The making of *Superman III*—pixel by pixel

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It started out simply enough: a screenwriter working on one of the earlier drafts of *Superman III* called for a scene containing a sequence that "looks like an Atari videogame." As preproduction on the film progressed, this bit of writer's fancy was bounced from the chief of Warner Brothers to the CEO of Warner Communications in New York (the parent company of Warner Brothers and Atari), who in turn gave it to the president of Atari, who passed it along to other Atari execs, until the idea was finally shown to Steve Wright, the director of Atari's Special Programs group. Steve immediately said, "Sure, we can do that."

For Atari, the project was the first of its kind, and the results of Wright's confidence in his team's technical and creative abilities can be seen at the climax of the film, where 26 seconds of 2½-dimensional stop-frame computer graphics animation are intercut with live action footage. (Frames from this animation sequence are reproduced below and on the cover.)

In a Grand Canyon showdown between archvillain Ross Webster, played by veteran actor Robert Vaughn, and Superman (Christopher Reeve), Webster attempts to destroy the Man of Steel by shooting him down with autotracking rockets. To control the timing of the rockets' detonations, Webster uses a joystick with a "Fire" button on the end of the stalk, the "ultimate" supervillain computer, and a video monitor. Everything that appears on this monitor—the joystick's cursor, Superman, the Grand Canyon, the rockets, the explosions, even the monitor's "warm-up" images—was produced by the Special Programs group in Sunnyvale, California.

But in keeping with the writer's original call for the "look" of an Atari video game, Wright's group made the decision to forgo any use of realistic 3-D graphics. "There's definitely a place in the world to produce the biggest, 'baddest' images that technology allows," said Pat Cole, Atari's Special Programs software manager, "but there's also a place to use computer graphics in the most effective manner possible, where the needs of the film are met, and the director is satisfied. Had we tried to make our images look too real, we would have failed." Or as Wright said, "It would have looked like a shoddy attempt to do live footage."

In *Superman III*, this belief eventually translated into 2½-D multiplanar animation, the net effect of which is an image that has the look of video games yet to come. (For a discussion of some of the latest developments in this graphics field, see box on the following page.)
To get this look, Atari—using two Symbolics LM2 Lisp machines for hosting a 32-bit Ikonas frame buffer—produced images for the film that were intentionally "blocky"—images that had specially developed antialiasing techniques applied to them to preserve the "pixelly" effect of a simulated video game. The final print was produced at 508 × 216 resolution to match the aspect ratio of a Panavision screen.

Sixty seconds of footage, broken into about eight sequences, were actually produced by the Special Programs group, which, at the 24-frame-per-second rate of projected 35mm feature film, meant that 1440 individual frames had to be computed and filmed.

The effort took about 15 weeks, of which 10 to 11 weeks were taken up by utilities and software development. This basically entailed building stop-frame 2½-D capabilities on top of existing hardware.

System software

All of the application and production software packages used to create the Superman III graphics were developed in-house by Atari and were written in Lisp. Being able to use Lisp turned out to be a great help to the project because, according to Cole, Symbolic's object-oriented programming system, "Flavors," makes it "incredibly easy to code graphics."

Animation software. The animation modules—the paint program, the animation editor, etc.—created under the direction of Paul Hughett, a consultant to Atari and system architect for software development, had to handle every thing from coloring the earth-toned walls of the Grand Canyon to the acrobatics of Superman as he tries to dodge exploding missiles. For example, as the image of Superman turns and swoops through the canyon, it is subjected to 2-D transforms, cubic spline interpolation, and antialiasing (to keep, among other things, the edges of his cape smooth as it flutters in the air). Each element in a sequence—Superman, rockets, explosions, etc.—was painted separately by a computer graphics artist using the paint program designed by Mike Marshall.

The animation software also aided in Superman III's deliberate emulation of the multiplanar animation technique of the old Disney feature cartoons. When Superman flies through the canyon, the canyon walls in the background scroll by fairly slowly, but the foreground rocks...
that come between Superman and the audience scroll across the screen at a much faster rate.

The scripting language. Written by Vicki Parish, the scripting language integrated all of the pieces of the images in time. It was this software that told the computer how to generate each key frame, and the computer interpolated all of the frames in between two key frames. As Wright said, “Although it may take four full weeks to develop a scripting language, once you’ve got it, it allows you to produce a complete script for a 10- to 20-second sequence in less than a day.”

The production story

While the technical problems were being worked out through software development and some additional hardware acquisition, the film’s production people were talking to the Special Programs group about the plot of Superman III and discussing some of the more creative aspects of the scene that Wright and his team were to produce. Unlike most ventures of this kind, there was no preset sequence of images — no storyboard. “We were given pretty free rein,” Cole commented. “Colors, timing, what kind of gags to use—all that was left to us. True, we worked within some general guidelines, but we were given an amazing amount of initial freedom. It was a somewhat unique situation.”

To help with the project, Atari hired Larry Wright, an experienced film art director. He was responsible for creating a script for each sequence. After some initial orientation, Wright proved quite adaptable to working with what, for him, was a new science—computer graphics animation. Key-frame animation storyboards with their coordinates and geometric symbols quickly became routine creative vehicles for Wright. “We wanted to bring in an artist here,” Steve Wright commented, “because we like to focus on the creative aspects of computer graphics animation—not just on the technology itself.”

Previewing a sequence. Once a script was in hand, the called-for objects had been entered into the computer by the graphics artist, and the scripting language was set to manipulate the sequence, the long-standing graphics problem of lengthy computation time remained. Even at the purposefully low 508 x 216 resolution that Atari was working with, an eight- to ten-second sequence required 12 to 15 hours for the computer to process it—a long time to wait to see the rough “cut” of a sequence.

“Is a new class, a new type, a new style of gaming.”

Atari hopes to announce its own first-generation laser-disc-based, coin-operated game by the end of this year. Wholly computer-generated imagery for these games is one of the future directions Atari plans to take. This imagery will eventually be produced in-house on Special Program’s new 3-D graphics system.

Once the problem of melding the limitations of videodisc technology with high-resolution computer-generated graphics has been overcome, it’s the prospect of the second generation of laser-disc-based games that excites Wright. “We’ll be able to put the processing power of a mainframe into generating all of our backgrounds, storing these images on the disc, and then using a separate microprocessor to provide the real-time, manipulating images that the player controls. It will allow us to produce an unprecedented level of realism... or fantasy. For example, we’ll be able to take a spaceship, rotate it in 3-D, and have starlight reflecting off the hull. We can even explode the universe,” Wright said with a smile, “if we want to.”

Videodisc games in the home? According to Wright, the gaming and videodisc industries are currently in the process of trying to set some sort of standards as the marketplace brings these industries together.

Since none of the currently marketed home videodisc units have an RS-232 interface, the introduction of videodisc-based games into the home seems to be a number of years off. “Most of the units out now don’t even have track-jumping capability,” said Wright, “and those that do usually have very limited capabilities, which is not to say that we couldn’t do something, even with this limitation.”

“The technology needs a chance to evolve,” Wright concluded. “It has what I call a technology niche in the arcades, and eventually it will drop down to the consumer level.”

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To alleviate this problem, Atari opted to go with a video preview system—a Lyon Lamb VAS IV animation controller interfaced to ¾-inch Sony BVU-800 U-matic VTRs. The previewing was done in two stages.

In the first stage, antialiasing was dropped from the computation, only every fourth frame was generated, and the sequence was computed at reduced (254 x 108) resolution. The VAS IV, functioning as a digital tape operator, recorded each frame as soon as the computer completed processing on it. To compensate for the different frame rates between the two media—30 fps for video and 24 fps for 35mm film—the computer took every fourth frame and made five copies of it. This meant that observed motion in the sequence was jerky, but the speed was accurate. Instead of waiting 12 to 15 hours to see what a sequence looked like, the Special Programs group now only had to wait about an hour and a half.

After technical and creative adjustments were made to the sequence, the second preview stage was taped. Anti-aliasing was still left out to save on processing time, but in this pass every frame was computed, and at full resolution. All in all, producing a sequence in this manner generally took from three to four hours.

Filming. When a sequence was completed to everyone’s satisfaction, the final images were filmed from a computer monitor directly to 35mm movie film. To do this, a Mitchell 35mm cinema camera was custom-mounted and interfaced to a Dunn Instruments 632 system. Since Superman III was produced in the elongated Panavision format, the Special Programs group decided to change their standard 35mm format through software instead of through the use of elaborate and expensive lenses. “This had the advantage of meaning that we weren’t hard-coded to a Panavision camera,” Cole explained.

One possible problem with the Panavision format—the potential for the score and rocket count numbers to be partially cropped off—was avoided by supplying the film company with four separate pieces of film: the full images, the rocket counts, the scores, and black rectangles. This allowed the company to optically composite the scores and rocket counts directly onto the master film negative.

Comments from the set, comments from the crew. Superman’s animated flight through the Grand Canyon was computed and filmed from three viewpoints: head-on, from the side, and from directly overhead. These three master sequences had a combined run time of 60 seconds, yet only 26 seconds were finally incorporated into Superman III by the film’s director, Richard Lester. Some of the film from the head-on and side views was cut in the normal film editing process, but none of the bird’s-eye footage—a particular favorite of the Special Programs crew—was used. (Two frames from this point of view are shown on the preceding pages of this story.)

Although the top view was interesting in its own right, Lester felt that intercutting it into the scene would have diminished the scene’s pacing.

In the end, Atari’s Special Programs group completed their assigned footage—actually, more than they had originally planned on because of a last-minute problem in the live-action shooting—on time and under budget. The completed footage was shipped to Lester in mid-February, and on February 22, Cole received the following telex from him: “Have received all latest shots. All cut in and we are highly delighted with the finished product.”

Summing up the experience, Steve Wright said, “It was wonderful . . . it was painful . . . it was blood and sweat. But, most of all, it was glorious. We’ve never worked so hard.”