

# Strong nuclear force

**Matt Leonard** takes an in-depth look at 3D compositor, Nuke, recently bought by The Foundry, and now upgraded to version 2.7.

In March 2002, Bill Spitzak, Paul Van Camp, Jonathan Egstad and Price Pethel of D2 Software, a subsidiary of Digital Domain, were awarded an Academy Award for Scientific and Technical Achievement for their development of Nuke, a high-end desktop compositing system. Five years on Nuke, has been used on nearly 100 films, such as *Transformers*, *Pirates of the Caribbean: At World's End*, *King Kong*, *Letters from Iwo Jima* and *The Wild*, along with countless television commercials and music videos. In March this year The Foundry, a UK-based leader in developing visual effects and image processing technologies, took on the development, ushering in a new era for Nuke. The Foundry, which develops plug-ins such as Tinder, Tinderbox, Furnace and Keylight, are now hard at work taking Nuke to the next level with the help of Bill Spitzak, the primary author of Nuke, and Matt Plec, formerly of Sony Pictures.

## What is Nuke?

Nuke is a node based, high-end, film focused, desktop compositing system running on Windows, Linux and Mac OSX. For those unfamiliar with node-based systems, the name refers to the way in which the compositor builds and works with the composite. Adobe After Effects would be considered a timeline based system, where footage is primarily organized in layers on a time line, similar to an edit suite. The top layer controls the foreground object and the bottom layer the background, everything else is sandwiched in between. Effects are applied directly to a layer along with masks and any translations (move, rotate, scale, etc).

A node-based system on the

other hand is focused around a more schematic setup; footage being imported into the system is represented by a single node. Effects, transforms and masks are each represented again by single nodes, which are connected together into a tree-like structure. Multiple strands of nodes can be merged into a single path, and these can be merged to create an ever-growing complex schematic. Although at first glance this system can appear more complicated than a time-based system, on larger projects it is much easier and faster to work with.

## Setting Nuke apart

One of the key areas that sets Nuke apart from its competitors is that all footage being imported into the system is instantly converted into a 32-bit floating point color space. This means that, where a normal 8-bit system lets you work with 16 million colors, Nuke gives you access to a staggering 80 septillion colors, enabling you to color correct to a much higher accuracy, among other things. Nuke also supports a unique 64-channel layering system, which enables the compositor to store multiple mattes and passes inside Nuke. This means that the output from any node, such as a matte created from a keyer, can be assigned to a new channel and layer, which can then be passed down to subsequent nodes in the script. This gives you the ability to reuse any channel further on, so in our example the matte from the keyer can be used directly inside a color correction node as a hold-out matte, without ever having to go back to the keyer. This system is perfectly designed to work with Industrial Light and Magic's openEXR format, which enables a user to store an arbitrary number of

channels in a single file. This could include red, green, blue, alpha, zDepth, occlusion, specular, defuse, reflection, normal and UV information, etc.

The other feature within Nuke that sets it apart from many of its competitors is its powerful 3D workspace. Within the software you are able to use simple geometry, such as spheres and cards, as well as import 3D meshes from industry-standard .obj files. Once in these, models can be animated, textured and rendered out using Nuke's inbuilt 32-bit scanline renderer. The 3D system also supports the ability to import baked animation data and apply it directly to objects. On top of this, you can also use projection mapping, use UV information, add various forms of noise/displacement to your models, and apply true motion blur to your rendered output. The system can be used not only to create pan and tilt setups, but to give the compositor the flexibility to recreate camera moves (used in *I, Robot*), greatly speed up rotoscoping (*Flags of our Fathers*) and reposition objects in the shot through the use of projection mapping (*Stealth*).

Introduced in December 2006 was the new Image-based keyer (IBK). The IBK performs some difference math on the red, green and blue channels using an input image to drive the key, as opposed to using a single color picker. The IBK includes tools for controlling matte edges and color spill.

## Featureset

On top of the image-based keyer, the inbuilt 3D system and the 64 channels of 32-bit floating point color data, Nuke supports a wide range of professional film based compositing features. First, I/O: Nuke has the ability to read most

industry standard file types including tif, Maya iff, Wavefront, rla, Cineon, cin and DPX. As mentioned earlier you have support for openEXR, which greatly enhances the use of the open channel system. On top of being able to load footage directly into Nuke you can also create various noise patterns, ramps, solids, test patterns and color bars. Nuke comes with its own text-based generator tool, which gives you a surprising amount of control for a film-based system.

**Merges and Channel Controls:** At the heart of compositing is the ability to merge one image over another, either directly via a blend mode or through some form of matting process. Nuke has a huge number of tools available to you which gives you maximum control. Every conceivable mathematical formula seems to have been thought of, the most I've seen in a compositing tool, and this gives you fantastic flexibility when building your composite. On top of the functionality to merge images together, Nuke gives you the ability to swap channels about, either from a single node or combining channels from multiple nodes, such as taking the alpha channel from node A and inserting it into the zDepth channel of node B. Although I found the setup quite confusing at first, after playing with it for a while it made perfect sense and became a very speedy way of working.

**Transforming Elements and Temporal Operations:** built into Nuke is a myriad of controls for adjusting factors such as positional information, wraps, lens distortions, corner pinning, cropping and general reformatting. But not only does Nuke give you the ability to control elements in physical space, it also has a number of tools that let you control the timing and speed at which objects move. These tools include various time warps, optical flow and time blurs. You also have some powerful 3:2 pulldown tools included.

**Color correction:** Nuke offers a robust set of color correction tools, which enable a very high level of precision when color correcting material. The main color correct node enables compositors to adjust

color on a per channel basis, along with master, shadows, midtones and highlight controls. These again can be broken down in Saturation, Contrast, Gamma, Gain and Offset. You have full control over hue correction, channel swapping/combining, spline-based curve controls, log to linear and LUT controls, to name a few.

**Masks Creation, Drawing Tools and Paint:** Nuke comes with one main Bezier tool, which you would use for most of your rotoscoping work. On top of that you have the ability to create various general shapes, such as rectangles, ellipses, etc. You also have a reasonable paint system, which gives you the ability to clone, as well as standard paint operations.

**More keyers:** On top of Nuke's image-based keyer, you also have available Nuke's original powerful keyer, a difference keyer, a hue keyer and Photron's award-winning Primatte. You also have various tools for edge/spill suppression, lightwrap, edge blur and the like.

**Trackers:** Nuke includes a powerful 2D tracker and stabilizer, which can not only drive transform data for objects, but can also be used to control matte positions, corner pin effects, etc.

**Filters:** The is a huge array of filters and effects in the box, including glints, lens flairs, blurs, defocus, erode, glow, godrays, fog effects, grain and dust removal, the list goes on and on, and now Nuke supports most, if not all, of The Foundry's plugins, you will find pretty much every effect you can imagine at your disposal.

### Under the hood

Nuke scripting is currently based on the TCL language, although Python will be coming soon, I believe. You also have full expression functionality throughout, which is fantastic. All of Nuke's main commands are covered by hotkeys, which greatly speed up workflow, and most of these can be customized with a bit of code fiddling if necessary. Nuke can support images up to 20K, and due to its robust scanline rendering system, it runs pretty smoothly. The scanline renderer itself is quite amazing, having

three significant benefits over full frame processing. First, since you aren't waiting for each node to process one after another, you can see lines start filling in and, if need be, stop the processing or make a change after just a small amount has been rendered. Second, memory efficiency is much better because the system is not processing full images node by node. And third, because the unit of work is a scanline and not a full image, the renderer is able to run many threads, each processing a single line, again speeding up the process.

### Conclusion

As a compositor myself, I was eager to test Nuke's capabilities, having used other systems, both timeline-based and node-based in the past. What I found was a system that is extremely flexible and powerful, although slightly daunting at first due mainly to the clean UI design. My friends at fxphd.com, an online VFX training site co-founded by John Montgomery and Mike Seymour, have been testing Nuke on their project *The Last Caress*. Having used a number of other high-end packages, Tahl Niran, one of the fxphd professors, says, "we have been using Nuke for the last few versions and have been astonished by the speed. Especially floating point on 2K and larger files. Nuke has the best handling of multi-channel files, especially .exr, of any program we have seen, and really fits in brilliantly with our multi-pass pipeline. Transitioning from Shake has been very quick and easy, and I am enjoying the 3D features very much. On the whole I have to say that I am using it for most of my shots more often."

Overall, I have been extremely impressed with Nuke: the speed and functionality is fantastic and with effects houses such as Cinesite, Digital Domain, MPC, Weta Digital and The Orphanage using it, you know you have a strong package. If there were any cons to what I saw, they would be the need for 3D lighting to be incorporated and perhaps a better paint system, but neither of these take away from the fact that Nuke is a fantastic film compositing tool.

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