Software Defined [In Situ] Visualization

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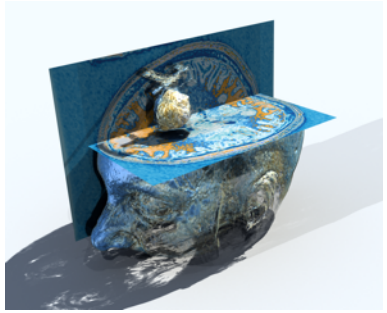
SDVis Quick Recap

Intel supported community effort for high performance, high fidelity, in-situ CPU based rendering

- High, interactive performance for even *very large (TB+) datasets*
- Fully *Open Source* with liberal Apache 2 and MIT License
- Single Node and Cluster-wide *Scalability* in 1) Render Time; 2) Render Quality; 3) 3D Model Data Size
- *OpenGL and Ray Tracing* Support with shadows, ambient occlusion, up to photorealistic quality

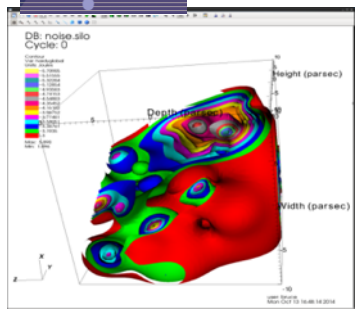
Now broadly Integrated and tested with both general and targeted domain applications

ParaView



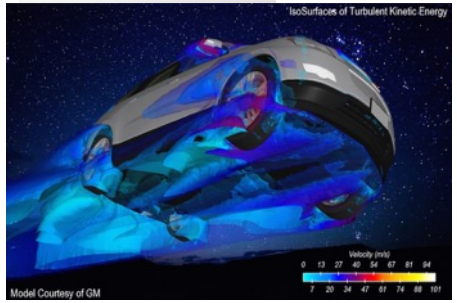
Data courtesy Kitware.
Visualization, Carson Brownlee, Intel

VisIt



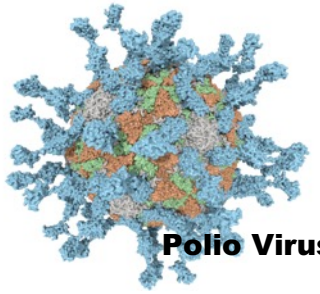
Courtesy Hank Childs, U Oregon, Jian Huang and Alok Hota, UTenn

CEI EnSight Extreme Visualization Software



Courtesy Sean Ahern, CEI and General Motors

VMD Visual Molecular Dynamics



Courtesy John Stone, Beckman Institute, Univ. Illinois at Urbana-Champaign

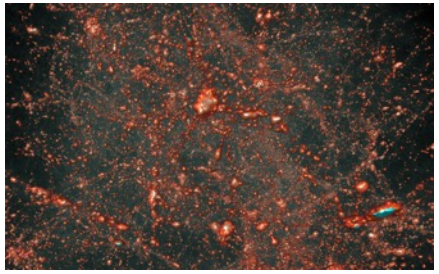
EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Brayns

Data and Visualization courtesy Cyrille Favreau, EPFL

Argonne NATIONAL LABORATORY

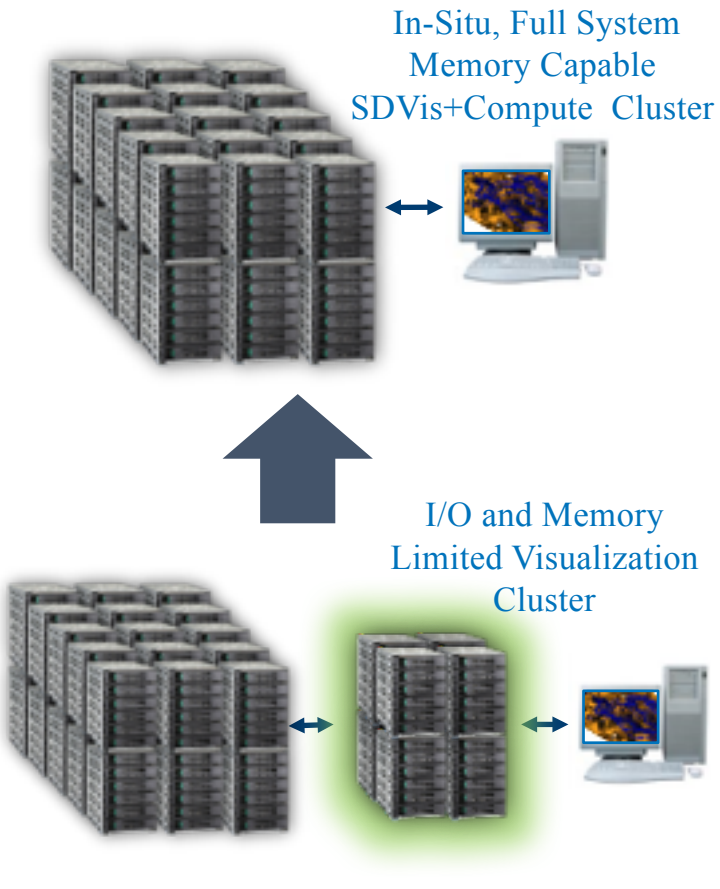
VL3

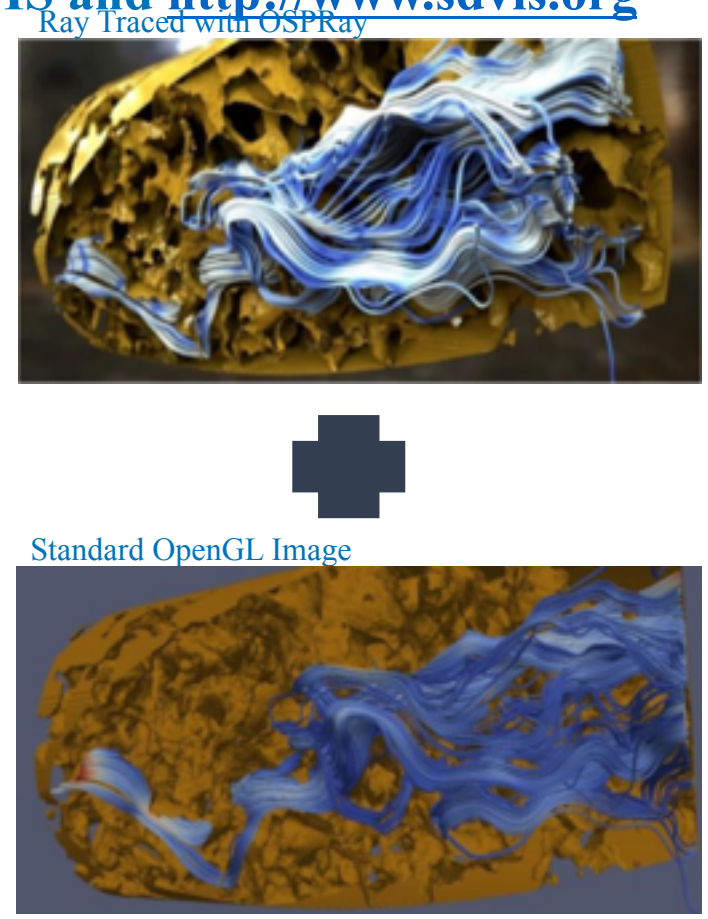


Data: Salman Habib, Katrin Heitmann, and the HACC team.
Visualization: Joe Insley, Slivio Rizzi, ANL

Software Defined Visualization (SDVis) OVERVIEW

https://software.intel.com/SDVIS and http://www.sdvis.org





Embree

- CPU Optimized Ray Tracing Algorithms
- 'Tool kit' for Building Ray Tracings Apps
- Broadly Adopted by 3rd Party ISVs
- More at http://embree.github.io

OSPRay

- Rendering Engine Based on Embree
- API Designed to Ease Creation of Visualization Software
- More at http://ospray.org

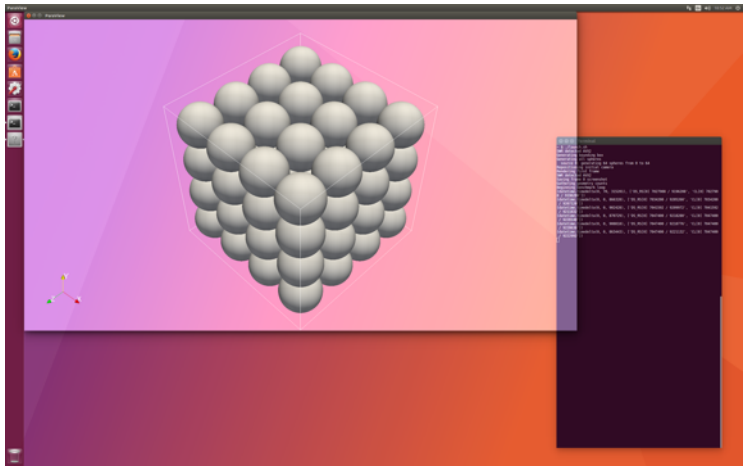
OpenSWR

- High Performance CPU Vis Rasterization
- Fully Integrated into MESA v12.0+ ParaView, VTK, Visit, EnSight, VL3
- More at http://openswr.org

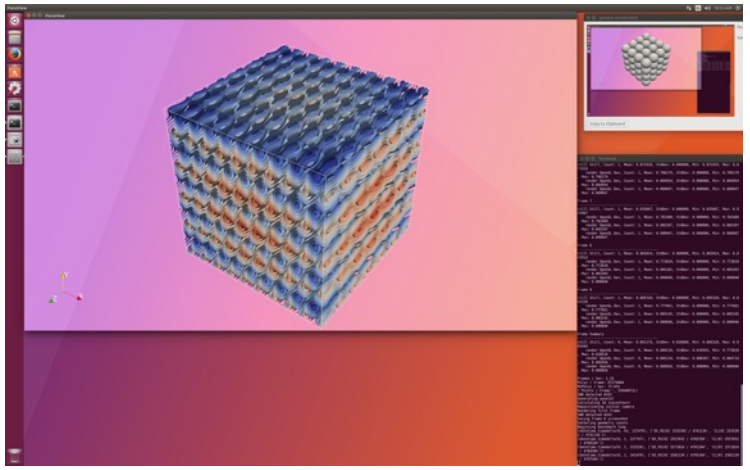
Data and Vis Courtesy Florida International University and TACCl

SDVIS PERFORMANCE UPDATE

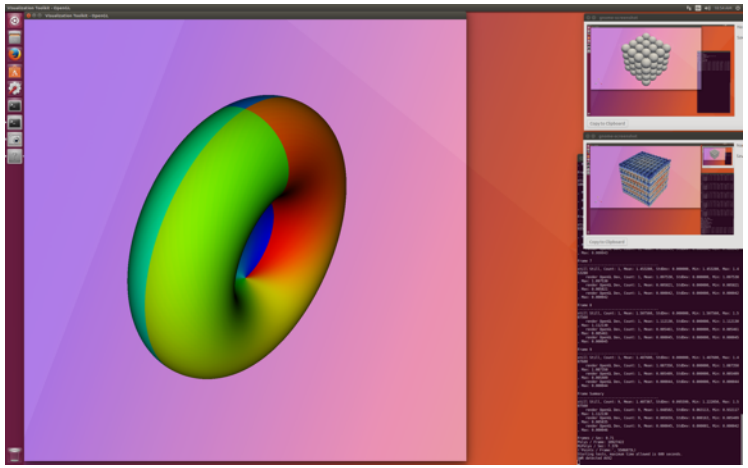
OPENGL (OpenSWR) benchmarks



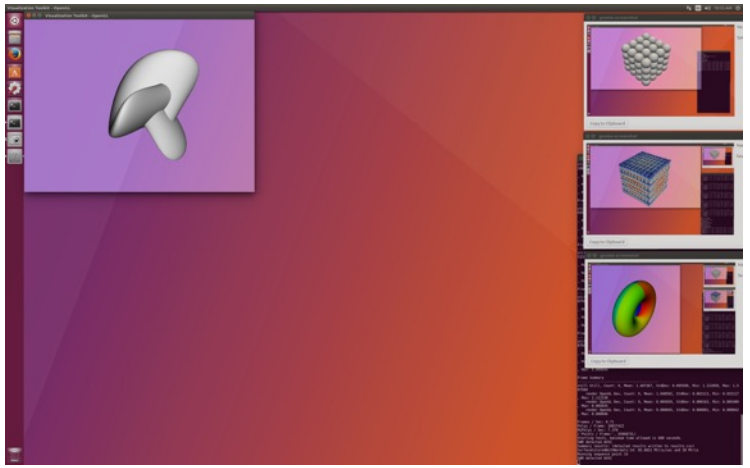
manyspheres.py
67 MiPolys



wavelets.py
11 MiPolys

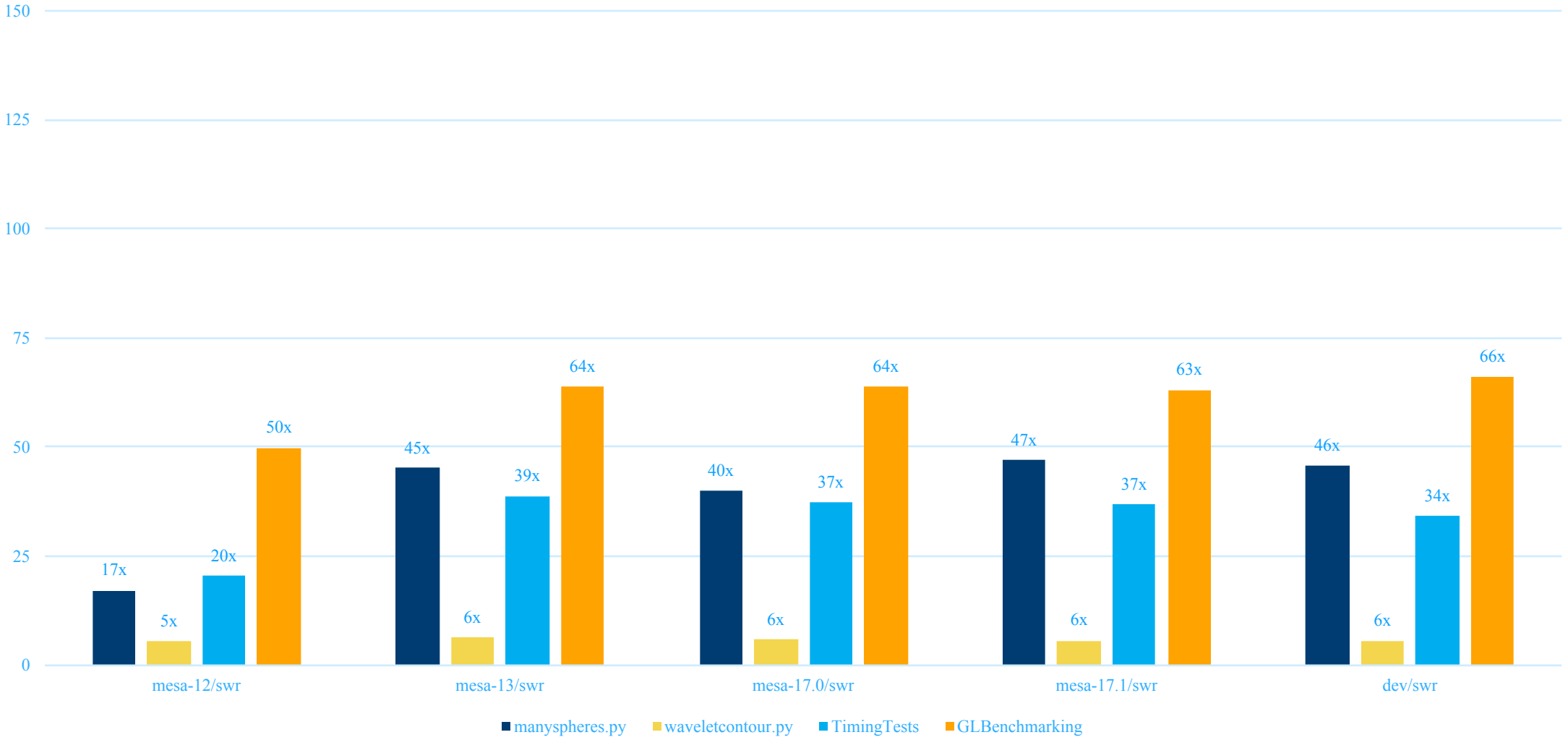


TimingTests
30 MiTris



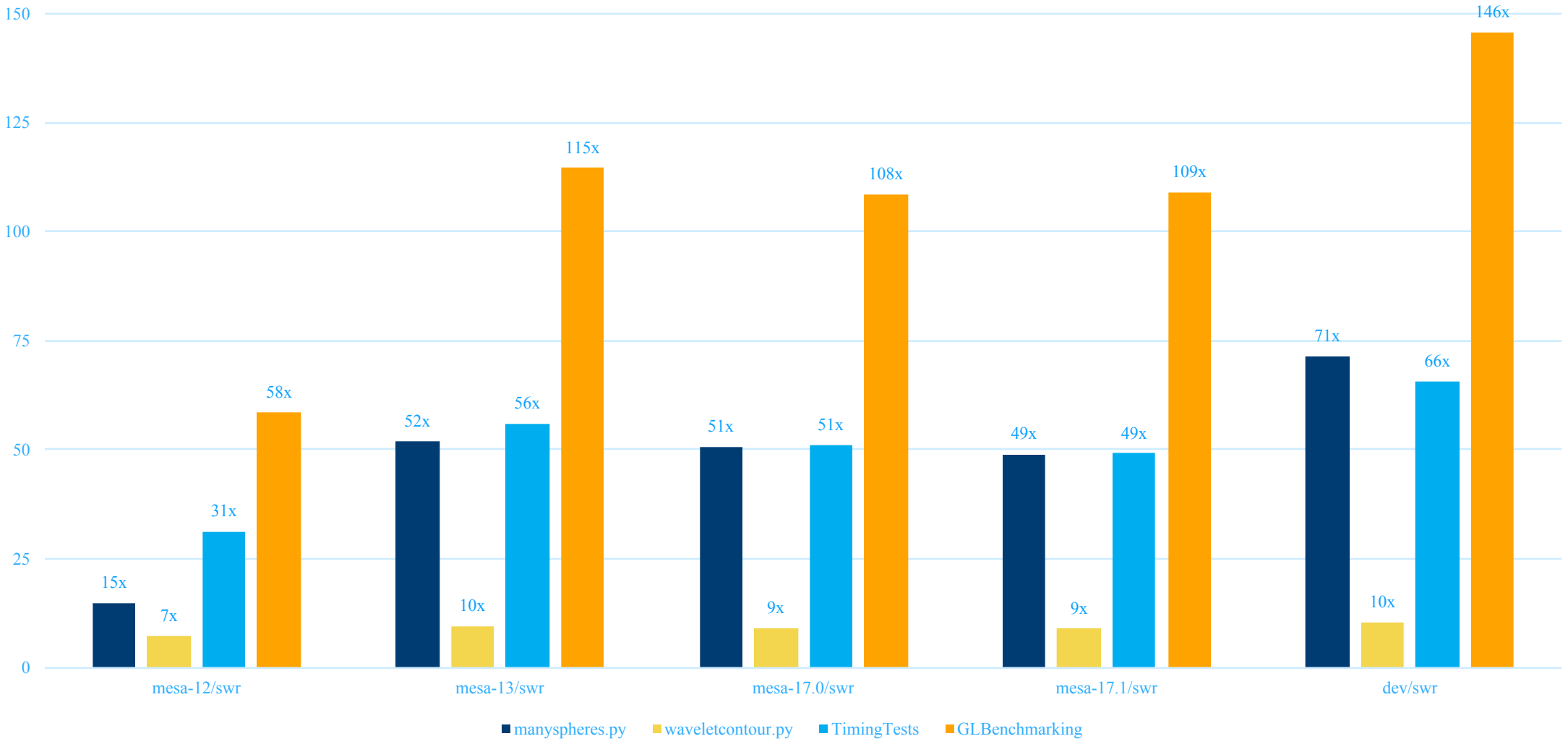
GLBenchmarking
30MiTris

OPENSWR/LLVMPIPE PERFORMANCE RATIO



Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark* and MobileMark*, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more information go to http://www.intel.com/performance.

OPENSWR/LLVMPIPE PERFORMANCE RATIO



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PERFORMANCE TEST PLATFORMS

Two machines:

- KNL: Intel® Xeon Phi™ CPU 7210 @ 1.30GHz, Ubuntu 17.10, 4.10.0-20-generic, gcc 6.3.0
- BDW: Intel® Xeon 2699v4 x 2 (44 cores) @ 2.20GHz, Ubuntu 17.10, 4.10.0-19-generic, gcc 6.3.0

Four tests:

- manyspheres.py (-s 64 -r 726 -v 1920,1080) – paraview benchmark script
- waveletcontour.py (-d 256 -v 1920,1080) – paraview benchmark script
- TimingTests (-width 1536 -height 1536 -regex SurfaceColoredWithNormals -nochart -ss 14 -se 14) – vtk benchmarking app
- GLBenchmarking (--start 14 --end 14) – vtk benchmarking app

Ray Tracing Foundation: Embree Ray Tracing Kernel Library

Provides highly optimized and scalable ray tracing kernels

- Acceleration structure build and ray traversal
- Single Ray, Ray Packets(4,8,16), Ray Streams(N)

Targets up to photorealistic professional and scientific rendering applications

Highest ray tracing performance on CPUs

- 1.5–6× typical speedup reported by users

Support for latest CPUs / ISAs

- Intel® Xeon Phi™ Processor (codenamed *Knights Landing*) – AVX-512
- Intel® Xeon® Processor (codenamed Skylake) - AVX-512 (coming soon!)

API for easy integration into applications

Free and open source under Apache 2.0 license

- http://embree.github.com

Professional Rendering, Gaming Tools, and SIM Apps

UBISOFT MOTION PICTURES

AUTODESK.

DREAMWORKS

FluidRay RT
Physically Based Renderer

SURVICE ENGINEERING COMPANY

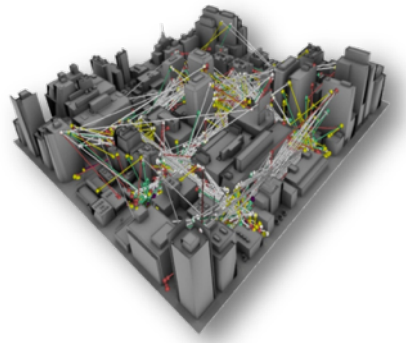
corona

Simlab Soft
Bringing Art closer

3DEXCITE

Courtesy of Jeff Patton, Rendered with Corona Renderer

Image rendered with FluidRay RT

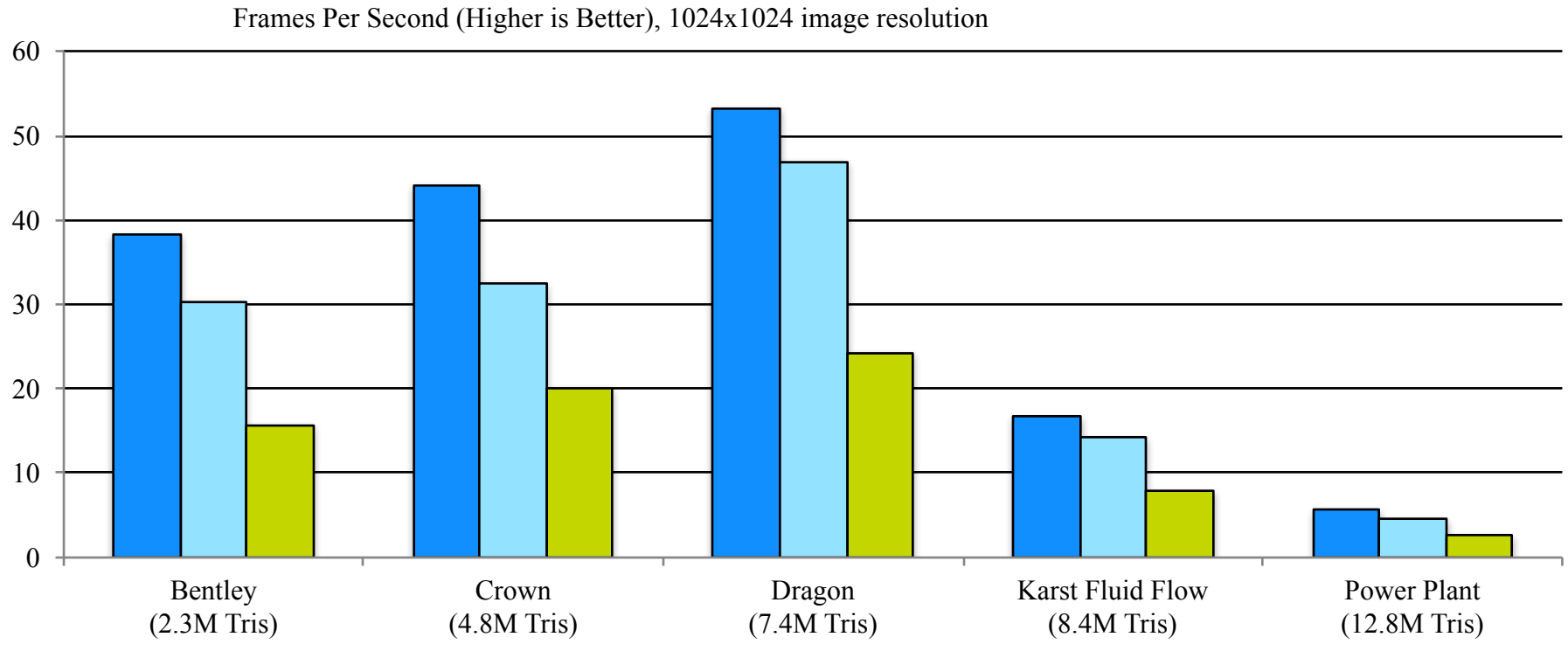


Rendered with StingRay, SURVICE Engineering

pCon.planner rendered courtesty EasternGraphics

*Many other announced users incl.: Pixar, Weta Digital, Activision, Chaos V-Ray, Ready At Dawn, FrostBite, EpicGames UnReal, High Moon, Blue Sky, UBISoft MP, Framestore, Illumination, ….

Performance: Embree vs. NVIDIA* OptiX*



- Intel® Xeon® E5-2699 v4 Processor
  2 x 22 cores, 2.2 GHz
- Intel® Xeon Phi™ 7250 Processor
  68 cores, 1.4 GHz
- NVIDIA Tesla P100 Coprocessor
  PCIe, 16 GB RAM

Embree 2.16.1, Intel® C++ Compiler 17.0.2, Intel® SPMD Program Compiler (Intel® ISPC) 1.9.1

NVIDIA* OptiX* 4.0.2, CUDA* 8.0.44

Source: Intel

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Path Tracer Renderer Configuration (slide 11)

Intel® Xeon Phi™ 7250 Configuration

Node count	1
Platform	
CPU	Intel® Xeon Phi™ 7250 Processor (16GB MCDRAM, 1.40 GHz, 68 cores)
RAM	64 GB DDR4 total, 16 GB MCDRAM in quad/cache mode
BIOS	Vendor: Intel Corporation Version: S72C610.86B.01.01.0147.060220162105 06/02/2016 BIOS Configuration: default, turbo on, hyper-threading on
OS / Kernel	Fedora* Core 23 Server / 4.8.13-100.fc23.x86_64 Linux Power Scheme: performance governor 8 GB of pre-allocated 2MB pages

Nvidia* Tesla* P100 GPU Accelerator Configuration

Node count	1
Platform	
CPU	2 x Intel® Xeon® E5-2697 v4 Processor (Dual socket, 2.3GHz, 2 x 18 cores)
RAM	256 GB total
BIOS	Vendor: Intel Corporation Version: Release Date: BIOS Configuration: default, turbo on, hyper-threading on
NVIDIA Co-Processor	Tesla P100-PCIE-16GB (GP100) 3584 CUDA Cores 16GB HBM2 memory Software Details: Driver Version: 375.20 CUDA Version 8.0.44 OptiX* Version 4.0.2
OS / Kernel	Red Hat* Enterprise Linux Server 7.2 / 3.10.0-327.el7.x86_64

*Other names and brands may be claimed as the property of others.

Rendering Engine for *High-Fidelity* Visualization

- Build on top of Embree; Launched June 2016

- Scalable Visualization targeted features
  - Surfaces (both polygonal and non-polygonal)
  - Volumes, and volume rendering
  - *High-Fidelity* rendering/shading methods
  - *Scalable* Cluster Wide Rendering

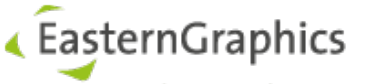
- Packed it up in an 'easy-to-use' rendering library for visualization
  - Same "spirit" as OpenGL, but different API

- 10+ Application adoption in 12 months, more under development!

Brayns

PowerCT

NASA



VL3

A TURNKEY SDVIS APPLIANCE SOLUTION

For:

In Situ Compute+Vis!; Vis Walls up to 6 UHD Displays; HPC Compute, Vis+HPC SW Development and EVEN Post-Processing Vis ☹

Announcing the Turnkey SDVis Appliance!

Improving Data Visualization with Intel® Solutions

Optimizing for Visualization

- Optimized for parallel processing and latest instruction sets
- OpenSWR, Embree, & OSPRay all available
- Used by ParaView, VisIt, VMD, CEI EnSight, and more…

Reducing Cost for Visualization

- Lower cost of host vs cost of host + card for GPUs
- Single host can address up to 384GB memory
- Additional use as general purpose compute platform

Pre-Configured Appliance Solution Available Now

- 1.58x to 1.91x better performance than GPUs[1]
- Supports data sets up to 1.5TB
- Standard configuration price $79,000[2]
- More Info: http://sdvis.xeonphi.com/

For in-situ, post-processing, and professional rendering visualization needs

*Other names and brands may be claimed as the property of others.

[2]Pricing as of June 15, 2017. Pricing is subject to change without notice

[1]Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit [illegible]. Source: Intel measured or estimated as of May 2017. See slide 7 for performance measurements. Configuration Details: See slide 5.

SDVis Appliance Solution

Appliance Configuration

Installed Software Intel® HPC Orchestrator, SDVis Software (ParaView, VTK, VisIt, VMD), Intel® Parallel Studio Cluster Edition, SW Dev. Tools

Nodes 8x Intel® Xeon Phi™ 7250 compute nodes, Intel® Xeon® E5-v4 head node, Intel® Xeon® E5-v4 storage node

Storage 32TB Raid

Network 24 port Omni-Path & Ethernet switches

Availability & Pricing

Available 4 weeks after ordering

Price $79,000 (1 year SW subscriptions)[1]

Ordering & More Info

sales@colfax-intl.com

http://sdvis.xeonphi.com/

SDVis Appliance	
Master Head Node Node + Display Management	**Software:** CentOS 7.3, HPC Orchestrator
	Hardware: 1 CX-87723 Intel® Xeon® Node Intel® Xeon ® E5-v4 36 cores, 256GB DDR4, OPA HFI, Up to 6 4K Monitors Display Card, SSD 480GB
Compute Nodes Compute + Render	**Software:** CentOS 7.3, SDVis Software (ParaView, VTK, VisIt, VMD), Intel Parallel Studio Cluster Edition, SW Dev. Tools
	Hardware: 8 CX-87719 Intel® Xeon Phi™ Nodes Intel® Xeon Phi™ 7250 68 cores, 192GB DDR4, Intel® OPA HFI, SSD 150GB
Storage System	**Software:** CentOS 7.3
	Hardware: 1 CX-87794 Intel® Xeon® Node Intel® Xeon ® E5-v4 16 cores, 64GB DDR4, Intel® OPA HFI, 32TB RAID
Networking OPA/100G Ethernet	**Hardware:** 24 Port OPA Edge Switch, 16 Port Ethernet Switch

Pre-configured solution for visualization needs

*Other names and brands may be claimed as the property of others.

[1]Pricing as of June 15, 2017. Pricing is subject to change without notice

SDVis Appliance

- Includes all the necessary software for visualization and rendering, node management, and software development
- Address up to 1.5TB data sets using 8 Intel® Xeon Phi™ 7250 68 core compute nodes
- Intel® Xeon® E5-v4 36 core management node
- Intel® Xeon® E5-v4 16 core storage node with 32TB RAID storage
- Features Intel® Omni-Path interconnect fabric

14U Rack

Software: SDVis Software (ParaView, VTK, VisIt, VMD), Intel® Parallel Studio XE Cluster Edition, Intel® HPC Orchestrator, SW Dev. Tools

- 24 port Ethernet Switch
- 24 port Intel® Omni-Path Switch
- Intel® Xeon® Management Node
- 4x Intel® Xeon Phi™ Compute Nodes
- 4x Intel® Xeon Phi™ Compute Nodes
- Intel® Xeon® Storage Node (32TB RAID)
- Power Distribution Unit

Available Now!

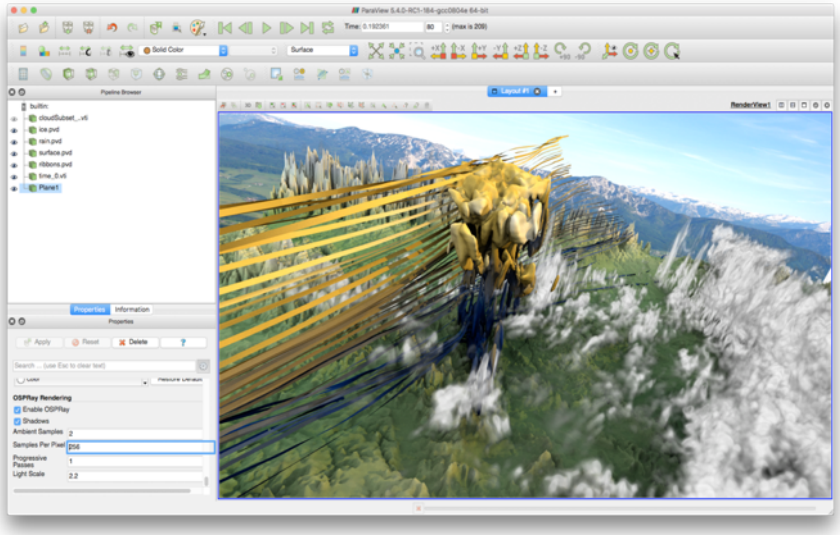
The SDVis Appliance is more than just a good idea, it is available now from Colfax International. For more information use the links below.

Product Webpage:
http://sdvis.xeonphi.com/

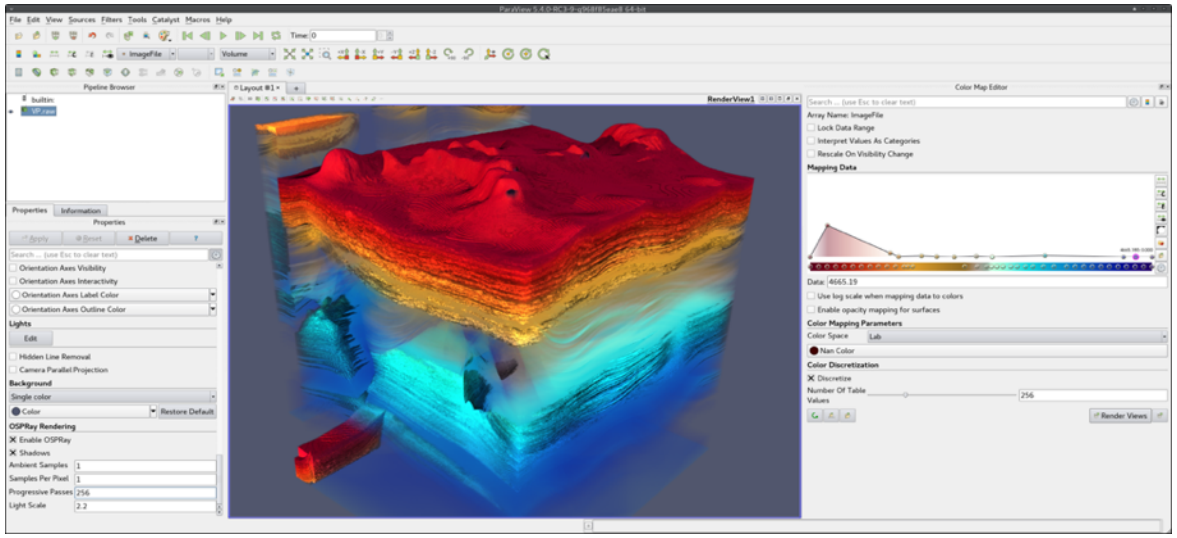
Sales Contact:
sales@colfax-intl.com

COLFAX
Customized Solutions

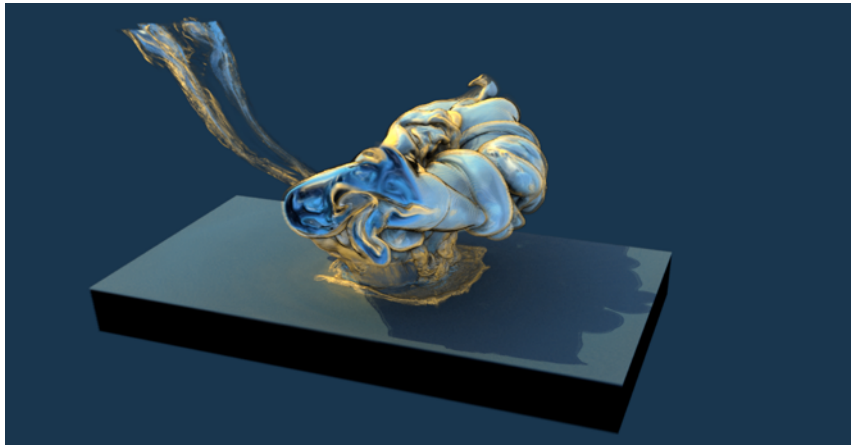
Live SDVis Demos @ ISC Intel Booth



DKRZ – German Weather Visualization



TOTAL – Seismic Oil & Gas Discovery Visualization



Los Alamos Nat'l Lab – Asteroid Deep Ocean Impact

EasternGraphics pCon.Planner – "Rendering in the Cloud"

Notices and Disclaimers

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For more complete information about performance and benchmark results, visit www.intel.com/benchmarks.

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Intel processors of the same SKU may vary in frequency or power as a result of natural variability in the production process.

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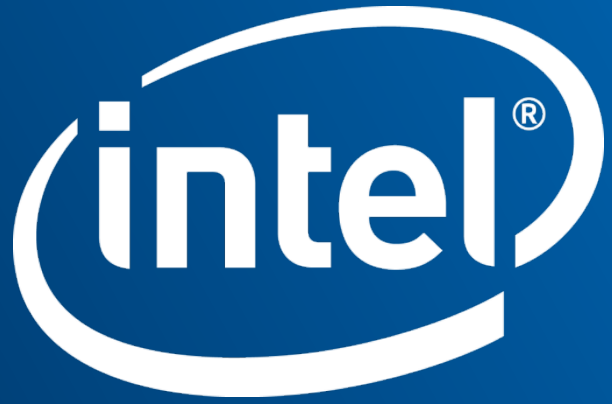
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