

Film Essay On The “Bullet Time” Scene In “The Matrix”

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THE “BULLET TIME” SEGMENT

The movie “The Matrix” describes a simulation created by artificially intelligent (AI) beings that use humans as their power source. Man’s reliance on machines led to the creation of this AI that multiplied (<http://www.ram.org/ramblings/movies/matrix.html>). The AI forms used human beings as power sources and these AI life forms became extremely adaptable. Ultimately there is a war between the humans and their AI counterparts. Neo (Thomas Anderson-played by Keanu Reeves) is a computer hacker that has committed every computer crime in the book and is recruited by Morpheus to fight the AI beings. The movie is a revolutionary rendering effort of computer graphics and cinematography. It utilized various plug-ins for SOFTIMAGE/3D that is an outgrowth of SIGGRAPH 97. Also utilized in the animation effects were Poser 4 and Photoshop. These tools were used to create male & female models and allowed simple modifications to features to produce the effects desired. Brushes Palettes, Paintbrush Tools, etc. are used in these software tools. Poser 4 provisioned for the adding of characters to the scene, and provides for transforming these characters to Xtrans=0.0, Ytrans=0.0, and Ztrans=0.0 as example to create a 0 position coordinate system. Rotation is provided when necessary, modifications to the characters appearance can easily be animated, and each of these functions is made simple through a simple GUI allowing scaling, texture, color, and etc. to be modified for separate sections of the film animation. Various camera control panels (GUI’s-see Figure 3), animation control panels, etc. are all provided in this application.

The segment that most captured my imagination is “The Bullet Time” scene. Here photogrammetric modeling and texture mapping were used. For the edification of the reader, John Gaeta supervised the visual effects, the bullet time supervisor was Kim Libreri and the director of research was Dan Piponi (<http://www.debevec.org/Campanile>). This project was

based on the work of George Borshukov with assistance from Paul Debevec and was initially explored at UC, Berkeley. A Dell Precision Workstation helped create the special effects and Manex Entertainment created many of the animations in their MVFX laboratory. At a critical point in the production process, MVFX used renderfarm software in conjunction with the Dell Precision Workstation to generate a number of computer graphics for the film. Since renderfarm required large memory blocks, Manex purchased 32 Dell Precision 410 Workstations each with dual CPU's and 1 GB of RAM.

Image Based Modeling was also used to build some aspects of the virtual environment for the "Bullet Time" scene. The first goal was to build an application that, given a set of photographs of a building as example would construct a 3D model of it, and later this building would be used to support a scene that has Neo dodging bullets on a rooftop near this building. The building must look realistic, capturing geometric nature, appearance, color and texture. The algorithm implemented was based on a PhD dissertation that demonstrated the Image Based Modeling technique. Note, the "Bullet Time" effect is effectively a technically expanded version of an old art photography, in which a large number of cameras are placed around an object and fired simultaneously. When the sequence of shots is viewed, the viewer sees what is in effect a 2D slice of a 3D moment.

In the scene, Neo is still captured in various unnatural positions while suspended by cables on what is considered a blue screen. A series of sophisticated still cameras were placed along a mapped curve linear path and each camera would shoot a still photo. These individual stills were scanned into the computer thereby creating a strip of still images similar to animation cells. Linear interpolation was used to fill in any gaps of the still images to produce a fluent dynamic motion. Note, the foreground and background shots are composed separately and the

blue screen provides a shade of blue (Chroma Blue) that is not a chrominance color of human skin. Therefore when areas of blue are erased from the final created scene, those blue areas removed have no affect on animated picture quality.

Since animation is a major element of studying computer graphics, the dynamics associated with the still images means exactly what our textbook by Foley implies - changes that spread across a sequence of pictures, including changes in position, size, lighting, material properties, and viewing specifications.

The scene portrays the ability of still images when graphically enhanced and with individual foreground & background composites merged, provides a simulated animation. Since we are viewing in 3D, the camera settings along the path (including camera position relative to Neo) are extremely important to ensure film reproduction quality. Equally important is the transformation of each component of the scene, i.e. Neo and the superimposed bullet with computer animated spiral trails that need to be properly oriented such that no transformation error in the final image is noticed. These are depicted as image viewing reference coordinates and projection reference points respectively. An example of still camera shots is shown in Figure 1.



Figure 1 Still Shots (http://whatisthematrix.warnerbros.com/cmp/sfx_index.html)

As a smooth image flow is required to avoid flickering effects, computer enhancement for motion using linear interpolation between successive stills is utilized as an additional editing feature. Note also the time varying position of each camera along the track & triggered using laser tracking provides motion dynamics yielding the visual effect of realization to the scene. Frame rates implemented, texture evaluation, etc. must all be properly analyzed to avoid temporal aliasing, problems with focusing or binocular disparity. These are all the concern of the video production crew.

The bottom line for me is that we enjoy the entertainment provided by films such as “The Matrix” yet we have a proclivity for ignoring the genius and hard work that must go into these productions. What I garnered from revisiting the film and researching information provided by the Web is that this film took 1 year of creative animation and 1 year of re-editing to get it right.

What is achieved in this film footage segment is what appears to be a realistic recreation of a human being having the capabilities to project their body in such a way as to avoid several bullets fired at them. This is only 1 chapter of the film’s animation, however many of the scenes such as the “Kicking Scene” where Trinity played by Carrie Ann Moss, is also suspended on cables at the pinnacle of her jump while still cameras again record her motion from start to finish at different angles. The producer’s objective was to be able to have a series of animated images and that he could control the actions of his actors by having them contort their bodies, have them suspended in mid-air, etc. Ultimately the producer could then also control the frame rate of delivery of several scenes to achieve various special animation effects. Figure 2 provides insight into the suspension and animation setup while Figure 3 provides a GUI panel used for control of Trinity and the Policeman in the “Kicking Scene”.



Figure 2 Animation Effects (<http://www.debevec.org/Campanile>).

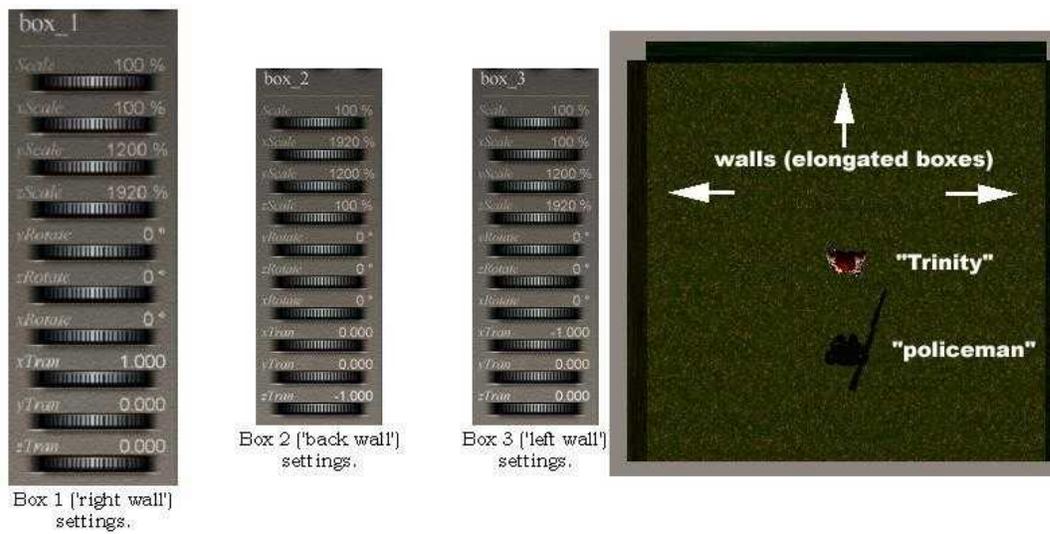


Figure 3 GUI Panels (<http://www.debevec.org/Campanile>).

What must also be appreciated is the accuracy of camera sequencing to provide what appears to be a realistic scene with Neo dodging bullets fired at him or the realism depicted when Trinity is at the peak of her jump while kicking the policeman. Any camera vibration or positional change could cause the realistic qualities strived for in the recreation to be lost or distorted.

References

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