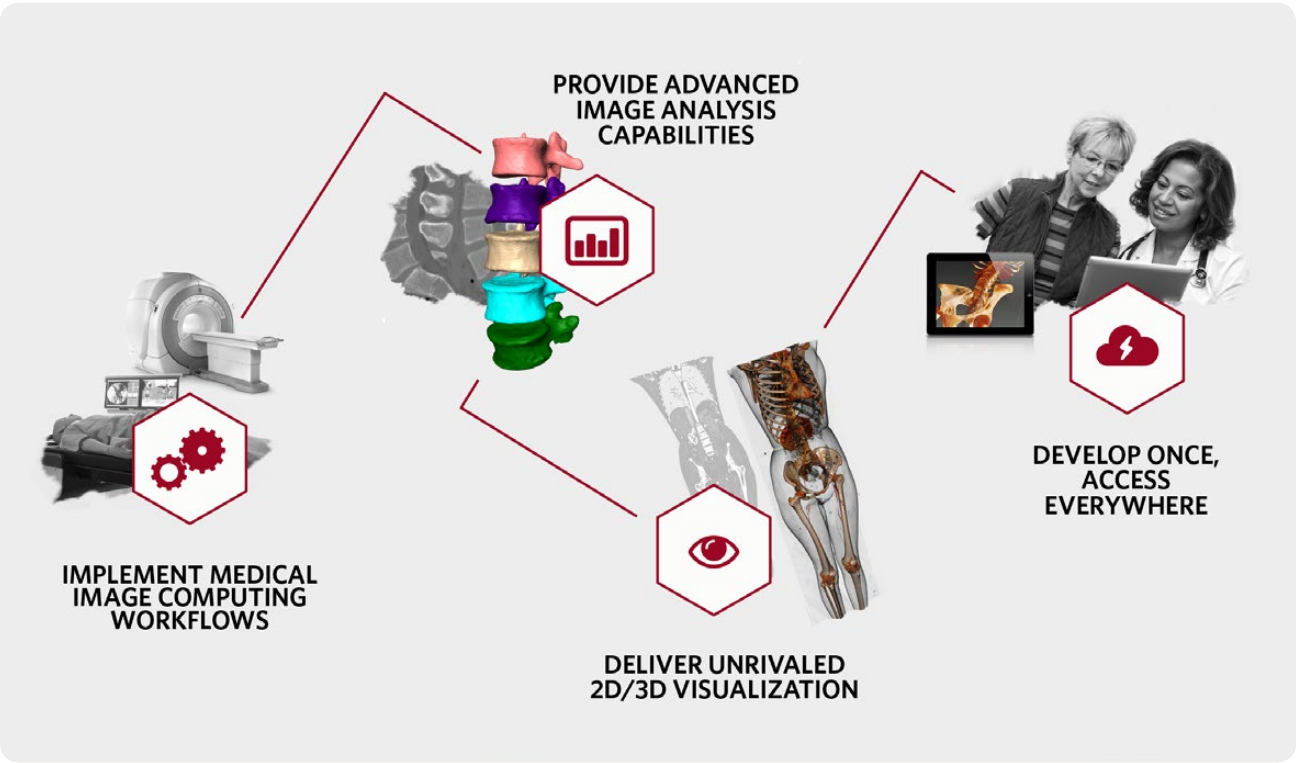
Open Inventor Medical Edition

High-performance 3D software development tools

Open Inventor® Medical Edition is an object-oriented 2D and 3D software development toolkit (SDK) for developing professional interactive applications using C++, .NET or Java, for cloud, desktop and mobile environments. Its easy-to-use API, extensible architecture, and large set of advanced built-in components provide developers with a high-level platform for integrating powerful 2D/3D visualization and analysis capabilities into software applications in a simple and consistent way.



Power your software development with Open Inventor Medical Edition

Open Inventor® Medical Edition is a cross-platform software development toolkit (SDK) for implementing applications with 2D and 3D medical image computing workflows. Based on the widely used Open Inventor 3D toolkit, this edition provides high-level image visualization, processing and analysis through an object-oriented API.

Whether you are an independent software vendor or a hardware vendor, Open Inventor Medical Edition gets your software to market faster, with superior images and performance. Partnering with the visualization experts at FEI means that your in-house developers can focus on their domain specific expertise.

3D rendering is now practical for any application, whether it's a new development or an upgrade, and Open Inventor makes it easy to add this extra dimension. The speed and capacity of graphics processing units (GPU) allow Open Inventor to provide better performance and quality than CPU-based renderers and to seamlessly mix image rendering with geometry including CAD data.

Remote visualization allows your end-users to be at one machine while the application and the 3D rendering run on a rendering server located anywhere on the network or in the cloud. End-users do not need any 3D hardware or client software, just an HTML5-enabled web browser.

Industry leading algorithms for image enhancement, segmentation and analysis allow your end-users to work faster and smarter than ever before. Segmented objects can be converted to geometry and exported for use with simulation tools and 3D printing.

Go to market faster

- Object-oriented API and components
- Develop in C++, .NET or Java
- Advanced debugging and productivity tools
- Easy integration with existing applications

Deliver state-of-the-art 3D

- High performance and high image quality
- State-of-the-art volume rendering
- Advanced image processing and analysis
- Advanced support of meshes and grids

Solve tough 3D challenges

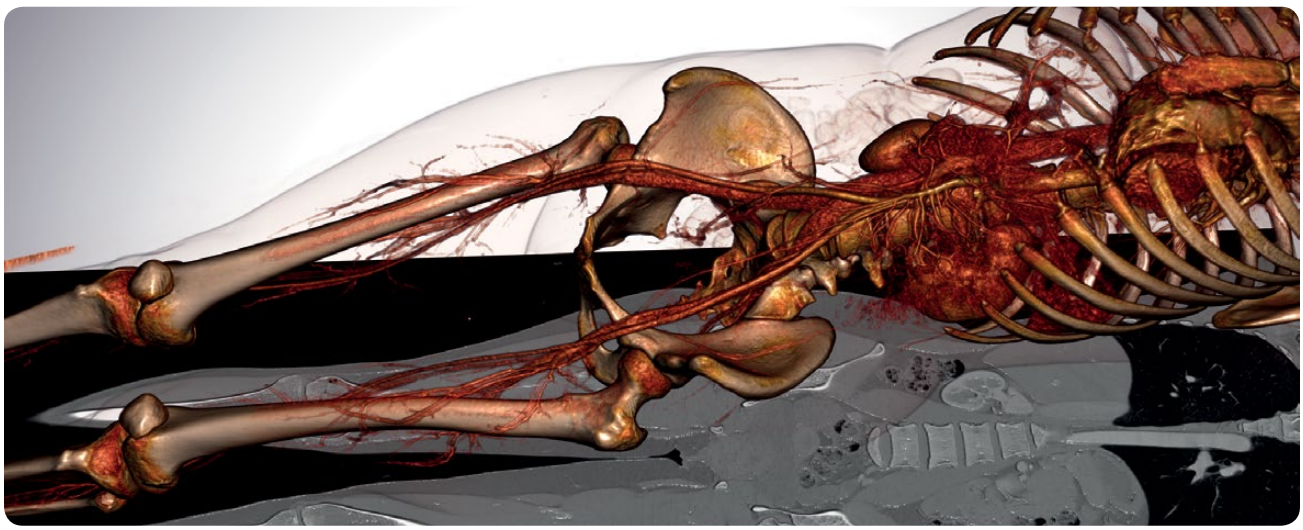
- Cloud/mobile remote visualization
- Fusion of multiple data types
- Very large data sets management

Increase productivity

- Programming examples and tutorials
- Clear and thorough documentation
- On-site training
- Prompt, effective support hotline

Reduce maintenance costs

- Professional consulting
- Professional services (custom development)
- Active user community
- Flexible licensing model



About Open Inventor Medical Edition

Open Inventor Medical Edition is a cross-platform software development toolkit (SDK) for implementing applications with 2D and 3D medical image computing workflows. Open Inventor provides high-level image visualization, processing and analysis libraries accessible through an object-oriented API.

Image and volume data

Open Inventor can load images, volumes or stacks of images from DICOM and many other standard formats. Data can be rendered using slices, multiplanar reconstruction (MPR), curved MPR, slab MPR, shaded surface (SSD) and direct volume rendering (DVR). Modern GPUs are massively parallel multi-core processors that allow off-loading computational tasks from a computer's CPU. Open Inventor uses the GPU to render high quality images at interactive speed. Slices can be arbitrarily aligned, curved or defined by any geometric surface. Isosurfaces (SSD) are rendered directly from the image data, allowing the threshold value to be modified interactively. Volume rendering uses the GPU to do physically correct ray-casting in real time with multiple light sources, shadowing and material properties. Rendering parameters such as window level, color and opacity can be modified instantly. The image can be generated using blending, MIP, MinIP or SumIP. Multiple volumes from the same or different modalities can be rendered in the same scene (data fusion).

Geometry

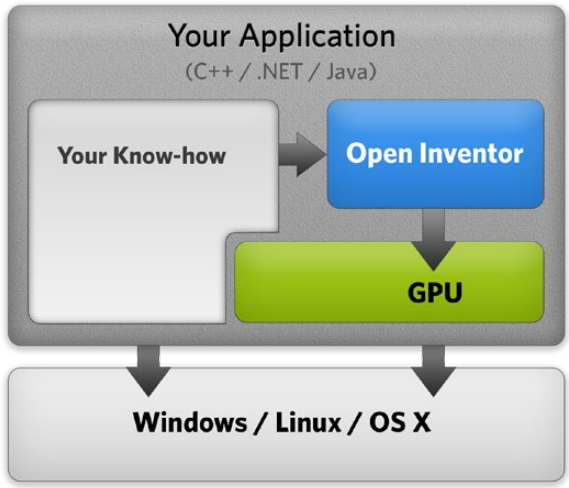
Open Inventor supports 3D geometry including points, markers, lines, polygonal shapes and NURBS surfaces. Open Inventor can also import CAD models from formats including Catia, Parasolid, SolidEdge and STEP. This allows geometry such as prostheses and devices to be displayed together with the image data for surgical planning, simulation and training applications.

Mesh data

Open Inventor supports geometry such as triangle surface mesh and tetrahedron volume mesh. Scalar and vector data sets can be visualized on a mesh using color mapping, contouring, vector glyphs and streamlines. This allows data generated by external simulation tools using FEA or CFD methods to be displayed together with the image data.

Interaction

Open Inventor supports mouse and keyboard input as well as touch, swipe and gesture based input techniques. The location and value of the voxel currently under the user's cursor is always available. Open Inventor also provides 3D interaction tools that allow users to directly manipulate objects, such as slices and clip planes, by clicking and dragging.



Annotation and measurement

Open Inventor provides geometry and input tools to enable 2D and 3D annotation. Annotations can include markers, lines, curves, rectangles, ellipses, polygons and text. Screen drawing tools allow users to interactively define annotations and measurements. High level annotation tools are also provided for 2D and 3D axes, graphs and charts.

Image processing

Open Inventor provides image enhancement, segmentation and analysis tools that can be applied to both 2D and 3D image data. Image enhancement includes sharpening, smoothing and denoising filters in the intensity domain and the frequency domain (FFT). Image segmentation includes intensity (thresholding and watershed), edge and region based algorithms. Image analysis includes a tool for computing statistics such as area, volume, number of objects, Feret diameter and more. Segmentation and virtual resection can also be done in the spatial domain using powerful tools including region of interest, clipping planes, clipping geometry (volume sculpting) and mask volumes.

Export

Open Inventor can export geometry directly to STL format for 3D printing. Open Inventor can also render very high resolution images, at any size, for posters and publications.

Remote rendering

Open Inventor also provides all these image visualization, processing and analysis features as a web service. While the actual data remains secure on the server, users can access the resulting 2D and 3D visualizations anywhere, on any device, using any HTML5 browser. No 3D hardware is required on the client side, multiple users can connect and collaborate in the same session and multi-touch and gesture input is fully supported. This is well suited for both in-house and cloud-based applications, including upgrading PACS viewers to 3D.

Integrate high-performance 3D visualization into your software applications

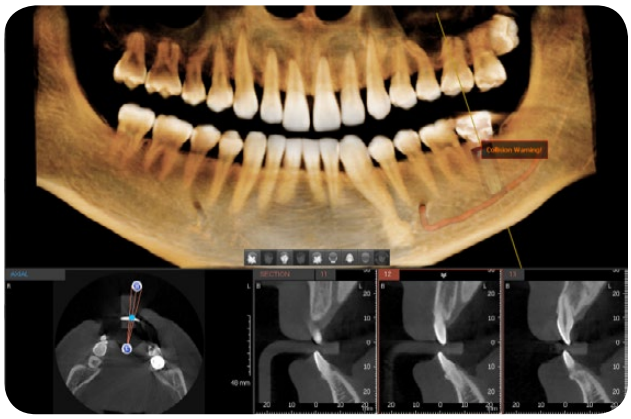
Developers of both commercial and internal use software applications leverage Open Inventor Medical Edition for integrating advanced 2D/3D visualization and image processing into their applications. Just a few of the many organizations using Open Inventor Medical Edition are: SYAC, Ewoosoft, spontech, iGene, Imricor, Zuse Institute Berlin (ZIB), and the Hannover Medical School.

Ewoosoft

Ewoosoft is a world leading provider of dental diagnostic imaging software and solutions, and a subsidiary of Vatech, the global leader in digital dental X-ray. Ewoosoft is using Open Inventor as the core 3D visualization component for their **Ez3D-i dental software**.

Ez3D-i is a 3D imaging viewer which allows dentists to quickly and accurately diagnose their patients. Its capabilities include 3D visual simulation, 2D image analysis, and various ways of manipulating CT images through a variety of MPR functions. Ez3D-i takes advantage of Open Inventor to provide advanced 3D rendering and simulation features, and also allows for easy integration with other software, for example surgical guide applications for implant placement. Ez3D-i has raised the bar for advanced features such as accurate collision detection and 3D panorama. "We are very happy to choose Open Inventor as the 3D core engine. Thanks to the comprehensive features of Open Inventor, we could focus more on which features to provide to our customers rather than how." Ike Kim, CTO at Ewoosoft.

ewoosoft.com

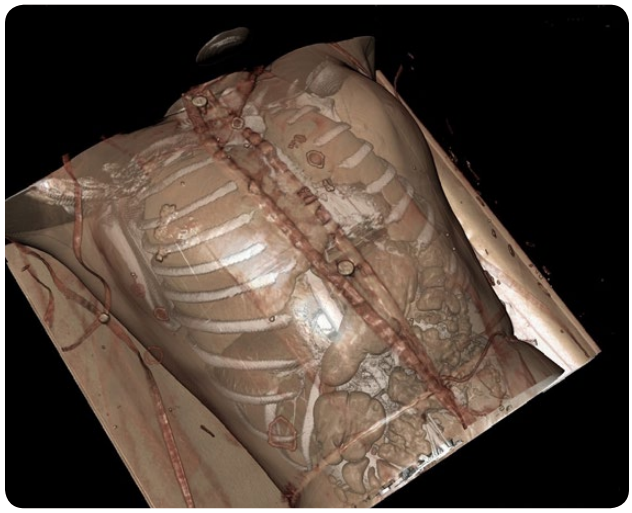


↑ **Collision detection between implant and canal.** Courtesy of Ewoosoft.

iGene

iGene, an Infovalley company, develops **iDASS**™ software that employs images from medical imaging modalities, mostly CT scanner, to produce a 3D digital body for forensic autopsy. Powered by Open Inventor's advanced volume rendering technology, iDASS is the first application in the forensic domain that enables pathologists to investigate the human body without physically manipulating it. High-quality interactive 3D rendering integrated into a complete virtual autopsy environment allows forensic pathologists to examine digital representations of real bodies.

digitalautopsy.co.uk



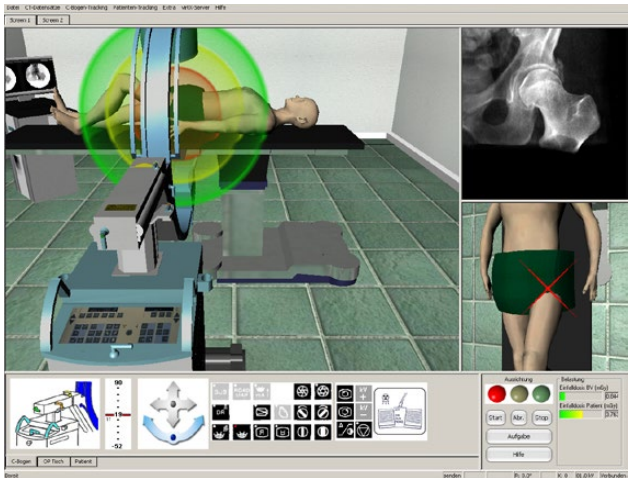
↑ **3D volume rendering of internal organs of a cadaver.** Courtesy of iGene Sdn. Bhd.

↑ **iDASSmart LCD Screen for digital examinations.** Courtesy of iGene Sdn. Bhd.

Peter L. Reichertz Institute for Medical Informatics

The institute uses Open Inventor in their **virtX** and **virtusMED** applications. virtX is a computer-based training system (CBT) for mobile image intensifier systems (C-arm systems), which are used in trauma andorthopedic surgery. virtusMED (Virtual Scenes for Medical Education and Diagnostics) deals with intuitive human-machine interfaces for exploring volumetric medical image data and is usable for education or diagnosis.

virtusmed.info
plri.de



↑ **virtX application.** Courtesy of PLRI.

The computer-based training system virtX provides the user with different exercises of adjusting the equipment and evaluates their execution and the results. These tasks can be created with the help of an authoring tool and can be accomplished by the trainee in a pure virtual mode or a combined virtual-real mode.

In the pure virtual mode the user controls the virtual C-arm in a virtual operating theater via the virtX user interface. In the virtual-real mode however the position and orientation of a real C-arm are mapped onto the virtualC-arm. At any time during an exercise the user can produce a close-to-reality and virtual radiograph built on virtusMED, and can control parameters like the positions of the apertures, X-ray intensity, etc. In the above figure, notice that Open Inventor makes it easy to combine 2D images, volume rendering and polygonal geometry in the same scene. It also makes it easy to get correct rendering of multiple nested translucent objects in the scene.

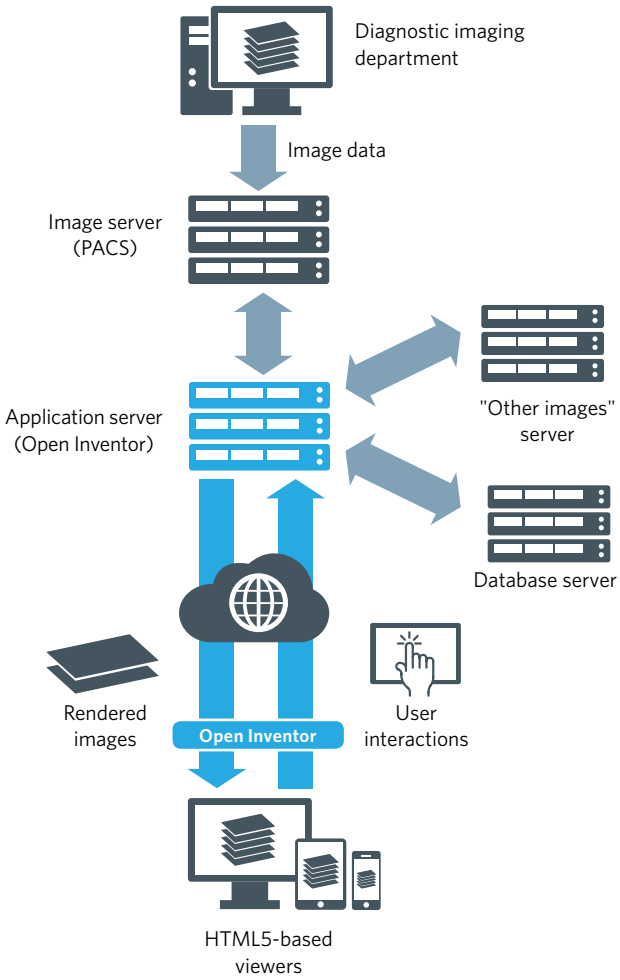
SYAC

Sistemas y Asesorías de Colombia S.A. (SYAC) is the leading software application development company for the public and private health sector in Colombia. SYAC provides **Dinámica Gerencial Hospitalaria**, a hospital information system that allows healthcare professionals to concisely evaluate 2D and 3D images that are stored in a PACS, regardless of the PACS supplier.

Using Open Inventor's 2D and 3D remote rendering capabilities, SYAC is developing an optimized web-based version of Dinámica Gerencial Hospitalaria, allowing a seamless workflow from the radiologist to the doctor.

"We found in Open Inventor a tool that met all our expectations for developing our web-based 2D and 3D analysis software. And beyond the tool, a professional, experienced and committed team of people that facilitated a very good partnership, which enabled us to develop our project and quickly achieve the expected results." Ricardo Pinzón Díaz, CEO at SYAC.

syac.net.co



↑ **Project workflow** of the web-based HIS by SYAC.

Why use Open Inventor Medical Edition

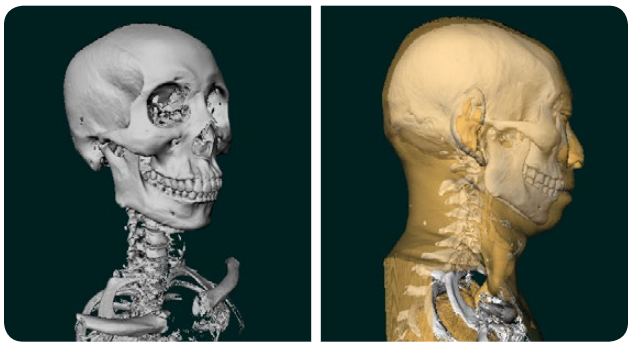
Open Inventor's advanced visualization features are based on treating the data as a 3D volume and taking advantage of the massively parallel computing power of the graphics processing unit (GPU). Operations like MPR, that can be time consuming when working with a classic ''stack of images," can be done in real-time on the GPU.

Slice rendering

Open Inventor supports planar slices with any orientation, plus slices can have any shape, e.g. a curved surface, defined by application supplied geometry. Slices can also have thickness and be displayed in 2D using (for example) MIP or be displayed in 3D as a ''slab''. GPU rendering also allows multi-sample interpolation which gives better image quality than simple linear interpolation.

Surface rendering

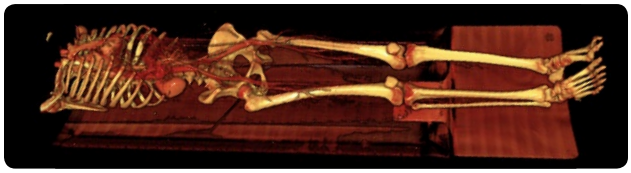
Using the GPU, Open Inventor is able to render surfaces (SSD) directly from the image data, without the need to extract triangles. This allows the threshold value to be modified interactively, making isosurface a powerful tool for exploring volume data. Open Inventor can render multiple isosurfaces simultaneously, each with its own color and transparency, as shown below. It is also possible to extract the actual triangles and export this geometry. .



↑ **Multiple isosurfaces with correct transparency.**

Volume rendering

Volume rendering is implemented using physically correct ray-casting with multiple light sources, shadowing and material properties. Very high performance is possible using the huge number of compute cores available on the GPU to process many rays in parallel. This allows rendering parameters such as window level, color and opacity to be modified interactively even for large data sets. Images can be generated using MIP, MinIP, SumIP, alpha compositing, cube rendering and other techniques.

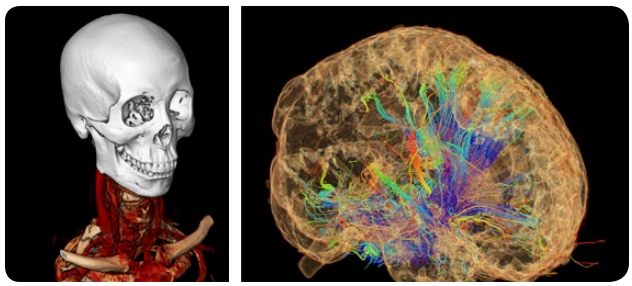


↑ **Alpha compositing.**

Lighting and shading is a critical technique for interpreting complex volume data. Open Inventor has many options to improve both quality and readability of complex data sets. For example edge detection, boundary opacity, shadows and ambient occlusion.

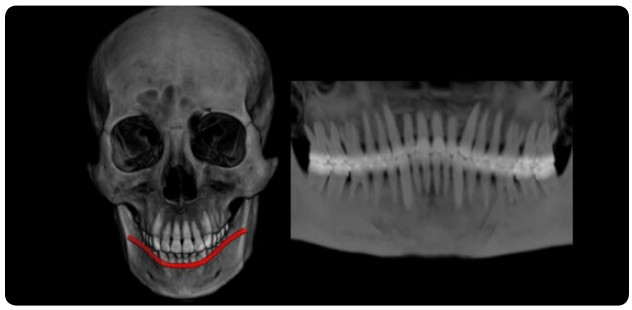
↑ **Lighting enhancement with ambient occlusion.**

The highly configurable rendering pipeline handles complex combinations of data. Multiple volumes from the same or different modalities can be rendered in the same scene (data fusion). Volume masks can be used to apply different transfer functions to different regions of the volume. Volume data and geometry can be rendered together with correct transparency.



↑ **Multiple transfer functions/Volume+DTI geometry rendering.**

The rendering pipeline also allows advanced developers to create custom ''shader'' functions that run on the GPU. These functions can be used to implement proprietary coloring, blending, masking and displacement algorithms.

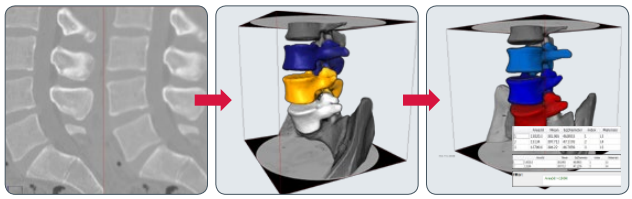


↑ **Custom flattening shader for panorama**

Designed with input from our most demanding customers to allow rapid application development, Open Inventor Medical Edition rendering tools are easy to learn and integrate quickly into your development process. Your developers can focus more on their domain specific expertise and bring effective solutions to market faster.

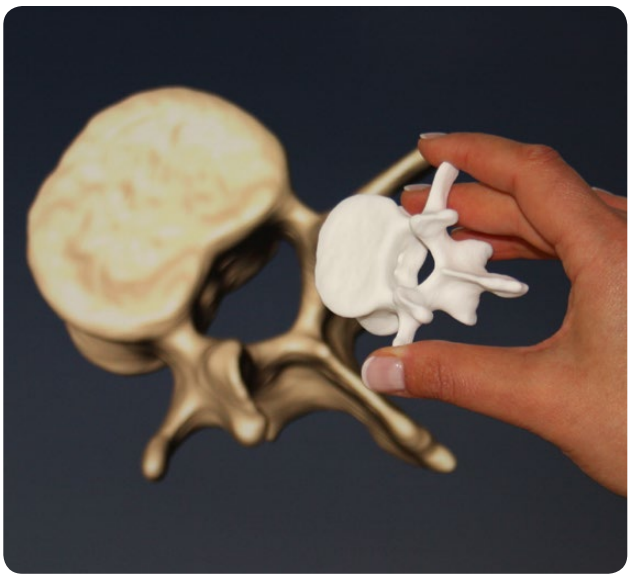
Advanced image processing and analysis

Open Inventor provides more than 300 image enhancement, segmentation and analysis tools for implementing medical image computing workflows. These tools have been optimized over more than 20 years by in-house image processing experts, who continue to add new and improved algorithms.



Filter **Segment** **Analyze**

Image processing includes enhancement tools like sharpening, smoothing and edge detection, but also morphology operators, FFT and distance maps. Open Inventor supports both manual and automated segmentation using tools like adaptive thresholding, watershed and hole filling. Image analysis tools for quantification compute measurements about the segmented data like number, area and volume of objects. Custom measurements can be defined by the application. Image processing tools can be linked together to create processing pipelines. These pipelines can be saved and re-applied to new data sets



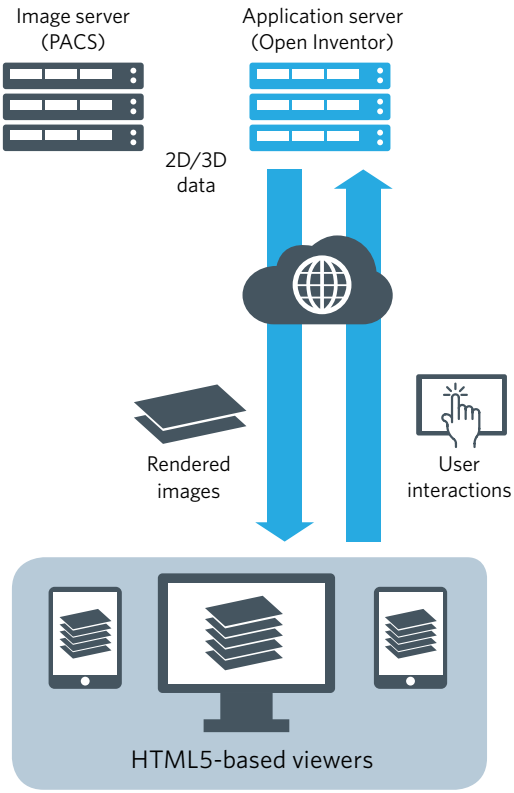
↑ Segmented objects can be converted to geometry and exported directly to STL format for 3D printing.

Interactive remote visualization

Remote visualization allows your end-user to work anywhere with network access while your data remains secure and your application runs on a server located anywhere on your network or in the Cloud. The visualization and image processing power of Open Inventor is available to the application as a web service and Open Inventor efficiently transmits rendered images to the display device(s) and notifies the application of events resulting from the user interactions.

End-users do not need any client software, only an HTML5 web browser. Multiple users can connect to the same server, working independently or sharing a session for collaboration. Users can interact with the application using touch and gestures in addition to traditional input devices.

Remote visualization allows you to add resources on the network to handle growing data and to provide users with more advanced visualization and analysis. Use Open Inventor to add 3D to your web-based application or to evolve your desktop application to web-based access.



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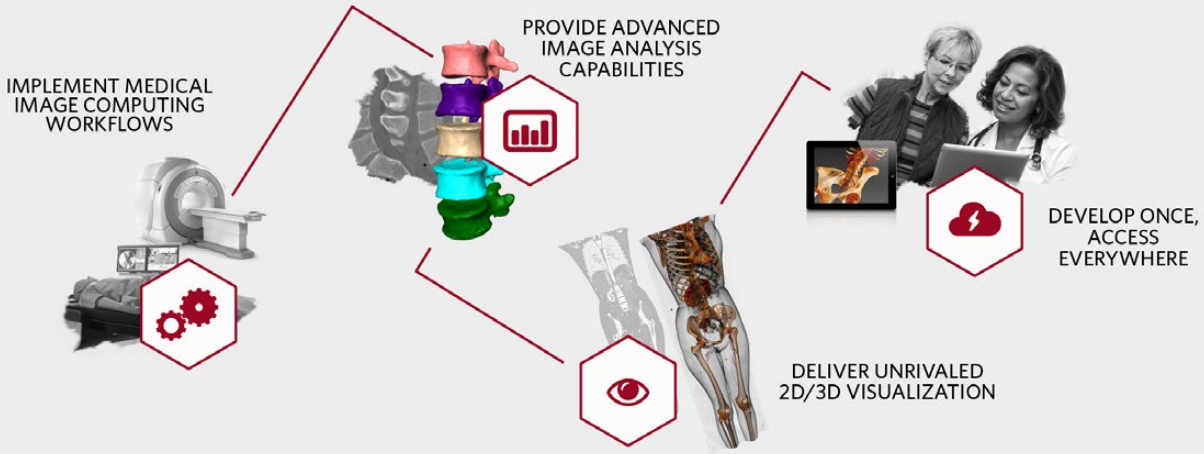

Deliver state-of-the-art 3D

Open Inventor Medical Edition provides the power and functionality of 3D visualization at an object-oriented level. The easy-to-use API, extensible architecture, and large set of advanced components provide software developers with a high-level platform for rapid prototyping and development of advanced 3D graphics applications.

Open Inventor also provides specialized capabilities for the interactive visualization of very large (out-of-core) volume data, advanced image processing and analysis, efficient support for very large cell 3D models, interactive remote visualization, and 3D graphics output.

Build robust foundations

Open Inventor is proven to be the safe choice for the long term and the most flexible tool to transfer technology evolutions and unique innovations to your solutions.

Open Inventor is carefully designed to introduce powerful new capabilities for your application in the most simple, transparent and consistent way, protecting your investment and anticipating needs that you may not even foresee. Last, the interoperability and extensibility ensure your complete freedom to best adapt the toolkit to your specific needs.

Rely on strong support and innovation

Dedicated to serving our customers, FEI brings more than 30 years' experience in 3D visualization. Our support team pays particular attention to the constraints of professional developers, and works closely with R&D to coordinate with your development schedule.

Our Professional Services team is available to increase your efficiency through training, consultancy and custom development covering the whole life cycle of your project: from software and hardware requirements, prototyping, migration assistance, to system deployment and even cooperative R&D.

Open Inventor Medical Edition is available for Windows®, OS X®, Linux.
Languages: C++, .NET, Java™.

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