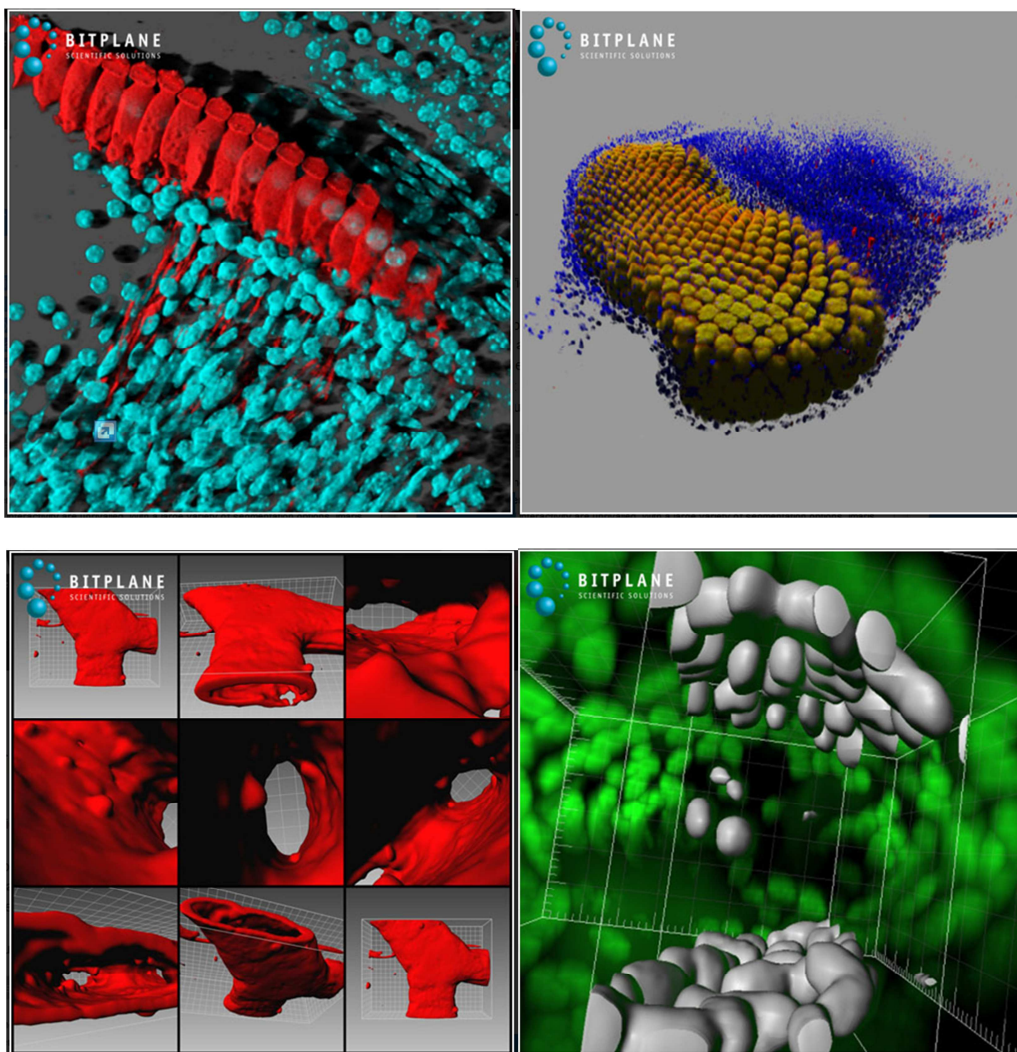


# Imaris 7 (3D and 4D Microscopy Software)

## 3D and 4D Real-Time Interactive Data Visualization

Imaris is Bitplane's core scientific software module that delivers all the necessary functionality for **data visualization, analysis, segmentation and interpretation** of 3D and 4D microscopy datasets. Combining speed, precision and ease-of-use, Imaris provides a complete set of features for working with three- and four-dimensional multi-channel images of any size, from a few megabytes to multiple gigabytes in size. Conveniently load, process and visualize data and images acquired from almost any confocal and wide field microscope to gain new and groundbreaking insight from your image data.



Imaris allows visualization of original and derived data objects in a real time interactive manner so you can quickly make visual assessments of your experiments in 3D and 4D to discover relationships that are otherwise hidden. Its rendering quality, speed, precision and interactivity are unrivalled. With a large variety of segmentation options, Imaris provides you with the most

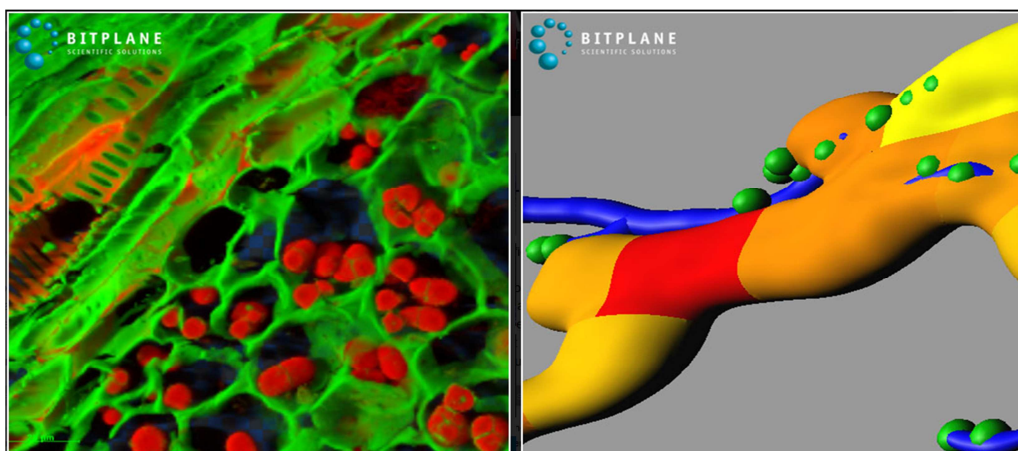
effective tools to segment even the toughest datasets to identify, separate, and visualize individual objects.

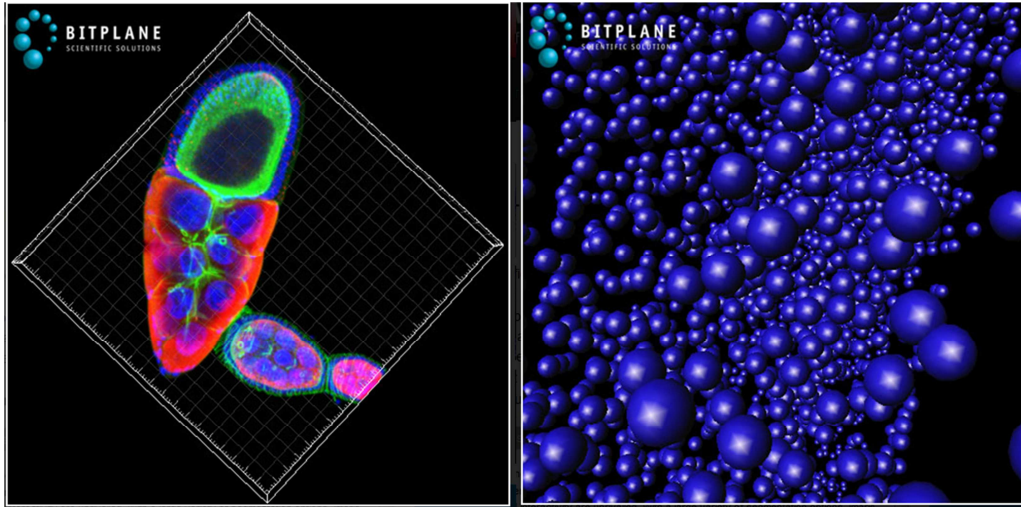
Imaris includes features to communicate and share results convincingly: The "Snapshot" command is a convenient way to export any image view in a standard format that can be used for presentations and publications. The highly advanced "Key Frame Animator" allows intuitive creation of even the most complex movie from 3D and 4D scenes and allows those movies to be saved as a QuickTime or AVI file. The option to generate a QuickTime VR movie is also provided. No other software gives you so much control at so many levels.

- Visualize volume images and objects in real time using a rich selection of rendering modes.
- Automatically or manually identify objects based on morphology, intensity, size and many more parameters.
- Validate segmentation by superimposing objects on the original volume image.
- Interact dynamically with individual objects.
- Create the most impressive pictures and stunning movies and animations for your publication with just a few mouse clicks

The Imaris interface has been carefully designed for the life sciences. Imaris takes away the burden of selecting and managing multiple poorly integrated imaging tools and increases time spent on research. Imaris exploits the latest hardware technologies to put new capabilities at your fingertips.

Since its launch in 1993 Imaris has been installed at hundreds of leading sites throughout Europe, America, and Asia. Imaris has been chosen as the primary tool for image visualization and analysis by individual investigators, core facility managers as well as operators of our [Advanced Imaging Centers](#).





**The following features are available within Imapris:**

- (1) Premier Volume Rendering**
- (2) Surfaces, Segmentation and Interaction**
- (3) Spots, Segmentation and Interaction**
- (4) Interactive, Intuitive; Navigation and Selection**
- (5) Smart Handling of Huge Images**
- (6) Integrated Fiji/ImageJ Plugins**
- (7) Animations and Movies**
- (8) Multithreading & Advanced Computer Graphics**
- (9) Image Editing**
- (10) Time**
- (11) Calibration**
- (12) Topography**

## (1) Premier Volume Rendering

Imaris contains multiple high-class volume rendering algorithms to produce exceptional 3D and 4D images.

- **MIP (Maximum Intensity Projection)** - This projection is implemented in Imaris so that even the largest datasets can be interactively rotated in 3D or 4D space.
- **Blend Projection** – Weights the data that is closer to the viewer, so that on a 2D screen the viewer can get a more realistic 3D impression of the data set and the depth relationship of the objects being viewed.
- **Real-Time Shadow Rendering** - The fast hardware driven shadow projection can produce shadows on the three planes of the “Frame Object” to enhance the realism of the images and introduce additional depth perception.
- **Normal Shading** – Similar in appearance to surface rendering, “Normal Shading” does not require the computation of a triangle mesh. Instead it computes the orientation of the virtual surface from the voxels directly and uses this information to shade the surface appropriately. This allows you to carry out fast and flexible surface rendering for very large datasets
- **Display Adjustment** – The intensity for each color channel in the image can be interactively adjusted in real-time to eliminate background noise and to brighten the image. The gamma for each channel can also be interactively adjusted. For rendering techniques that utilize transparency, this characteristic can also be changed in real time.

## (2) Surfaces, Segmentation and Interaction

The “Surface Object” is a computer-generated representation of a specified region of interest in the data set. This surface object is visualized as an artificial solid object, and allows you to verify the accuracy of segmentation against the original data in an interactive manner. The surface object acts as a container from which statistics can be calculated with the [Imaris MeasurementPro](#) module. “Surface Objects” can also be tracked with the [ImarisTrack](#) module. Surface objects can be generated in the following ways:

- **Automatic Iso-Surfaces** – “Surface Objects” are created on an intensity value on a per channel basis. Selection of the threshold is completely interactive.
- **Automatic Local Contrast Surfaces** – “Surface Objects” are created based on the contrast in the area around the object. This allows the accurate section of objects where the overall intensity may vary within the depth of the image or over time. Selection is completely interactive.
- **Automatic Region Growing** – “Surface Objects” are created by first identifying a region to look in for the objects of interest using either the local contrast or iso intensity methods, then “Seed

Points” are calculated to mark each individual object. The result is that complex images, where the out of focus light overlaps between what should be separate objects, can have the objects split apart and treated individually.

- **Surface Scissors** - Manually split two touching “Surface Objects” along an interactively specified cutting plane. One click separates the objects.
- **Semi-Automatic Surface Generation** – The “Magic Wand” allows automatic global surface creation based on a manually selected ROI. The “Marching Cubes” algorithm allows automatic surface additions only in selected local regions.
- **Surface Visualization** – “Surface Objects” can be visualized with the original data for verification purposes. The surface can be colored any desired color and given visualization properties for shininess and transparency. Visualization color properties can be selected from a predefined color palette or can be custom designed and saved for future use.

### **(3) Spots, Segmentation and Interaction**

The “Spot Object” is available to model point-like structures in the data. Like the “Surface Object” above, a Creation Wizard guides the user through the step-by-step procedure to automatically detect point-like structures, an editor to manually correct detection errors if necessary, and a viewer to visualize the point-like structures as spheres. The advantage of the “Spots Object” is that local maxima can be identified and images with 10’s or 100’s of thousands of objects can be individually identified quickly.

- **Spots** – Like the “Surface Object” the “Spots Object” is an artificial object allowing the comparison between the original data and what has been segmented. Like the surface object, the spots object acts as a container from which statistics can be calculated with the [Imaris MeasurementPro](#) module and tracking can be performed with the [ImarisTrack](#) module. The difference between a “Spot Object” and a “Surface Object” is that a “Spot Object” is always spherical, but can vary in diameter.
- **Automatic Creation of Spots** - Spherical models of objects can be created automatically based on the approximate size of the object regardless of the overall intensity. This is ideal for images that have attenuation of intensity in Z or over time where pure intensity based methods fail.
- **Manual Creation of Spots** – Spots may be manually added or deleted in any image in 3D or 4D by simply moving the mouse over an object and clicking or double clicking. This allows for quick and easy editing if automatic detection has problems or for the possibility to do the work completely manually. Imaris assists the user with spot placement by automatically detecting the correct depth to place the spot into the screen saving the user tremendous amounts of time. When combined with “InMotion”, object identification and segmentation that previously took hours is completed in minutes.

- **Visualization of Spots** - Spots can be visualized together with any of the other available objects and with the original data.

#### **(4) Interactive, Intuitive; Navigation and Selection**

- **Advanced On-Line Interaction With The Object** – Rotating, zooming in and out of the object and flying through the volume in real-time.
- **Kinetic Depth Effect** - Imaris offers a series of motion animation and depth cueing tools that are unique in the microscopy market and enhance 3D interaction. “InMotion” introduces stationary or animated visual elements into the visual data scene to provide a structured frame of reference if needed. The “InMotion” function allows the user to accurately visualize and easily select data in even the most complex 3D or 4D images.
- **Navigation Window** – A Navigation Window displays an overview of the data set in the “Surpass View”. While exploring datasets, you will never be lost because as you move within the data set the overview image updates in real-time.
- **Filtering** - The “Object Filtering” is incorporated into the creation process of surfaces and spots enabling the composition of filters consisting of several criteria and interactive visual feedback on parameter selection.

#### **(5) Smart Handling of Huge Images**

Imaris provides smart handling of huge data sets (50GB or more), that exceed the available main memory, e.g. on computers with only a small amount of RAM or when using a 32 bit operating system. This allows for the processing of images in Imaris where other programs completely fail.

- **Block-Wise Paging** – The handling of huge data sets is based on the principle that only the parts of the dataset and the resolution of the dataset needed for the actual view are loaded to RAM and displayed. This principle makes the most efficient use of RAM memory space.
- **Processing** - Load, open and render huge images instantaneously and easily. If the computer system has multiple hard disk drives, Imaris can use all of them in parallel to transfer data that cannot be held in RAM or graphics memory. This results in improved performance for the largest datasets.

## (6) Integrated Fiji/ImageJ plugins

Imaris provides Fiji/ImageJ compatible plug-ins aimed at performing additional image processing. Fiji/ImageJ offers a solution for specific problems with image analysis and boosts the analytical capability of Imapris.

- Fiji/ImageJ is integrated into Imapris and can be executed from within the application.
- Use your current Fiji/ImageJ routines while working within the Imapris structure
- Enhance and extend the functions of Imapris with Fiji/ImageJ plug-ins
- Customize the Fiji/ImageJ menu by integrating new plug-ins into Imapris - grow and and expand your analytical capabilities
- The list of available plug-ins is organized into familiar ImageJ menu structure. Each plug-in collection is displayed as a sub-menu on this list.

## (7) Animations and Movies

Imaris allows for the simple and straightforward creation of movies from simple rotations to complex animations with objects being turned on and off or cut away and fly through's being performed.

- **Key Frame Animation** - The “Key Frame Animator” allows creation of a movie from key views (key frames) in the image. It interpolates frames between the user-defined views to create a smooth movie with only a few keystrokes. Simply move the image to the desired position and press the add button to build a movie quickly.
- **Generate Storyboard** – The “Key Frame Animator” stores object visibility states, such as brightness and contrast, color, “Clipping Plane” position and more, in addition to the camera position and the time point. This feature allows the generation of small storyboards and creation of complex movies.
- **Pre-Defined Rotations** – For those that want a simple movie, just click one of the pre-defined movie buttons to make a simple rotation about a given axis.
- **Share Your Results** - create movie files on any platform and easily export these 3D and 4D movies as a QuickTime, AVI, MPEG or Flash files with the press of a button. The frame rate and compression settings can be easily controlled.
- **QuickTime-VR Movie** – Record a QuickTime-VR movie of anything that is displayed in the 3D view of Imapris. A QuickTime-VR allows the 3D interactive rotation of the resulting image by anyone who has QuickTime outside of Imapris, allowing easy collaboration with other researchers.
- **Z-Movie** – Record a simple movie of playing up and down through the different focal planes of your Z stack.

## (8) Multithreading & Advanced Computer Graphics

The speed and performance of Imaris is enhanced through the use of advanced computer graphics and multiple processors / cores. Using a top-of-the-line computer graphics card allows visualization tasks to be completed at a much faster rate, which can be especially convenient for larger datasets. Utilizing multiple processors or multi-core processors can significantly speed calculation times.

- **Multithreading** – Imaris is able to utilize multiple cores and / or multiple processors to significantly improve the speed and performance of the software. Most image processing functions and object creation (segmentation) steps are capable of utilizing multiple threads. You can set the number of cores or processors that Imaris can use.
- **High Resolution Rendering** - Imaris allows creation of high-resolution images, larger than the resolution of the computer screen for use in publications and poster production.
- **Hardware Driven Computation** –Shadow Rendering and most other visualization processes are computed by the graphics processing unit (GPU) to improve the performance of Imaris.
- **Selective Clipping Planes** – The “Oblique Slicer” selectively cuts away objects on one side of the plane. It can be freely moved and rotated in the scene and allows you to look inside any object at any angle and any depth.
- **Multiple Light Sources** – A “light source” serves to illuminate objects in the viewing area and gives a more 3D appearance through shadows that are cast and reflections on the object for an image presented on a 2D screen. Applying multiple light sources to your image creates spectacular 3D objects because it highlights fine surface details that may otherwise be hidden.
- **3D Holographic Rendering Modes** – Imaris is capable of rendering images on a 2D screen so that they may appear 3D to the human eye. The Red/Cyan Anaglyph mode allows 3D viewing with Red/Cyan glasses. Interleaved or Quard Buffered modes allow for use of the software with 3D shuttered glasses.

## (9) Image Editing

One of the key strengths of Imaris is its usability. Automation and hidden image processing intelligence allows users to focus on experiments rather than on the technicalities of the software. However, if more control over the software is needed, Imaris provides the necessary tools to edit datasets manually but effortlessly. The combination of all these tools, which take a matter of seconds to use, will result in a dataset that can provide amazing pictures.

- **Basic Editing** – Imaris allows the addition or deletion of channels, slices, and/or time points.
- **Re-Sampling In Space And Time** – Data sets can easily be re-sampled. Re-sampling in 3D reduces the voxel density in a data set, re-sampling in 4D total reduces the number of time points.

Resampling can happen before the data set is opened or once the dataset is already open in the program and therefore speeds up image data processing.

- **Free Rotation tool** - If your 3/4D image stack was acquired from a less than optimal point of view, for example due to unfortunate embedding and positioning of the sample, it can now be arbitrarily rotated in three dimensions. By resampling the image along your preferred axis of view it is now possible to access all the hidden information of your specimen's rendering. This may help you freely reorient your sample in 3D so that all your samples have identical orientation when it comes to comparing various samples between different experiments.
- **Crop Images In Space And Time** – Cropping the data set in 2, 3 or 4D allows re-sizing of the images down to a region of interest (ROI), making it easier and faster to handle the viewing and storing of the images. The total number of time points can be reduced at the beginning or end of the series of images. Cropping of the dataset has a real-time preview and can be completed both before opening a dataset or once a dataset has been opened.
- **Subregion Processing** - By setting a customized subregion Imaris can remain interactive even when working on very large images. Interactively define the subregion in a 3D view and create Spots and Surfaces only within one or more sub ROIs. Once all the correct processing parameters have been determined for the sub region(s), the algorithms can be automatically run on the entire dataset.
- **Volume Painter** – Drawing disks, spheres, or hollow spheres into the selected image channel, Imaris uses the “Volume Painter” to manually clear selected areas in the volume image. Additionally, the “Volume Painter” allows adjustment of the voxel intensities before segmentation is completed with Surfaces, Spots, or Filament Objects.
- **Image Processing Tools** - Imaris contains several basic image-processing tools to aid in basic visualization and image analysis. These tools include 3D Gaussian and Median filters, Baseline and Background Subtraction, and Threshold Cut-off, all which can be used to refine the dataset.

## (10) Time

For 4D data, a simple to use time-slider extends all 3D functionality to 3D + time (4D). Imaris memory management and caching mechanisms allow processing large datasets and achieving extraordinary visualization performance. Often images can be rotated in real-time in 3D as they play over time.

- **Loading** – Time based images (2D+Time or 3D+time) can be loaded from all native file formats as well as TIFF and BMP images. If time stamp calibration is available with the original image it is utilized. Users have the option to time code non-calibrated images within Imaris.
- **Time-Slider** – The Time Slider is visible in all display modes (Slice, Section, Gallery Easy 3D, and Surpass). It allows viewing of a particular time point or to automatically play images through time simply by moving the time slider or pressing the play button
- **Identical Interface** - All visualization, image processing, display adjustment, segmentation, and object creation steps can be carried out in the exact same manner on 4D images as they are on 3D images.

## (11) Calibration

Imaris always displays the correct aspect ratio of all pixels or voxels (a pixel with depth) in an image regardless of the view. Images are automatically calibrated if calibration information is present in the native file format. Alternatively, the user can calibrate the image by simply entering the size of each voxel in the program.

- **Scale Bar** - Imaris includes an automatically adjusting scale bar that is present in the “Slice”, “Section”, “Gallery”, and “Easy 3D” views. This scale bar can be resized and moved interactively based on each user’s needs.
- **Grid** – In the Surpass view a grid behind a 3D image can be turned on to provide information about the size of its structures. The properties of the grid can be edited to change color, grid spacing, font, shading, etc.
- **Image Axis** - The image axis can also be displayed to simplify orientation of the data set.

## (12) Topography

The “Topography Object” is a 3D relief representation, created from a 2D input file that contains intensity coding represented in the height data of the relief representation.

- **Input File** - The input file can be an ordinary TIFF file or a selected slice of a 3D data set.
- **Topography** - An independent texture can be overlaid on the relief image to colorize the representation.