

DeltaVision®

3D Image Restoration and Optical Selectivity

INTRODUCTION

The wide-field imaging capabilities of the DeltaVision's industry-acclaimed 3D Image Restoration process combined with the most advanced light delivery system in the industry produces the world's most admired fluorescence images. DeltaVision's image quality is widely documented and quantifiably validated in major peer-reviewed journals and core research labs worldwide. DeltaVision images are regularly selected for the covers of many major journals. DeltaVision has been established as the leader in high-resolution fluorescence imaging.

3D IMAGE RESTORATION

Contrast and resolution in microscopes are limited by the amount of information that the objective lens can collect. This loss of information results in images that do not fully express the location and concentration of signals in the actual sample. Deconvolution is a mathematical treatment that restores the contrast and resolution lost in the microscope to generate an image that more closely represents the original sample. Applied Precision has pioneered the application of deconvolution to live cell imaging and, as a result, many companies sell deconvolution software for virtually any microscope. However, it is not enough to merely apply a deconvolution method to images from the microscope. The deconvolution system must be designed as a whole in order to obtain the highest quality images and data. The DeltaVision High Resolution Imaging Systems are designed from the ground up for deconvolution and the results are obvious.

Light collected from a wide field system comes from points outside the focal plane, due to out-of-focus blur. This blur is unique for every optical system. By carefully measuring and monitoring that blur, deconvolution can generate a more accurate image of the intensities of the signals and their actual locations.

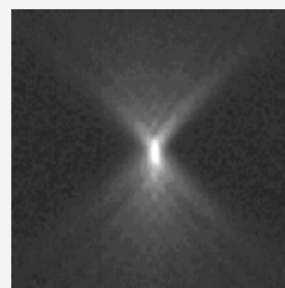
DeltaVision RT utilizes the industry's finest 3D Image Restoration algorithm and delivers high contrast images that are numerically accurate. The DeltaVision 3D Image Restoration algorithm is one of the fastest available – 512 x 512 x 64 in under 22 seconds!

OPTICS

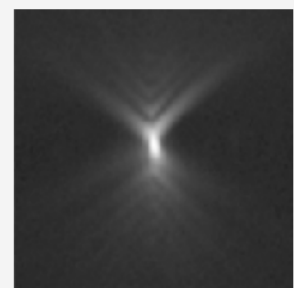
The best image starts with the best optics. Applied Precision hand selects objectives that are optimally suited for 2D and 3D imaging. Only the objectives that pass strict performance criteria (over and above manufacturer's specifications) are approved for use on a DeltaVision system. Specific criteria include: astigmatism, spherical aberration, and axial skew.

Internal Skew Test

These X-Z views of an imaged bead are from our internal skew test. The objective that produced the image on the right, although fine for normal resolution applications, is rejected due to the artifact it would create in high resolution biological imaging.



Good Objective



Rejected Objective

The image of an ideal object (a bead) is also used to create the Point Spread Function (PSF). As seen in the previous image, the blur of light in three dimensions is obtained for the optical system and used to calculate what the object looks like.

$$\text{Image} = \text{Object} \otimes \text{PSF}$$

$$\text{Object} = \text{Image Deconvolved with the PSF}$$

Only with excellent acquired images, however, will the output of the 3D Image Restoration process be ideal. The DeltaVision High Resolution Imaging Systems are uniquely designed to acquire the highest fidelity 3-dimensional images.

All Image Restoration Processes Are Not Equal!

While other systems merely deblur the image and provide simple smoothing operations to sharpen the image contrast, DeltaVision's sophisticated constrained iterative algorithm enhances the image contrast while actually increasing the numerical accuracy of the image. No data is thrown away. This algorithm has been quantitatively verified (Swedlow et al, PNAS 2002) to accurately represent the original 3D object.

To minimize spherical aberrations, DeltaVision utilizes a specialized set of immersion oils that have been optimized for a range of NAs (numerical aperture). An NA "calculator" is provided to help the user pick the right oil for each experimental condition, objective lens, coverslip, sample type, etc. By reducing the effect of aberrations, the positional integrity of the collected light is preserved. This fidelity of the collected light is integral to creating high quality images.

The highest resolution 3-dimensional images require particularly close attention to every detail...

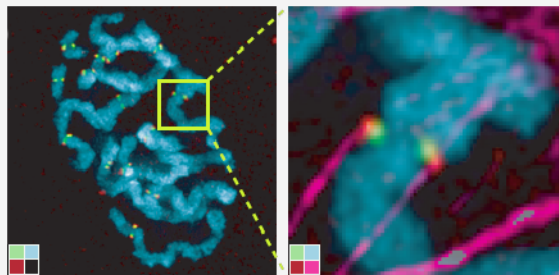
...details that come standard in each DeltaVision High Resolution Imaging System...

...the leader in high-resolution fluorescence imaging.



3D Projections

These are 3-D projections of deconvolved images of mitotic PTK cells that were stained with antibodies from patients suffering with CREST to visualize kinetochores (green), APC protein antibody (red) and DAPI (blue). Staining of APC was also observed at centrosomes, which were located to the left and right of the chromosomes in these images.



■ CREST ■ APC ■ DNA ■ Tubulin

Images courtesy of Nature Cell Biology