



Solution Brief
Autodesk® Maya® on Intel® Core™
Microarchitecture

Autodesk

"With Maya software, we work hard to meet the creative needs of our customers. When we are dealing with companies such as Industrial Light & Magic, Disney, DreamWorks, Electronic Arts, you name it, the demand for increased productivity, creativity, flexibility, and performance is insatiable."

— Kevin Tureski,
Product Director, Autodesk

Autodesk® Maya®: Core Hungry and Ready for Action

In many respects, the veritable explosion in animated 3D feature films, including increasingly popular stereoscopic movies, owes its very existence to new technologies: innovative software applications that drive the creative process and the processor architectures that carry the workloads. The animation platform and design software developed by Autodesk®, Maya® 2009, has garnered accolades throughout the entertainment industry and won the acceptance of top studios by keeping pace with technological advances and delivering the features and performance that enable some of today's most successful productions. Multi-core processing platforms are helping fuel many of the advances, presenting new opportunities for filmmakers, as digital cinema techniques grow more complex and special effects become more intricate.

Animation and digital moviemaking benefit strongly from parallelism. From the rendering of stereo video streams to the application of visual computing algorithms for special effects, many-core processing accelerates production workflow and speeds up the pipeline. Working in close collaboration with Intel engineering staff members, Maya developers optimized the code to take advantage of available processing cores using a potent combination of tools from the Intel® Software Development Products arsenal. Intel® Threading Building Blocks and Intel® VTune™ Performance Analyzer with Intel® Thread Profiler for Windows* helped unlock the power of multi-core processing and tap into the potential of multi-threaded tasking. For example, playback of the Maya wrap deformer, which modifies the shape of animated characters, speeds up nearly as many times as there are available processor cores. The Maya team collaborated closely with Intel on the design of the Intel Threading Building Blocks library, which contributed significantly to these impressive results.

The film industry stands as a clear beneficiary of technological advances that merge live actors and animation, enhance stereoscopic moviemaking processes, bring digital workflow techniques into production and post-production tasks, and add creative flexibility to special effects. The cooperative design and development achievements of engineering teams from Autodesk and Intel, which optimized design software to run on next-generation multi-core processing platforms, help drive these advances.

"We've put a lot of effort into threading and have collaborated with Intel on the design of their Threading Building Blocks library, from which we are getting impressive results."

— Kevin Tureski, Product Director, Autodesk

Autodesk Maya: Platform of Choice for the Film Industry

The latest release of Autodesk's preeminent 3D modeling and animation software, Maya 2009, has a storied history in cinema, including an Oscar* for scientific and technical achievement. Many of the industry's leading studios have won Academy Awards* for work done with Maya as an integral part of their animation and visual-effects pipelines. Maya has made a strong impression on a variety of industries, including film, television, game development, design, and manufacturing. Focusing on workflow efficiency for artists—with a software architecture optimized for multi-core computing platforms—Maya excels at bringing innovative capabilities to creative professionals in film, broadcasting, and gaming.

The artist-oriented user interface, which has been widely copied for its ease of use, is one source of its popularity. Another is the open architecture design, as well as the evolving APIs that expose the broad functionality to a worldwide community of developers. Extensions and plug-ins to Maya provide rich, specialized enhancements to an already robust set of product features.

Maya has played a starring role in a number of feature films and television series. The upcoming television series, *Star Wars: The Clone Wars**, as well as the full-length feature film of the same name, employed the creative tools of Maya to achieve a new look and feel. The efficient production pipeline combines input from digital artists at the Skywalker Ranch in northern California and animation specialists at Lucasfilm Animation in Singapore, and the CGCG studio in Taipei to generate eight finished minutes of animation per week. *Star Wars: The Clone Wars* will be airing in the fall on The Cartoon Network and TNT.

Pivotal moments in the M. Night Shyamalan film *The Happening** were crafted using Maya software. The Third Floor, a Los Angeles-based digital studio, used pre-visualization techniques to create a car crash scene and lion attack scene. This technique lets the director make necessary adjustments for timing, camera angle, and other factors to obtain the best results during filming. Pre-visualization of scenes by The Third Floor also helped in the production of *The Chronicles of Narnia: Prince Caspian**.



A stereoscopic 3D segment of *Kung Fu Panda** aired at SIGGRAPH 2008, revealing the vast potential for this revitalized entertainment medium.

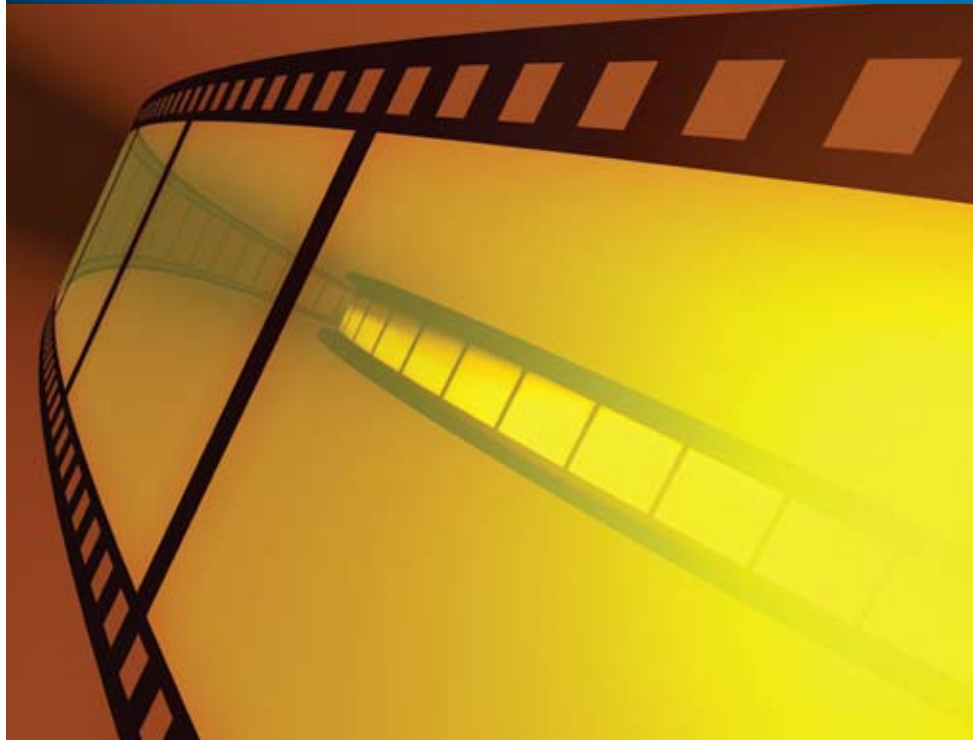
As Maya celebrates its 10th anniversary this year, the list of achievements—including the following Academy Award-winning projects in which Maya played a role—continues to grow.

- **The Matrix***—Manex Visual Effects (MVFX)
1999, Academy of Motion Picture Arts and Sciences Award for Visual Effects
- **Shrek***—DreamWorks SKG
2001, Academy of Motion Picture Arts and Sciences Award for Animated Feature Film
- **Lord of the Rings: Fellowship of the Ring***
—Weta Digital
2001, Academy of Motion Picture Arts and Sciences Award for Visual Effects
- **Lord of the Rings: Two Towers***—Weta Digital
2002, Academy of Motion Picture Arts and Sciences Award for Visual Effects
- **Lord of the Rings: Return of the King***
—Weta Digital
2003, Academy of Motion Picture Arts and Sciences Award for Visual Effects
- **Ryan***—Chris Landreth
2004, Academy of Motion Picture Arts and Sciences Award for Short Film (Animated)
- **Spider-Man* 2**—Sony Pictures Imageworks
2004, Academy of Motion Picture Arts and Sciences Award for Visual Effects
- **King Kong***—Weta Digital
2005, Academy of Motion Picture Arts and Sciences Award for Visual Effects
- **Pirates of the Caribbean: Dead Man's Chest***
—Industrial Light & Magic
2006, Academy of Motion Picture Arts and Sciences Award for Visual Effects
- **The Golden Compass***—Framestore CFC
2007, Academy of Motion Picture Arts and Sciences Award for Visual Effects

A number of these films also used Autodesk® Inferno®, Autodesk® Flame®, and Autodesk® Lustre® software to help achieve the final result.

"Our customers are always pushing and expanding creative boundaries in order to create a more immersive, believable experience and tell better stories. The size and complexity of the data sets that they're managing is massive. Anything we can do to help them gain the performance they need is vital. In real estate, the three most important things are: location, location, location. In an application like Maya, it's performance, performance, performance. So, we will continue to push and push hard to take advantage of any performance gains we can. Multi-threading is absolutely right in the center of that and we rely on Intel® Software Development Products, such as Intel® C++ Compiler, Intel® Threading Building Blocks, and Intel® Thread Profiler, to deliver that performance."

— Kevin Tureski, Product Director, Autodesk



Milestones in computer gaming have also borne the mark of Maya, including the *Resistance: Fall of Man** and *John Woo Presents Stranglehold** games. Maya also demonstrated its cross-platform expertise as a development platform for a string of high-profile games targeting the Sony PlayStation* 3 console, including *Gran Turismo**, *Jak & Dexter**, and *Ratchet & Clank**.

Maya developers have learned how to successfully exploit the capabilities of the latest hardware platforms to bring the highest level of performance to their software. In recent iterations, this means unlocking the performance pathways of parallelization, equipping the software to utilize multi-threaded design architecture and scale to the capabilities of multi-core processor platforms whenever possible. The engineering relationship between Intel and the Maya development team goes back nearly a decade and has resulted in some of the most noteworthy achievements being carried forward and refined in Autodesk Maya 2009.

"Technology is changing at a rapid pace," Kevin Tureski said. "Whether we're talking hardware, whether it be in the CPU and multi-core, whether it be in the GPU—taking advantage of that power is a real challenge. Intel has been helping us with our multi-threading work and we've been helping Intel ensure their threading tool set meets the demands of Maya and in turn the demands of our customers. Our customers are constantly creating even more believable special effects or even more realistic games. Maya needs to continually evolve; it needs to take advantage of all that the latest technology offers, so that our customers can create even more stunning experiences."

"Ultimately, Star Wars: The Clone Wars is about great storytelling. From a technological standpoint, we need to be flexible in order to take the creative vision wherever George Lucas and supervising director Dave Filoni dream of taking it. Autodesk Maya allows us to do that."*

— Danny Keller, Animation Supervisor, Lucasfilm

Stereoscopic Workflow in *Beowulf**

Maya played a central role in the stereoscopic movie *Beowulf**, which captivated the imaginations of moviegoers when it reached cinema screens in late 2007. In a number of ways, 3D cinema is reinvigorating the movie industry and drawing new patrons to theaters, and this trend is likely to continue as major chains commit to new projection equipment and studios discover the strong interest from the public in this type of cinema. According to *Media Daily News*, Regal Entertainment Group is planning to install 1,500 new screens with 3D capabilities over the next two years. At the moment, of the roughly 5,000 digital cinema screens in the U.S., approximately 1,000 are equipped for 3D projection.

The technologies used in next-generation 3D cinema bear little resemblance to the headache-inducing, gimmicky films that gained notoriety in the '50s. RealD and Dolby Laboratories have elevated 3D cinema to an art form and supporting technologies—new digital cameras that vary intraocular distances, direct-to-disk image capture, and new types of effects processing and color grading—have removed much of the difficulty from creating and editing 3D works. Tools such as Maya bring additional capabilities to animated works, even displaying interim 3D content on specially equipped displays.

Beowulf combined performance capture of actors with visual effects and animated sequences to achieve a stylistically unique form of storytelling with the additional enhancement of 3D imaging. Many of the most visually stunning sequences in the film relied strongly on tools from Autodesk, including Maya and MotionBuilder*. Intricate motion tasks, such as handling muscle movements in the physiques of animated characters and manipulating facial expressions, were accomplished using Maya.

Modifications to the Maya interface were also made to provide creative manipulation of the 3D effects in the movie, even supporting real-time changes that allowed the *Beowulf* team and director Robert Zemeckis to interactively view depth and layout changes and determine how they would appear to the audience. This degree of creative control added a layer of artistic freedom to a process that is often difficult to fathom because of the layering of technical effects.



Image courtesy of DreamWorks SKG.

Significant attention was given to the expressions of individual characters, a task that was aided through the construction of intricate facial rigs. Kenn McDonald, the animation supervisor at Sony Pictures Imageworks, noted, “We wrote custom tools for our facial controls, and each of our characters eventually had as many as 300 facial controls for us to manipulate. Right up until the very end, we were adding new facial shapes and new levels of control. In the end, our job was all about getting the best realization of each actor’s performance. Maya gave us the ability to animate these characters, and the ability to write plug-ins and custom tools for Maya was an integral part of that.”

The open architecture of Maya, with the potential for an unending array of plug-in possibilities, and the high-performance rendering and playback capabilities, which permitted many informed artistic decisions during the creative process, added substantially to the quality and visual experience of the film.

Enabling Fluid 3D Creativity

The complex animation pipeline in use at DreamWorks Animation also benefits from the flexibility and extensibility of Maya, as well as a hardware platform based on Intel® architecture that is helping unlock the potential of 3D stereoscopic filmmaking.

DreamWorks Animation global stereoscopic supervisor Phil McNally compares the difficulties of early 3D production with the process currently being refined today as Intel and DreamWorks Animation forge a technology partnership and use the InTru™ 3D logo to identify works created under this collaborative endeavor.

“Let’s say we were back in the ‘50s,” McNally said, “and we were shooting a stereo movie with film cameras. Obviously, we don’t really have any feedback as to what’s actually happening. There’s no way to put a live left and a right image from the cameras into any kind of 3D display.”

“At that point,” McNally continued, “you’re really relying on measuring tapes, calculators, and experience to try and understand what must be captured and what the result is going to be. By the time it’s captured, the 3D is locked in. In terms of getting the stereo settings right, you have either got it or you haven’t. And, when we go to the tools that we’ve now developed in Maya, we have a panel—a viewer that shows us the scene that we’re looking at in 3D. We can use the electronic active shutter glasses with our desktop systems.”

“In Maya,” McNally said, “we can literally look at the scene and see it in 3D. We can turn the effect up or down. Change whether the character is in front of the screen or behind the screen very easily—without having to wait for the result. We can literally sit there as we’re working and see the result happening in front of us. I guess the example would be something like: if you’re a sculptor working in clay, now you have your hands on the clay, as opposed to being in some remote room writing up parameters of what we want the clay to be like.”

Jim Mainard, head of production development at DreamWorks Animation, sees pre-visualization as an essential step in pushing forward the studio’s ambitious creative endeavors. “True visionary creativity is wholly supported by the ability of our creative leadership to express their specific vision with absolute responsiveness. Historically, the pencil in the creation of storyboards, or more recently the digital tablet, was the only means for doing that reliably.” Mainard joked, “Let’s face it, it has a great interface and it always works, or another pencil is just an arm’s length away.”

DreamWorks Animation has made a big shift in the last few years to incorporate new pre-visualization technologies that can ensure the responsiveness and reliability necessary, while providing intuitive, non-expert interfaces that open up new possibilities in storytelling, cinematography, and character development.

“A few years back, as 3D took center stage for our future planning, we took a hard look at the process of getting our movies up on reels to better understand them,” Mainard said. “We began a



Image courtesy of
DreamWorks Animation.

major initiative to overhaul our cinematography process—core to 3D filmmaking. We worked closely with Autodesk to build technologies that leveraged Maya’s open plug-in architecture to develop and integrate a set of plug-ins to represent real stereoscopic cameras. We then integrated that technology with a virtual camera system to form a pre-visualization technology with unprecedented capability. The great news for other filmmakers is that Maya 2009 has a version of that 3D plug-in technology today.”

“Today our filmmakers can load up shots in Maya, many of which will have imported motion capture data from MotionBuilder, and operate a physical camera in a virtual environment,” Mainard continued. “They can scout sets, lay out shots from scratch or even layer subtle camera movements on top of previous rough camera work (a.k.a. “camera sweetening”) with little to no understanding of the operation of Maya. And, they can do all of that in 3D in real-time. That has made a huge difference in how we visualize and refine our films. You’ll see it soon when *Monsters vs. Aliens* releases in March 2009.”

“We’re not done yet,” Mainard said confidently. “We are actively integrating game-engine technologies and partnering with Intel on the next generation of visual computing processors to provide an even higher fidelity experience for our filmmakers to express themselves. The next few years will be nothing short of a revolution for filmmakers as the rules of filmmaking evolve with 3D and an interactivity that is nearly unimaginable explodes on the scene from Intel!”

DreamWorks Animation CEO Jeffrey Katzenberg has been a major driving force for the adoption of stereoscopic 3D moviemaking. *Monsters vs. Aliens* will be the first animated feature to bear the InTru 3D logo. As Intel and DreamWorks Animation complete the technology overhaul of the pipeline, DreamWorks Animation plans to produce virtually all of its upcoming features in both 2D and 3D versions.

Making Progress in All Areas

Progress in all sectors of digital content creation—film, television, and gaming—continues to gain substantial momentum as processing platforms are able to handle greater and greater volumes of visual computing data with real-time efficiency. Every part of the digital content creation pipeline (modeling, animation, effects processing, and rendering) can potentially benefit from the parallelization advantages of multi-core processor architectures supporting multi-threaded application designs.

Autodesk and Intel have a long, rich history of cooperation and collaboration, working together to mutual advantage to bring top-notch entertainment and education to audiences and communities of computer users worldwide. The breakthrough hardware technologies pioneered by Intel unlock substantial opportunities for advanced software designs that achieve new performance milestones through multi-threading.

More Information about Autodesk

Autodesk, Inc. is a world leader in 2D and 3D design software for the manufacturing, building and construction, and media and entertainment markets. Since its introduction of AutoCAD* software in 1982, Autodesk has developed the broadest portfolio of state-of-the-art digital prototyping solutions to help customers experience their ideas before they are real. Fortune* 1000 companies rely on Autodesk for the tools to visualize, simulate, and analyze real-world performance early in the design process to save time and money, enhance quality, and foster innovation.

For additional information about Autodesk:

www.autodesk.com

For more details about the 10th anniversary of Maya®:

area.autodesk.com/maya_anniversary

or www.autodesk.com/me



Intel® workstation components deliver dependability, compatibility, scalability, and advanced architecture to your multi-processing environment. For more information, www.intel.com/products/workstation/index.htm.

Solution provided by:



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