iQ imaging software

conduct an imaging symphony

discover new ways of seeing™
core software and modules:

**Andor iQ Core**

- Extensive hardware control – filter wheels, motorized microscopes, confocal spinning disk.
- Optimized for EMCCD technology
- Extensive and flexible multi-dimensional acquisition, analysis and visualization
- Accessible wizards for protocol set-up
- Applications include:
  - Time-lapse fluorescence microscopy; FRAP/FLIP; Ion signalling;
  - Single molecule microscopy; GFP; Gene expression; luminescence;
  - Immunofluorescence microscopy;
  - Full camera frame rate synched with fast wavelength switching
  - z-sections at ~ 30/sec
  - Ratio analysis, including 'Dual View'
  - Applications include: Fast 4/5D Microscopy; Ca²⁺ ratio; FRET...

**Fast λ/Z**

- Full camera frame rate synched with fast wavelength switching
- z-sections at ~ 30/sec
- Ratio analysis, including 'Dual View'
- Applications include: Fast 4/5D Microscopy; Ca²⁺ ratio; FRET...

**ClearView**

- Image blurring and haze reduction
- Deconvolution of 3D, 4D and 5D data
- Handle huge data sets

**Tracker**

- Fully automatic and interactive motion analysis
- Multi-channel image management
- Comprehensive data analysis options for display of displacement speed and direction
- Overlay track presentation
- Applications include all motility and single molecule tracking

**Multi-field**

- Capture and stitch multiple fields
- Control of motorized stages
- Autofocus to enhance performance over long-term studies

**Multi-well**

- Capture and analyze data from wells of microtitre plates
- Control of motorized stages
- High content screening
- Drug dose response testing

Andor is available as core software and one of five modules depending on your application needs
**iQ imaging software:**

**Introduction**
Andor iQ is our flagship live-cell imaging software, designed with flexibility and power in mind. iQ – image and quantify – occupies a central role in our Revolution product range and provides optimized control of Andor’s award winning iXon EMCCD cameras and automation hardware for a range of Bioimaging applications. Continuous development and improvement ensures that Andor iQ represents a powerful and flexible core for live-cell imaging systems.

The software is in use in a wide range of applications, including confocal spinning disk imaging, TIRFM, intra-cellular ion imaging, gene-expression monitoring with GFP derivatives and Luciferase reporters, cell motility and protein-protein interactions. New applications are evolving as scientific enquiry demands.

**Key Benefits**
- **Power and flexibility** - Andor iQ the choice for building or enhancing systems.
- **Multi-dimensional core** - Time-lapse, 3D, 4D, 5D and 6D imaging.
- **Fast 4D imaging with hardware synchronization** up to 100 sections per second.
- **Z-series imaging** - deconvolution and 3/4D rendering module.
- **Capture and visualization of multi-fluorescence or DIC/phase-fluorescence.**
- **On-line data charting** - for single, multi-channel, ratio and FRET imaging.
- **Multi-field support (6D)** - enhanced experiment statistics and/or Montage.
- **Multi-well plate support** - multi-treatment or dose response live-cell work.

*Figure 1.* Courtesy Dr Paul Thomas, UEA, Norwich, UK. Ratio Imaging – A triplet of HEK cells show heterogeneous response to Ach stimulation.

*Figure 2.* Courtesy Dr James E. Bear, Lineberger Comprehensive Cancer Center, NC. Rat2 fibroblast expressing Pod-GFP (green) stained with phalladin (red).
**Multi-dimensional memory management:**

**Multi-dimensional at its Core**
Andor iQ is multi-dimensional at its Core. This means you can handle multi-channel, time-series, Z series and multi-field data with consummate ease. iQ provides easy to use tools for analysis, processing, visualization and management of live cell experiment data and “understands” dimensionality, so navigating and manipulating complex data sets is instant and interactive.

**Handle huge data sets with ease**
Andor iQ is built to handle huge data sets seamlessly with ImageDisk™ technology. ImageDisk™ has been developed and proven over more than ten years and is at the core of iQ’s multi-dimensional memory management. ImageDisk™ extends your system memory to include fast hard drives and even RAID arrays so that you are never limited by RAM.

A smart, pre-emptive disk swapping algorithm monitors memory levels and current frame requirements during all acquisition and processing operations. It avoids Windows™ file swapping and handles frame access seamlessly, making sure the data you need is always available. GB data sets are no longer a problem to acquire or manipulate and visualize.
powerful wizards help with settings and configuration:

- Channels Wizard lets you manage illumination and imaging for any illuminant, fluorescent or brightfield imaging configuration.
- Scan Wizard creates XY and Z Scans.
- Protocols define control acquisition sequence, timing, triggering and event monitoring.
- Rapid Setting and Protocol editing via right mouse click pop-up menus.

- Create and manage experiment acquisition protocols for easy re-use and sharing.
- Z-offset between channels to compensate for optical chromatic errors.
- Control and synchronization to external hardware via programmable Trigger and Event interface (PCB).
- Integrate with Electrophysiology Perfusion, Flash Photolysis and FRAP Solutions.

Figure 5. Protocol tree shows acquisition sequence control and enables easy editing of parameters.

Figure 6. Precision Controller Box (PCB)

Figure 7. Courtesy Drs. Dmitriy Fayuk and Jerry Yakel’s Neurobiology Laboratory, NIEHS, NC. Andor’s iXon 887-BV and iQ software is used to image calcium with Fura2. Dr. Fayuk studies neuron receptors in brain sections and cultures to elucidate processes of addiction. In this example a cultured neuron was patch-clamped and an iontophoretic electrode used to generate a 50ms Choline injection (200nA) at the spot shown. Synchronization to electrophysiology apparatus is achieved with Andor’s iQ software and Precision Controller Box (PCB).
powerful processing:

**On-Line Analysis and Charting**
- On-line Data is continuously streamed to a disk file. Charting of multi-channel, multi-region, multi-field or multi-well studies is possible, with optional ratio mode.
- Histogram analysis of multiple user-defined regions of interest.
- Line profiling for single or multi-channel image data on Live or stored data.

**High Performance Off-line Processing**
- Ratio analysis for dual channel analysis, time-series pairing and self ratio (with standing level from first n frames).
- Background correction and Mask image can be used to reduce noise in low signal regions. Ion concentration calibration options using either Grynkiewicz or Almers-Neher methods for ratio dyes.
- Kymograph tool allows oblique line and polyline probing of multi-dimensional data, with preview. Now with "Lamella" mode for protrusion/contraction rate analysis.
- Dual field splitting and alignment tool to allow analysis of simultaneous captured two or four channel data. Now with live-field subtraction alignment tool.
- Multi-dimensional Math – difference, average, encode and projection processing.
- Ergodic averaging – improve SNR from repetitive signal acquisition and processing.
- Photobleaching compensation - minimizes effect on analysis results or visualization for AVI (movie) creation.

![Image 1](image1.png)

**Figure 8.** Courtesy Dr. Tom Blanpied, UMD. 4D maximum intensity image with pseudo-color shows live neuron labeled with quantum dots.

**Figure 9.** Courtesy Dr. James E. Bear, Lineberger Comprehensive Cancer Center, NC. Still image from a time-lapse movie of a Rat2 fibroblast (left) with kymograph lines marked in red (1-6). Corresponding kymographs or time-space plots (right). Kymographs give detailed information about lamellipodial dynamics.
targeted analysis tools and flexible plug in architecture:

- Plug-in architecture allows for in-field updating and access to new processing modules as they become available. This structure replaces our legacy product, Lucida, as all previous functionality is migrated to the newer IQ software architecture. We now offer IQ-WS to function on satellite workstations. We are already planning a future with scripting to allow automation of many processing and analysis tasks.

- Andor's ClearView Deconvolution product is supplied as a plug-in option and provides powerful constrained iterative algorithms for image resolution enhancement, haze removal and preparation of wide-field microscopic images for 3D/4D visualization.

- ROI Feature definitions enhance ROI data manipulation and interpretation.

- Thru-series analysis – Region-based, time, Z or spectral dimensions. Analyze single or multi-channel image data with optional background correction.

- Text and Dimension stamp overlays for monitoring and export of data.

- Extend analysis dynamic range - “greys per second” mode.

- Co-localization analysis of multi-channel, RGB image data.

- Tracking - automatic and interactive tools for monitoring motion.

Figure 10. Deconvolution – mouse gut epithelium before and after treatment by ClearView. Two-channel data acquired in widefield on a Zeiss Axiovert 200, with a plan-apo 100X/1.4NA oil immersion objective. Standard specimen from Invitrogen/Molecular Probes.

Figure 11. Segmentation constrains values for analysis.
multi dimensional views and imaging options:

Multi-channel Views, Voxel Rendering, Orthogonal Viewing and Support for Confocal Instruments
Andor iQ offers powerful visualization tools as standard, with 3D, 4D and 5D capabilities. Raw data from 3D, 4D, 5D and 6D acquisition protocols, can generate image data fast and iQ provides powerful tools for rapid data visualization and analysis.

- Navigator - Explore the data with a multi-dimensional movie player interface and lets you view multi-channel data in overlay mode, merging imaging modes required.

- MC View - View and manipulate multi-channel data in an overlay mode. Channel contrast and balance are individually user-controlled.

3D/4D Viewer
Voxel renderer – methods - maximum intensity, minimum intensity, opacity blending and first pixel on ray trace. Options include:
- Zoom
- Intensity range
- Multi-channel with scaling/mapping to enhance features and study spatial coincidence.
- Wire-frame dragging adjusts angle of view.

- Animation method interpolates between user-defined key frames (and Zoom and Time points for 4D data) to create a movie.
- Export to AVI files through the movie editor.

OrthoView and Kymograph
Create orthogonal and oblique slices through multi-dimensional images and visualize as images. Kymograph allows Tracking of waves and features, and new Lamella mode enables extension/contraction rate analysis of e.g. filopodia and ruffling.

Figure 12. Courtesy Dr Rachel Errington, Medical Biochemistry, UWCM, Cardiff, UK. Single section and voxel rendering of a 3 channel zseries, acquired on a BioRad confocal instrument, viewed in multi-channel mode in iQ software.

Figure 13. Kymograph of floating point ratio image.

Figure 14. Orthogonal Viewer - new
**Strip View**

Film strip view of multidimensional images. Control frame size, number of columns, selected dimension, range and increment between frames, border color and width. Images can be shown with dimension stamps e.g. time of acquisition or Z-depth.

**Montage Imaging**

iQ-MF module includes a Montage scan mode. Strip View lets you visualize the montage of large specimens acquired at high power, as shown in the figures.

iQ-MF imaging also allows time-lapse recording from multiple fields of view, so that data can be gathered on a large number of cells, or multiple treatment groups, increasing ‘n’ for statistical analyses or speeding experimental throughput or both.

**Movie Editor**

A multi-dimensional file-handling interface for Windows AVI files. Choose start-end frames and animation dimension to create focus, spectral or time-series movies. Movie Editor provides ROI, overlay and multi-channel options to simplify production of presentation data.

**File-import-export capabilities**

- AVI - images from iQ can be exported via Windows CODECS for Powerpoint etc. Andor iQ will read AVI files.
- BioRad - file format support for confocal and multi-photon microscope systems.
- TIFF - most single frame and multi-frame formats supported.
- Zeiss LSM - multi-dimensional file support for the Zeiss LSM 510 confocal instruments.

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**Figure 15.** Courtesy Dr Iain Johnson, Invitrogen, Eugene, OR. Cultured neurons were loaded with DiSBAC2(3), a voltage sensitive dye and visualized with the Revolution 488. Exposure time of the iXon 887-BV was 100ms and EM Gain 200. The figure shows a film strip from Andor iQ of maximum intensity projection time series. Time point 4 is taken almost simultaneously with the addition of KCl, which depolarizes the cells and shows a near instantaneous rise in DiSBAC2(3) signal. ΔF of almost 45% is observed in this example. Imaged at The 3D Microscopy of Living Cells Course, Vancouver 2005.

**Figure 16.** Courtesy Dr Stephen Goodall, Leicester University, UK. Montage scanning is included in the iQ-MF module. This montage of a blood vessel section was created from 108 (12x9) fields. Raw data was acquired with iQ-MF controlling an iXon DV885 EMCCD camera and Ludl Biopoint stage on an Olympus BX61 with 20X/0.5 NA objective. Specimen was immuno-fluorescence labelled for elastin and also shows auto-fluorescence of collagen, when acquired with an FITC filter set.

**Figure 17.** Courtesy Dr Lance Prince’s lab in Pediatrics, UA Birmingham, AL. Transmission/relief contrast image of a portion of a live lung explant. The image was acquired with a 20X, 0.5 objective and Zeiss Axiovert 25 microscope. Dr Prince is studying lung development in live explants to better understand fetal lung development and pathology. Andor iQ hosts his live cell imaging system.
extensive hardware support:

Reconfigure your existing hardware or build new according to budget and technical requirements:

**Support for Scientific Grade CCD Cameras**
Cameras can be supplied for bright field, fluorescence and luminescence. Andor EMCCD, Hamamatsu, Roper Scientific, PCO, Q-Imaging.

**Support for Leading Confocal Spinning Disk Adapters**
Yokogawa CSU 10 and 22 (Revolution systems) and Olympus DSU.

**Andor's Solid State Light Source Technology with AOTF or Direct Modulation**
Lasers and LED illumination systems - fast switching, minimal sample exposure.

**Filters, Filter Wheels, Shutters and Emission Field Splitters**
Chroma and Semrock, Sutter Instruments, Ludl Electronics, Prior, Uniblitz, Optical Insights and Cairn Research.

**Monochromator Control for Fast Switching Excitation**
TILL Photonics, Sutter and Cairn Instruments.

**Motorized Stages**
Used for multi-field or multi-well plate imaging. Prior, Marzhauser, Ludl, ASI, Madcity Labs, Physike Instrumente.

**Automated/Motorized Microscopes**
Olympus - IX81, BX61; Zeiss - Axiovert, Axioplan; Leica - DMRE and DMIRE; Nikon - TE2000 and E1000.

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**Figure 18.** Dr. Zhang Hui, researcher in the lab of Dr. Peixuan Guo at Purdue University, IN, uses an Andor system with prism TIRF imaging of single molecule RNA complexes. Andor IQ controls Andor’s ALC-102 dual line laser source and iXon 887-BV for ultimate sensitivity and performance. “The Andor system provides the highest sensitivity and is the best on the market for our work with biomotors” says Dr. Guo who is a leading authority on bio-nanotechnology.

**Figure 19.** Dr. Ralph Albrecht and his research colleagues, Angki and Rainer, acquired Andor IQ and iXon 887-BV which has boosted the performance and power of their Zeiss-based CARV system. “There is delight obvious and the results are outstanding...” according to Ralph.
andor revolution:

A Family of Products

Andor Revolution provides a framework for our laser spinning disk, live cell confocal microscopy solutions, which combine our own award winning iXon EMCCD camera with the renowned Yokogawa CSU 10 and 22 units “inside”. Andor has a global distribution agreement with Yokogawa Electric Corporation, to integrate powerful confocal solutions. This partnership brings you unrivalled performance, product understanding and support. Revolution encompasses a range of components, both hardware and software that fit seamlessly together creating a complete confocal microscopy solution. A flexible component focus also allows us to provide key pieces of hardware stand-alone. We want to tailor solutions matched to your needs.

At the core of the Revolution systems is Andor iQ, which synchronizes iXon EMCCD cameras with the CSU 10 or 22 confocal spinning disk and other key hardware components such as Piezo Z100 z-stage and our SS Laser Combiner with AOTF for rapid laser line selection.

Our recommended microscope platform is the Olympus IX81, optimized for live-cell imaging, but customer supplied instruments from Olympus, Leica, Nikon or Zeiss can also be supported.

To find out more visit www.andorbio.com or contact your local Andor sales engineer.