



xRez Studio Explores Depth of Gigapixel Imagery for Visual Effects Production

xRez Studio is continuing to further the art and science behind panoramic gigapixel photography by recently launching a visual effects division, offering a production methodology for creating state-of-the-art, high-resolution virtual backgrounds for visual effects work. Taking gigapixel photography beyond an academic research topic and into a real production environment, xRez Studio provides gigapixel shooting expertise, efficient post-production of the images, photogrammetry of image elements, very high resolution high dynamic range acquisition, and 3D animation sourced from the images.

The xRez photographic process generates extremely high-resolution images up to 150,000 pixels wide, far surpassing feature film standards and 900 times larger than an IMAX frame. Gigapixel imagery refers to the amount of pixels or effective detail in an image, with one gigapixel being comprised of over 1,000 mega pixels. A standard digital camera produces around 10 megapixels, but the typical 2 to 14 gigapixel image created by the xRez production process contains anywhere from 100 to 1000 times greater resolution. In their methodology, a gigapixel image is created from a mosaic of anywhere from 300 to 800 overlapping images that are unified to form one complete, massive image that is astoundingly rich in texture and minute detail.

xRez Studio has recently completed an unprecedented library of over 270 gigapixel images of 34 major US cities for licensing as backgrounds by the visual effects field (a new version of a scenic backing or matte painting service). The shots in the collection were taken from a variety of dramatic urban vantage points, which can provide the foundation for virtual cinematography, modification of weather, light, or even the character of the space when applied to visual effects work. Adding an underlying layer of 3D geometry of terrain or structures present in the image allows creative integration of further CGI elements. Gigapixel image backgrounds offer vast new creative opportunities for projects relying on digital matte paintings or 3d environments.

xRez Studio's core expertise stems from their long experience at creating 3D digital environments, having contributed to several leading feature films while at many top tier VFX facilities. The studio's work with gigapixel images originally sourced from the intention to capture a variety of commonly used shooting locations around Los Angeles in high resolution for digital backlot purposes in visual effects shots. Considering that a DP may demand a very long lens within a virtual environment, the mathematics quickly demand a gigapixel level of required spherical image size. The gigapixel images themselves can provide a substitute for live action establishing shots in some cases, especially where accommodation of a standard film crew is limited or challenging in remote locations.

However, the real potential exists in unifying the gigapixel image with derived 3D geometry of a scene. Using DEM terrain data, photogrammetry, or LIDAR scans, one can establish very detailed hybrid 2-1/2 D spherical images of existing locations that provide a rich starting point for shots integrating CG characters or elements into the scene. xRez has developed a range of custom techniques which integrate the gigapixel images into the standard professional 3D applications and renderers. xRez has augmented the workflow with proprietary tools for streamlining the integration in a production setting.

xRez Studio produces the gigapixel images by using a specialized programmable motion-control camera rig, which can manage the fine precision and accuracy required to shoot up to 800 individual, carefully overlapping images. Programming the motion-control instructions for a given shoot is pre-visualized in Maya in 3D. Once taken, the images are then stitched together using gigapixel-capable panoramic stitching software to consolidate the array of shots into a single massive image.

The studio employs off-the-shelf professional SLR camera rigs such as the Canon EOS 5D, due to its light weight and large sensor, but have recently employed the world's largest digital camera system, the 39-megapixel Hasselblad H3D to both increase capture speed and raise the ultimate limit of resolution. A variety of unique camera mounts have also been developed by the studio, including a large custom pole mount to hoist the motion-control rig to higher ground elevations or out into exposed locations.

xRez Studio can shoot either "high-density narrow field" images that utilize very long telephoto lenses to maximize the given resolution into a standard field of view, as well as creating fully spherical panoramic shots, capturing an entire 360-degree environment which spreads the high resolution equally throughout a sphere surrounding the camera. Either offers

a wealth of resolution, but the narrow field is more commonly used when an extreme zoom of the image is desired, whereas the spherical image can be used as the basis for virtual cinematography and 3D visual effects shots.

Using the panoramic image as the basis for virtual cinematography offers tremendous opportunities. Cinematically, the image allows nodal pans and deep zooms with little restriction of focal length due to the gigapixel resolution. Standard dollies and crane movement of the camera can occur with a degree of parallax in some cases. Integrated with 3D geometry, gigapixel backgrounds can provide the foundation for a variety of animation stagings, from a crowds or armies interacting on varying terrain to providing virtual sets for commercial automotive spots, all properly integrating with the real-world imagery of the scene and extending the concept of the digital backlot.

The studio relies upon the fastest hardware currently available, using 8 CPU 64-bit machines with 8 GB of RAM and 26TB of RAID-0 disk to handle the magnitude of the images being created. A render farm normally used for rendering 3D animation is now used as a “stitching farm”, useful when render times can be up to a few days per gigapixel image. Custom scripting, written by xRez Studio, provides a fast transition between the motion control hardware and the stitching software. The studio is also developing code for use in Maya to readily align DEM terrain data from the GIS field with gigapixel images.

xRez Studio recently provided its services to Sassoon Film Design for a VFX shot on Tom Hank's *Magnificent Desolation* IMAX feature on the Apollo moon program. xRez re-created flying through a deep trench called the Hadley Rile, which was shot originally as a series of overlapping photographs taken by the Apollo 15 astronauts. A panoramic stitch of the images was made, then rigorous photogrammetry was employed to model the surface faithfully from the photographs. A layering of 24 matte paintings based on the photographs was then used to texture the canyon as the camera flew down its length. The shot illustrates the power and versatility of panoramic imagery and photogrammetry used towards visual effects work.

xRez Studio is also beginning to focus on the computer gaming space where opportunities utilizing gigapixel images are far-ranging. Panoramic spherical imagery has been used in gameplay previously, but new techniques are available now to allow gigapixel images to fit within the narrow bandwidth common to gaming. This can afford new creative possibilities of game play, capitalizing on exploration of highly detailed imagery previously not seen before.

xRez Studio was founded by advanced photography and feature film visual effects veterans Eric Hanson (professor of visual effects at the USC School of Cinema/TV and an expert in 3D digital environments) and Greg Downing (a specialist in image-based 3D technologies whose photographic work has been featured in some of the most prestigious museums in the country). Hanson has worked extensively in the visual effects industry for such studios as Digital Domain, Sony Imageworks, Dream Quest Images and Walt Disney Feature Animation. Downing has worked in film production integrating image-based technologies and as a lighting technical director at Rhythm & Hues and Sony Imageworks.