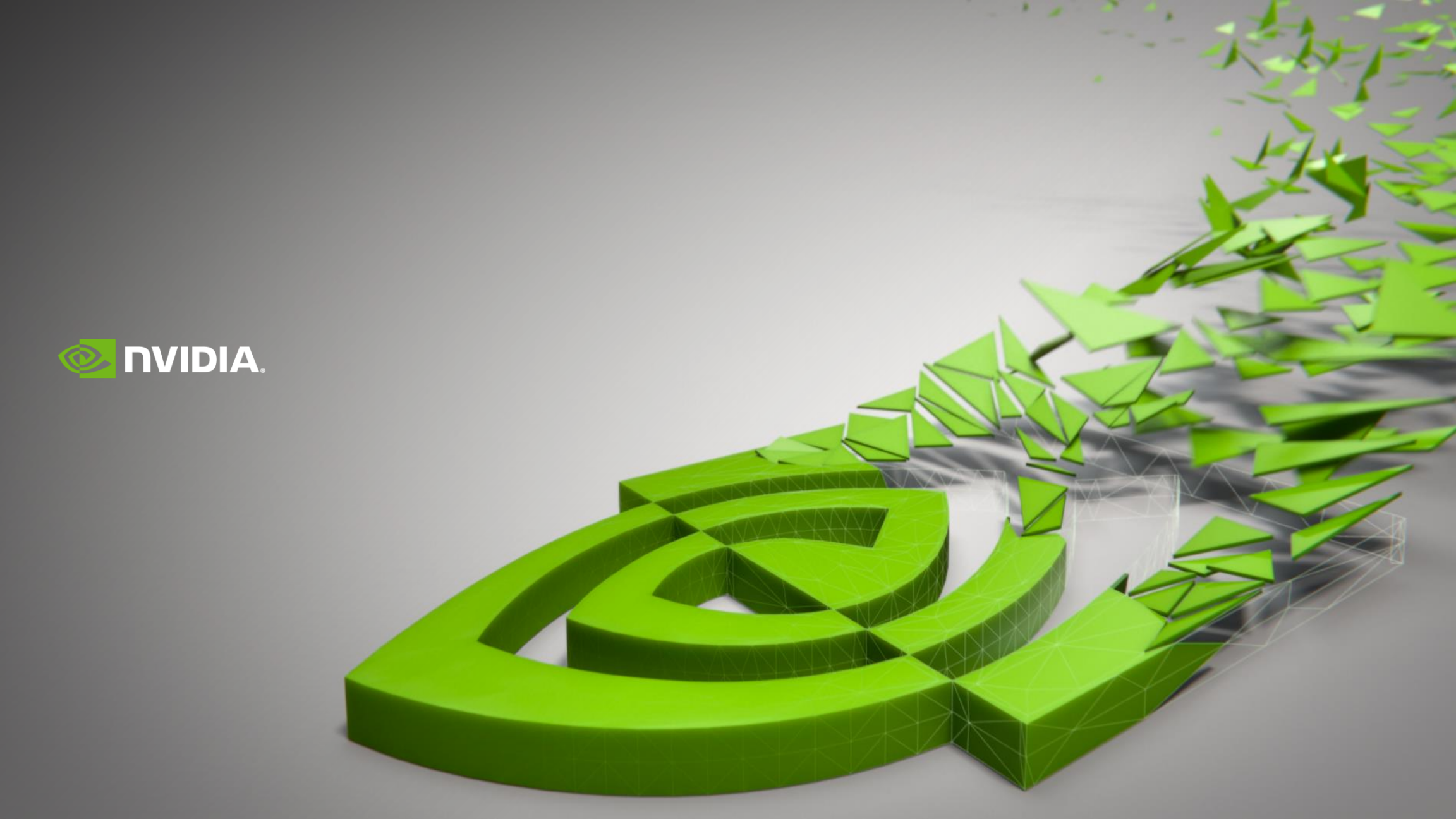


Motion Pictures



3D Printing

See GTC 2016 talk: Raytracing Scientific Data in NVIDIA OptiX with GVDB Sparse Volumes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