Blue Brain
Brayns

A platform for high fidelity large-scale and interactive visualization of scientific data and brain structures that renders photo realistic images

The Blue Brain Project has made major efforts to create morphologically accurate neurons to simulate sub-cellular and electrical activities, for example, molecular simulations of neuron biochemistry or multi-scale simulations of neuronal function. Blue Brain Brayns is a new visualization platform that can be used for large-scale and interactive ray tracing of all kinds of scientific data.

The interactive ray tracing can highlight areas of the circuits where cells touch each other and where synapses are being created. In combination with 'global illumination', which uses light, shadow, and depth of field effects to simulate photo-realistic images, this technique makes it easier to visualize how the neurons function.

As a lightweight library that allows optimized ray tracing rendering of meshes, point clouds, volumes, and parametric geometry, Blue Brain Brayns makes it possible to use the best rendering engine depending on the case.

Using **Blue Brain Brayns**

One of the keys towards understanding how the brain works as a whole, is visualization of how the individual cells function. In particular, the more morphologically accurate the visualization can be, the easier it is for experts in the biological field to validate cell structures; photo-realistic rendering is therefore important.

Blue Brain Brayns is a visualization platform that can interactively perform high-quality and high-fidelity rendering of neuroscience large data sets. Thanks to its client/server architecture, Blue Brain Brayns can be run in the cloud as well as on a supercomputer, and stream the rendering to any browser, either in a web UI or a Jupyter notebook.
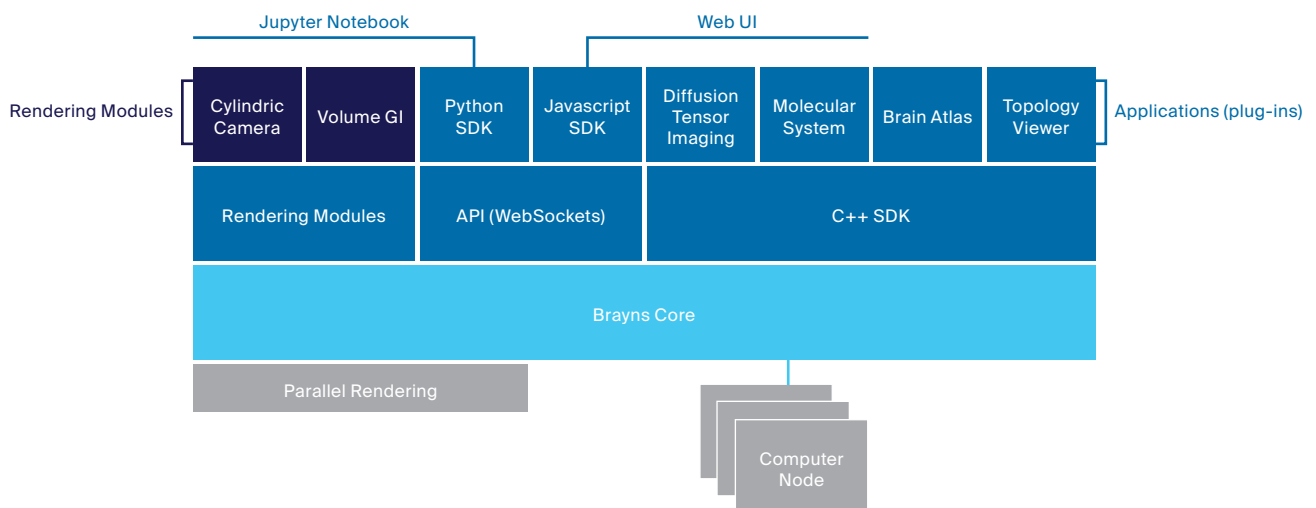
Scalability

- Designed for large scale datasets (tens of thousands of neurons, TB of simulation data)
- Scalable distributed system (from consumer PC to supercomputer)
- Remains interactive, even for very complex datasets
- Suitable for caves and high resolution displays (40 MPix) via parallel rendering
- Large volumes (TB of data with BBIC format, 8bit, 16bit, floats, etc.)

Research oriented

- Research oriented modular architecture. Easy experimentation since every scientific use-case is a plug-in that does not affect the rest of the system
- Modular framework with C++, Python and Javascript API
- Currently implements plug-ins for circuit simulation, topology, brain atlas, diffusion tensor imaging, volume rendering, morphology collage, interactive touch detection, and molecular systems

Ease of deployment

- Client/Server architecture
- Cloud ready via containers like Docker
- Hardware agnostic (GPU/CPU)

Advanced rendering

- Custom virtual cameras for any type of display (cylindric stereo, VR, etc.)
- Advanced geometry (signed distance field, streamlines, meshes, parametric geometry, point clouds, etc.)
- High fidelity rendering with physically accurate light transport
- Photorealistic rendering (global illumination, camera lens effects)
- Scene management (visibility, bounding boxes, transformations)

Software Adopters

Blue Brain Project

The Visualization team makes intensive use of Blue Brain Brayns to produce ultra-high resolution movies (8K) and high-fidelity images for scientific publications. Brayns is also used to serve immersive visualization on the large displays, as well as unique devices such as the curved OpenDeck located at the Blue Brain office.
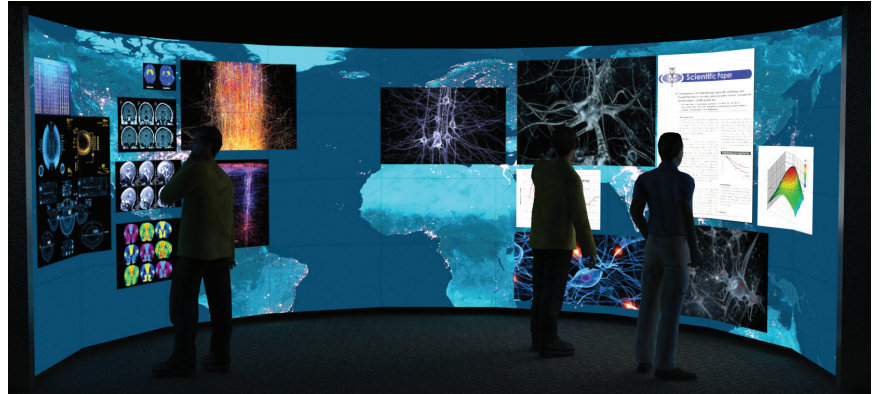
- The Communication team uses 3D stereo movies produced by Brayns for public events such as 'La nuit des musées' and 'Planète Santé'
- Blue Brain Scientists and Researchers use Brayns within their specialist areas

"Brayns is a cloud-based solution that allows us to interactively visualize diffusing molecules at synapses and other structures within neurons"

Daniel Keller, Section Manager, Molecular Systems
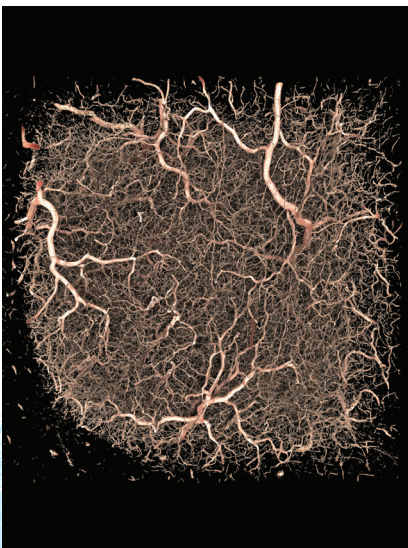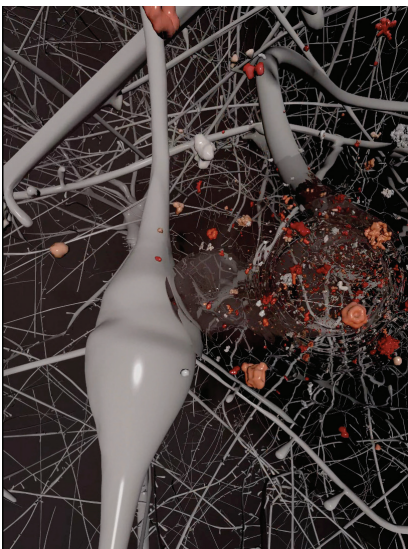
Human Brain Project

Blue Brain Brayns is used by two Human Brain Project sub projects:

- SP6 uses Brayns to empower its research on the Hippocampus circuit
- SP7 uses Brayns to validate the CEPH Key/Value store as a backend for simulation data

"Brayns is an invaluable tool in my everyday work, and it represents a new big step forward in scientific visualization. The very efficient implementation on HPC systems makes it a wonderful way to visualize on a web browser the static and dynamical properties of the large-scale cellular model circuits I am investigating"

Prof. Michele Migliore, CNR-IBF

About EPFL's
Blue Brain Project

The aim of the EPFL Blue Brain Project, a Swiss brain research initiative founded and directed by Professor Henry Markram, is to establish simulation neuroscience as a complementary approach alongside experimental, theoretical and clinical neuroscience to understanding the brain, by building the world's first biologically detailed digital reconstructions and simulations of the mouse brain.

Blue Brain Brayns is downloadable from GitHub, at: github.com/BlueBrain/Brayns

The home page contains information on how to build and use the platform (Core, SDK and Web UI).
Basic C++, Python or Javascript skills are required to interact with the platform and use the Brayns SDK and develop new plug-ins.

For technical information on Blue Brain Brayns or to request a trial or demonstration, please contact:

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github.com/BlueBrain/Brayns

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https://www.epfl.ch/research/domains/bluebrain/

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