

Explore and Visualize Massive Datasets with ParaView

January 30th 2024 - François Mazen

Who am I?

- François Mazen
- Director of Scientific Visualization at Kitware Europe, France
- Numerical Simulation Background (Ansys, Siemens PLM)
- Open-Source Software Enthusiast
- Debian Linux Distribution Developer



 **Ansys**

SIEMENS

 **kitware**



Kitware / Leader in AI & scientific open source solutions

Software development

Based on open source tools
300+ active projects worldwide



Sustained Growth

Since creation of the company
100% employee-owned



230 employees Worldwide

6 offices across USA/Europe



65% staff with PhD or Master

High Level customer expertise



20+ years of expertise

Kitware USA, 1998
Kitware Europe, 2010

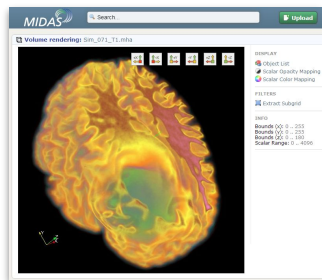


Revenue 2020

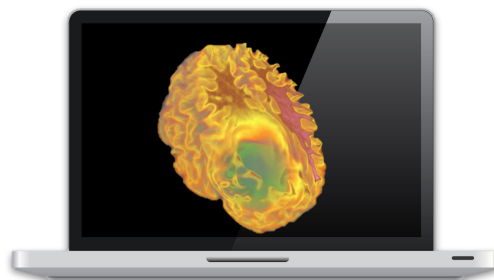
\$39M consolidated



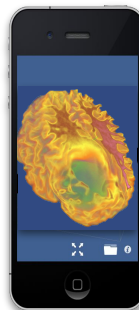
Applications / Universal Platforms



Web



Desktop



Mobile



Cloud /HPC

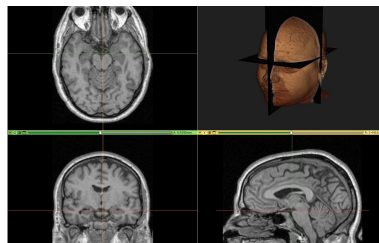
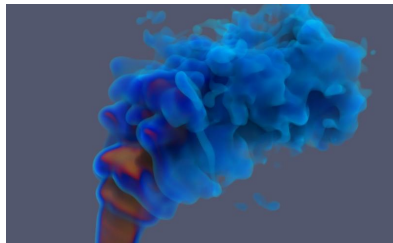
kitware
Platforms



3D Slicer



Areas of expertise / Built on open source



```
ceLists.txt
CMakeLists.txt x main.cp
1 cmake_minimum_requir
2 project(cmake_testap
3
4 set(CMAKE_CXX_STANDA
5
6 add_executable(cmake
soles
```



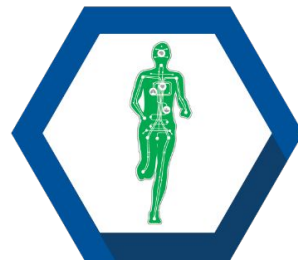
Computer
Vision



Data and
Analytics



Scientific
Computing



Medical
Computing



Software
Solutions

Kitware / Services



TRAINING



SUPPORT



DEVELOPMENT

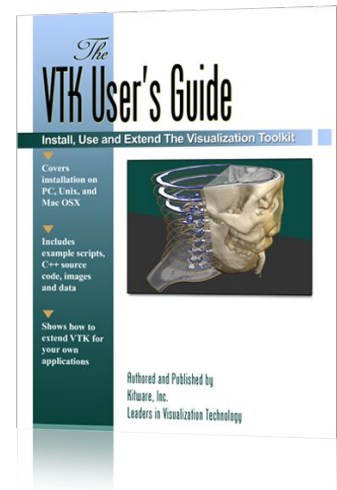
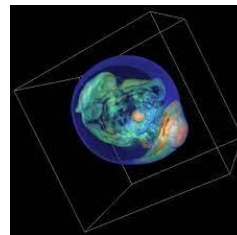
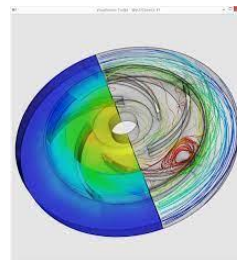


GRANT
COLLABORATION

VTK / Cross-Platform Visualization Toolkit (1993)

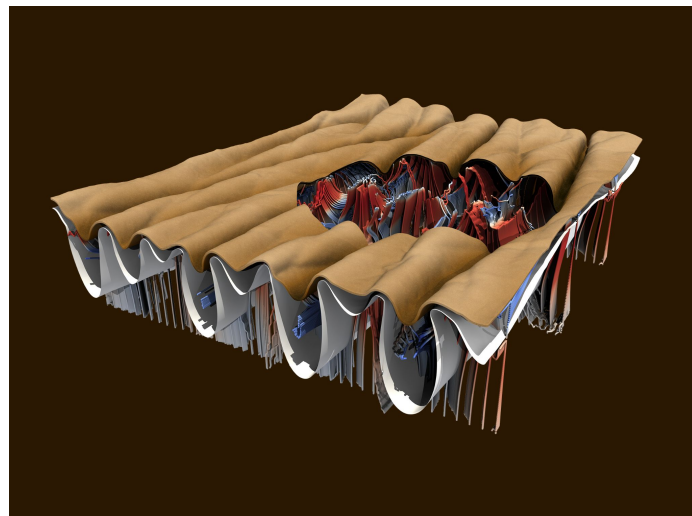
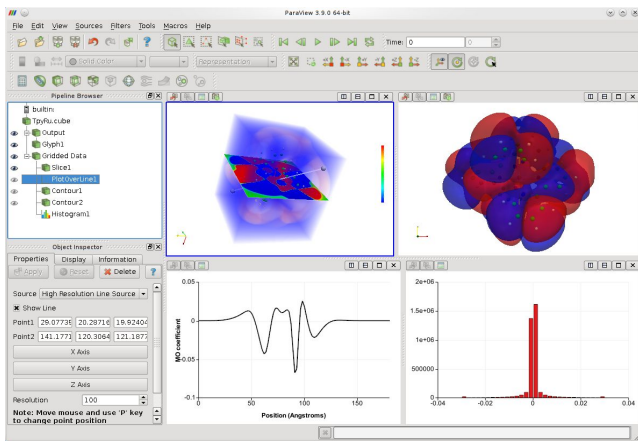
- Open-source (BSD-3 licence), freely available, cross-platform toolkit for post-processing and visualization of scientific data

VTK



ParaView / High-Performance Post-Processing (2002)

- Open-source, multi-platform, data analysis and visualization application
- Analysis of extremely large datasets using distributed memory computing resources

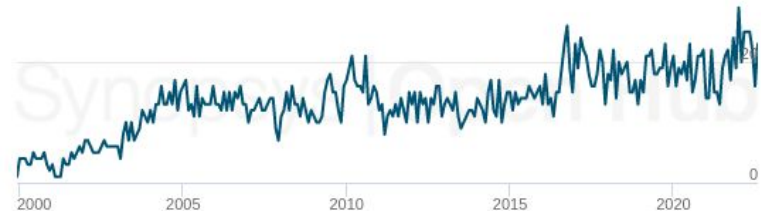


ParaView Community

- **Open Source Software (BSD license)**
- **Run on most of Top500 HPC**
- **300000+ download yearly from Kitware servers**
 - More users via other unknown download channel (Linux packaging, Enterprise distribution...)
- **157k commits made by 339 contributors since 2000**
- **1.6M lines of code**



Contributors per Month



Features / Application Domains



Fluid
Dynamic

Structural
Analysis



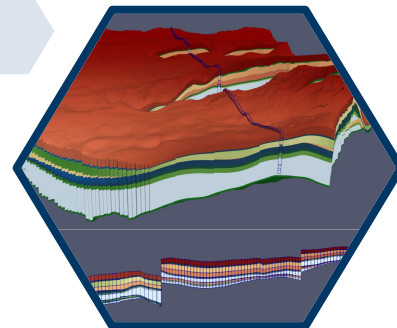
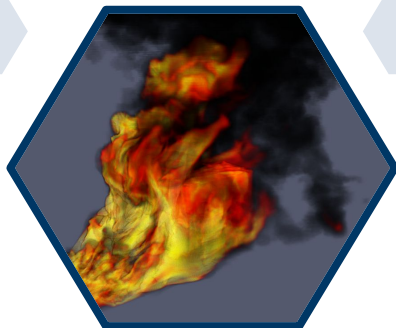
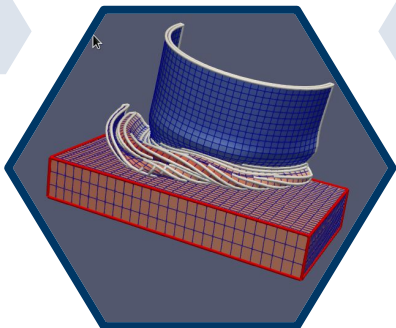
Medical

Particles

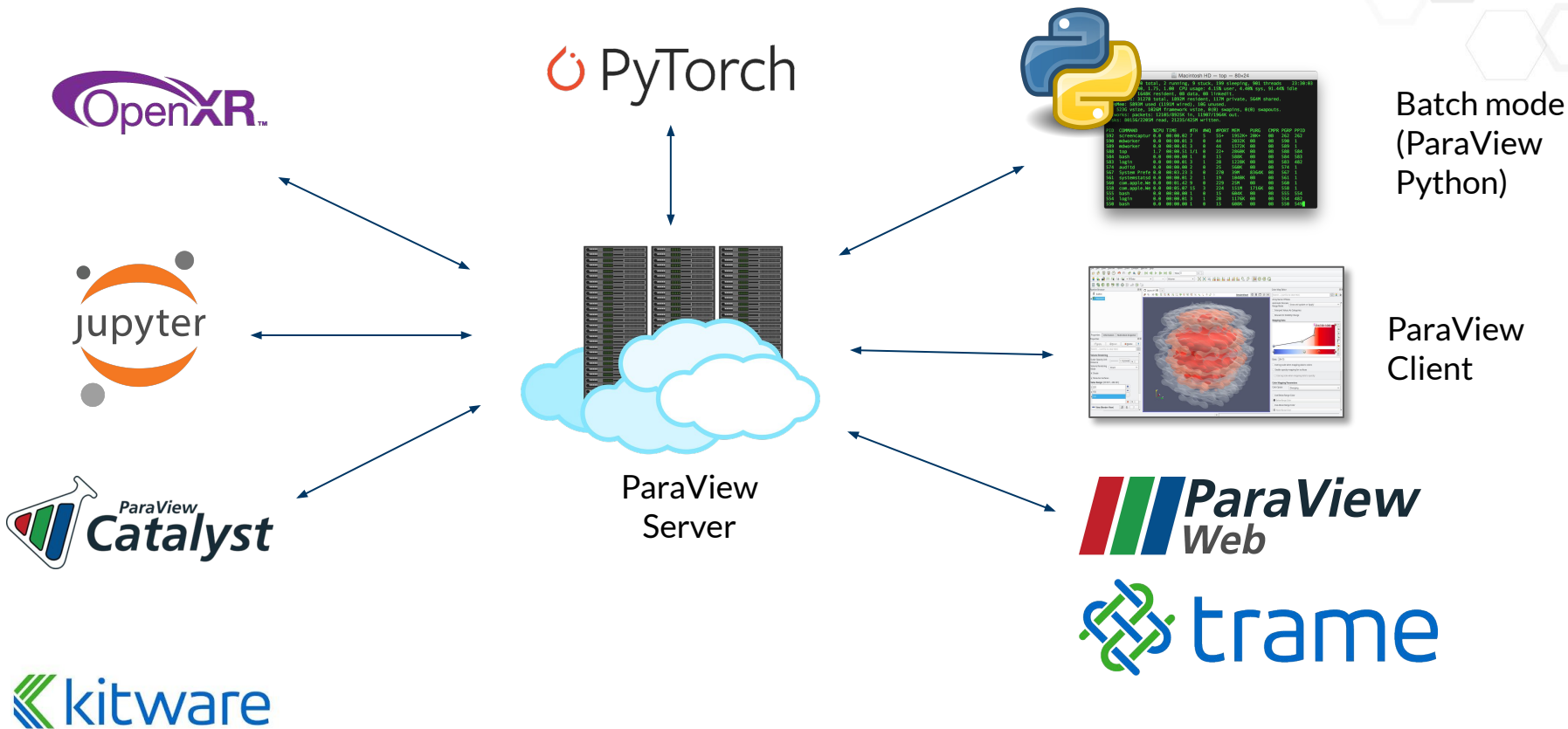


Astrophysic

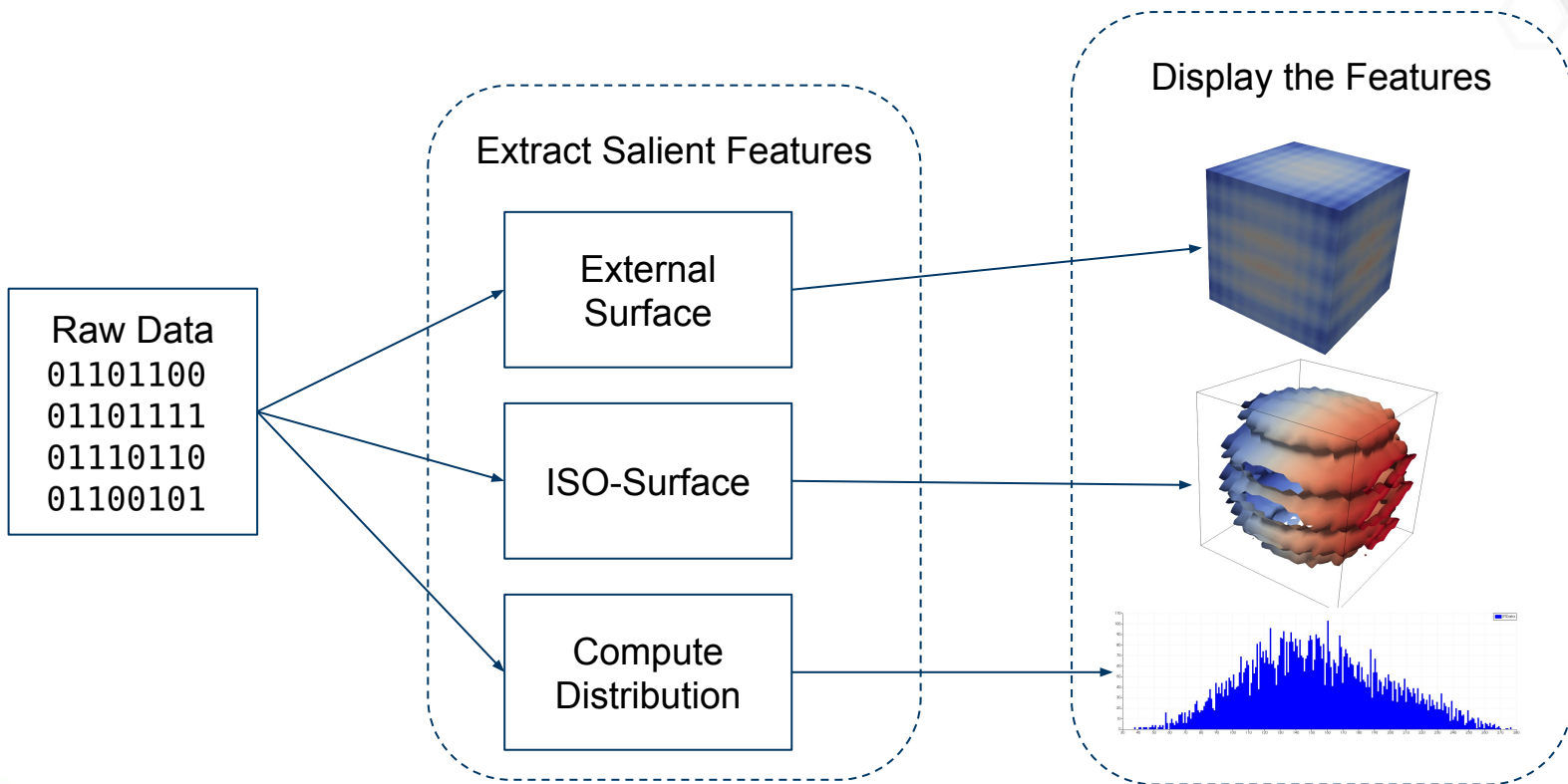
Geoscience



ParaView Ecosystem



Scientific Visualization Basics



ParaView - Graphical User Interface

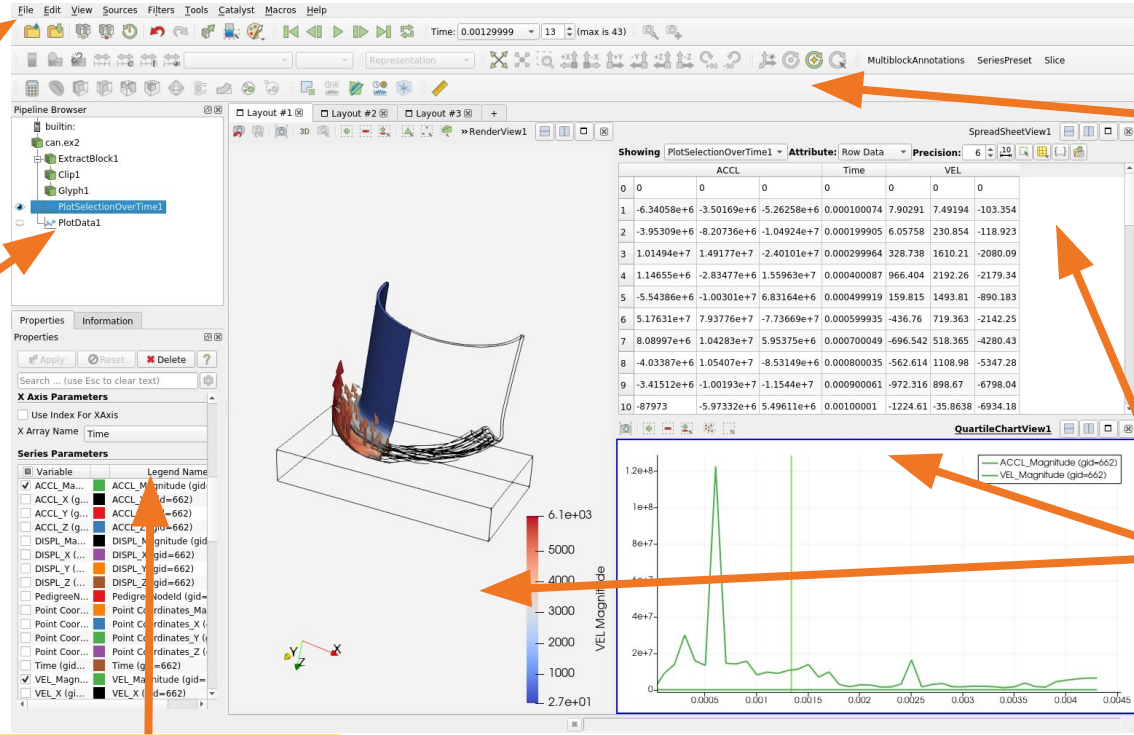
Menu bar

Pipeline Browser

Toolbars

View(s)

Object Inspector



Pipeline Browser

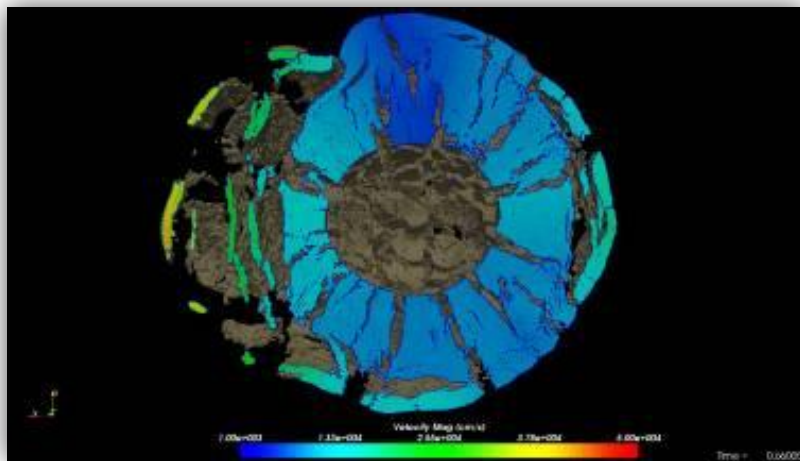
The screenshot displays a software interface with several key components:

- Pipeline Browser:** A tree view on the left showing a pipeline structure. The 'PlotSelectionOverTime1' node is highlighted with a green box.
- 3D Model:** A central 3D visualization of a car crash simulation, showing a blue car body and a red fire/explosion effect. A color scale on the right ranges from 2.7e+01 to 6.1e+03.
- Data Table:** A table titled 'Showing PlotSelectionOverTime1' with columns for 'ACCL' and 'VEL' over 'Time'. The table contains 11 rows of numerical data.
- QuartileChartView1:** A line chart at the bottom right showing 'ACCL_Magnitude (gid=662)' and 'VEL_Magnitude (gid=662)' over time. The Y-axis is 'VEL Magnitude' ranging from 0 to 1.2e+8. The X-axis is 'Time' ranging from 0 to 0.0045. A prominent spike is visible at approximately 0.00125.

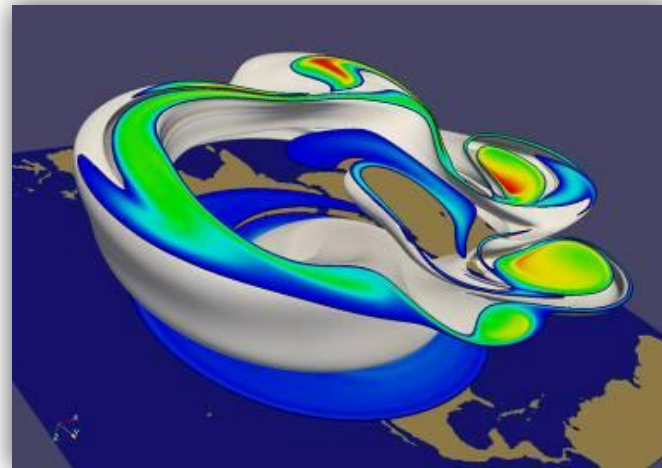
	ACCL	Time	VEL
0	0	0	0
1	-6.34058e+6	-3.50169e+6	-5.26258e+6
2	-3.95309e+6	-8.20736e+6	-1.04924e+7
3	1.01494e+7	1.49177e+7	-2.40101e+7
4	1.14655e+6	-2.83477e+6	1.55963e+7
5	-5.54386e+6	-1.00301e+7	6.83164e+6
6	5.17631e+7	7.93776e+7	-7.73669e+7
7	8.08997e+6	1.04283e+7	5.95375e+6
8	-4.03387e+6	1.05407e+7	-8.53149e+6
9	-3.41512e+6	-1.00193e+7	-1.1544e+7
10	-8.9793	-5.97332e+6	5.49611e+6

Extremely Large Data

1 billion cell asteroid
detonation simulation



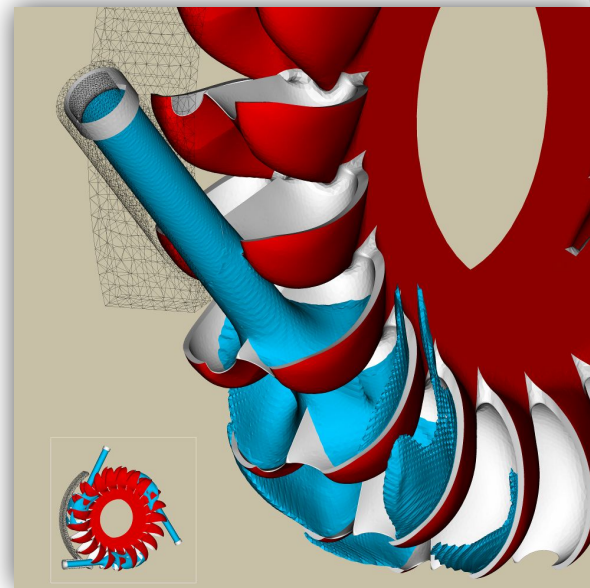
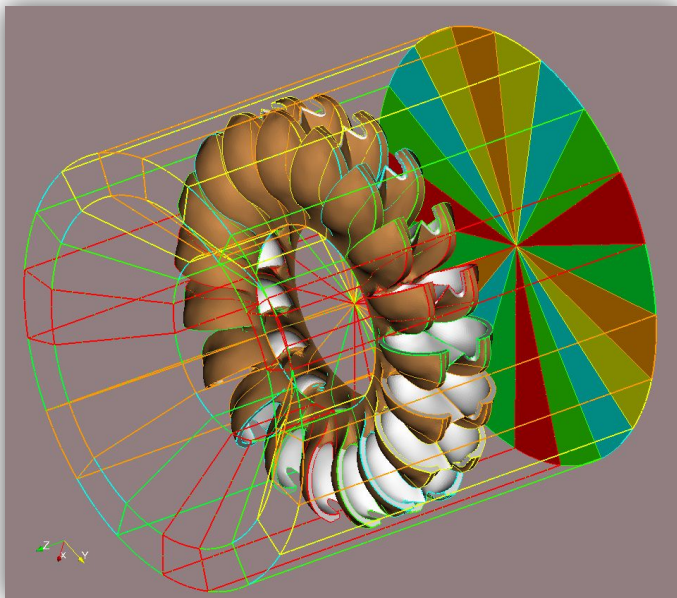
½ billion cell weather
simulation



Source: Sandia National Lab

Fast Large Data Interaction

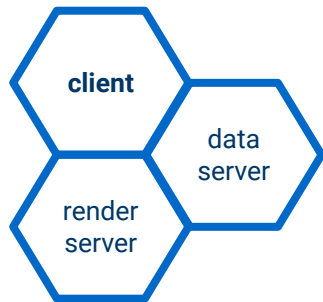
CFD simulation of 20-30 million cells
with load balancing



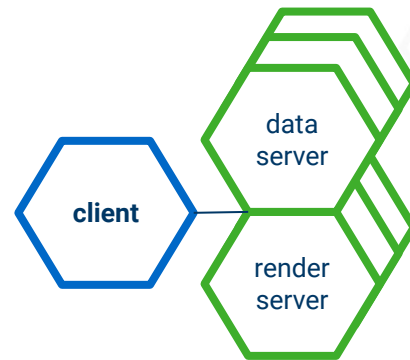
Source: Swiss supercomputing center

Client Server Architecture

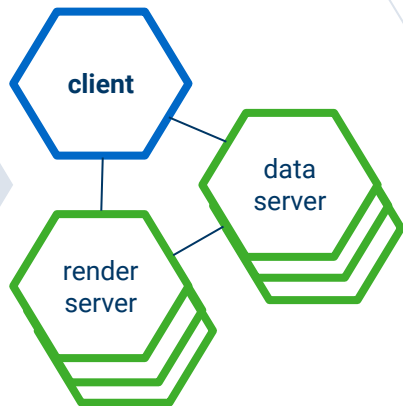
Built-in
paraview



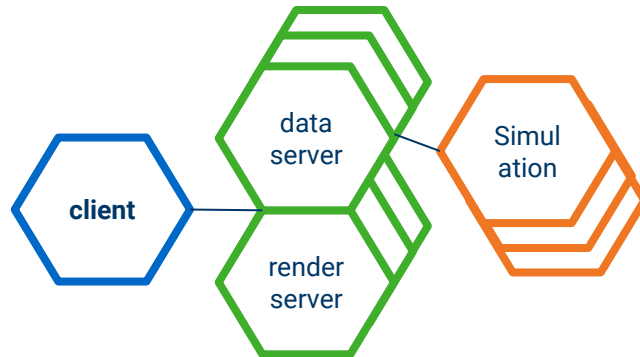
Distributed
pvserver



Graphic Nodes
data/render server

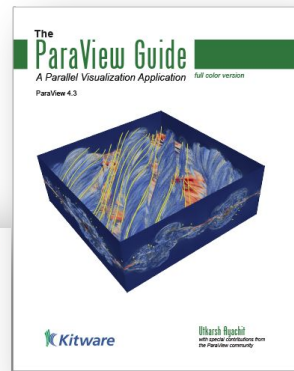
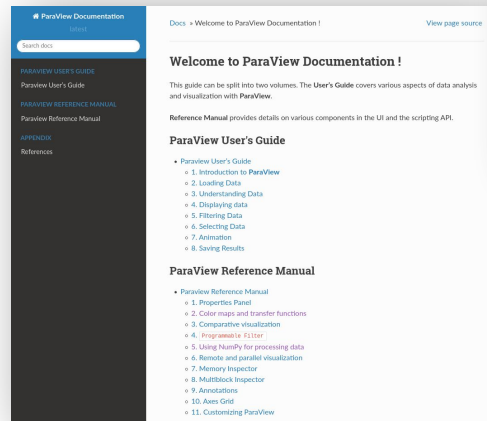
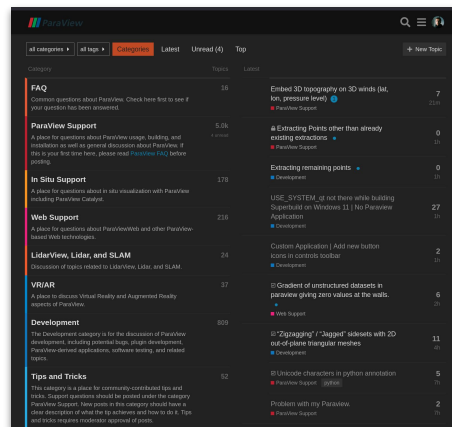


In Situ
catalyst



Going Further ...

- **ParaView User Doc (Guide) – Official user's manual and reference guide**
 - Accessible in the binary version of ParaView
 - Freely available as a website: <https://docs.paraview.org>
 - Printed version on Amazon
- **Wiki and Forum**
 - Plenty of user and developer resources
 - <https://discourse.paraview.org/>
- **Kitware**
 - <https://www.kitware.eu/contact/>





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