Making The Magic Egg: A Personal Account

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second draft

The cover image is a frame from a spectacular fifteen minute computer generated Omnimax film called *The Magic Egg* which was created as a collaborative effort among about 20 computer laboratories around the country. The film is all the more remarkable considering that the majority of the work was done in only five months, and for most of us it was our first attempt at generating high resolution animation, let alone animation for projection on a giant domed screen. The following is a personal account from the perspective of a contributor to the film of the exhilarating but chaotic process by which this project came together.

The idea for the film originated with Nelson Max and the co-chairs for the ACM SIGGRAPH '84 conference, Dick Weinberg and Dick Mueller. They proposed creating a computer generated Omnimax film to be shown during the conference, which took place in Minneapolis in July, 1984. Nelson announced the project with a call for storyboards and proposals in January, 1983. The project was especially enticing for those of us at the New York Institute of Technology's Computer Graphics Lab who had been frustrated in earlier attempts to bring our work to the big screen. At NYIT we had been making 3-D computer animation for over five years, but all of it had been for television broadcast, with its attendant poor image quality.

Omnimax theaters project film through a fisheye lens onto a hemispherical screen with the image covering 180 degrees horizontally and 135 degrees vertically. This fills the audience's field of view so very high resolution is required; Omnimax format uses 70mm film with a frame area ten times that of standard 35mm film.

At SIGGRAPH '83 in Detroit, potential contributors to the Omnimax film gathered for the first time to exchange ideas for the project. Filmmaker Eddie Garrick, who would direct and produce the film, showed us two minutes of Omnimax animation he had just produced for EPCOT Center and gave us a feeling for the medium. Representatives from other groups got up and summarized their planned contributions, but our group from NYIT was disorganized so we had nothing to present. Hearing the ambitious plans of the smaller computer labs gave us courage, however, because we knew they had little or no experience at computer animation. We were skeptical that many of them could pull it off. Although we did not commit ourselves at that meeting, we came away feeling challenged, not wanting to be outdone.

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In the following months we went back to our usual programming jobs, occasionally taking a few hours here and there to begin planning the animation, thinking about rendering algorithms, estimating how long it would take to compute, and wondering how we were going to justify the project to management. For me the Omnimax film was the most exciting project to come along in years, but it was difficult to convey this enthusiasm to those controlling the computer resources.

Eddie Garrick and Cal Kirchhof, who assisted Eddie on the EPCOT film, prodded the contributors along by mailing us instructions regarding the logistics of Omnimax animation. Contributors would compute the frames, write them to magnetic tape and mail them to Cal in Minneapolis where he would record them using a Dicomed film recorder fitted with an IMAX camera. Time was limited, so to "separate the men from the boys" Cal and Eddie established the following timetable: by Thanksgiving we were to send a tape containing a single frame format test, by December 15 a still frame at full resolution, in February a low resolution motion test was due, and by Easter we were to send the final frames at full resolution. It was a very helpful timetable, but as we will see, few of us were able to keep to it!

Animation could be in vector or raster format. The former is much less expensive to compute and store, but at NYIT we decided to go all out and do our animation in raster format. Omnimax requires a resolution of about 2000x1500 at 24 bits per pixel, which amounts to 8.5 megabytes per frame. This is twelve times the resolution of the TV-resolution images to which we were accustomed and even at high density we could fit only 19 frames of animation (less than a second) per mag tape.

In addition to the difficulties of high resolution, we were faced with the distortion of the Omnimax projection, which was incompatible with all of our existing rendering software. Fortunately Nelson had tested and published several algorithmic approaches to the problem. The most straightforward involved the use of ray tracing; straightforward, that is, if one had access to a supercomputer. All of the other 3-D raster contributors took advantage of CRAY or CDC time which was offered. At NYIT we considered this route but opted to finesse a solution rather than brute force it.

During November Eddie made the first of several tours around the country visiting the contributors, giving each group a pep talk on the project. He began to weave together the sequences proposed by each group to give the collage as much coherence as possible; the theme was to be a flight through a "magic egg". By this time the list of potential contributors at NYIT had narrowed to Dick Lundin, Pat Hanrahan and the two authors. Ned was proposing a camera truck through a grand architectural labyrinth. Ned's models were too complex to ray trace on our measly VAX-780's, so he began to work out an alternate method: warping several perspective images into an Omnimax frame [see article, p. ??]. Dick Lundin planned to have his fabulous robot ant climb out of an anthill and walk over the camera. The piece which Pat and Paul proposed was a flight through a lattice of metamorphosing crystals. It was to be a demonstration of the "beam tracing" technique which we had just begun to develop. Eddie worked our ideas and those of the other contributors into a storyboard which he mailed out in early January. It looked like the project was real!

Until Christmas we were able to keep to the proposed timetable fairly well, but before we knew it February rolled along and the final deadlines grew near. The phone calls from Eddie grew more frequent and more urgent by the day: "Send everything Federal Express from now on!", "All final animation must be shot by Easter!", "I need motion tests ASAP to assemble a rough edit!". We faced a critical decision at this point: do we jump into this risky, whirlwind project and neglect our regular responsibilities or do we pull out and return to a normal life? We went for it, and in the process devastated whatever social lives we had at the time, as our girlfriends can attest. The next three months were filled with 100 hour work weeks, restaurant placemats filled with C code, and mornings, er, afternoons awakening to find ourselves sleeping on piles of listings.

How were we going to compute our frames in time? Tests of Ned's warping and filtering program for creating Omnimax images took 7 hours per frame. Simple arithmetic told us that Dick's 600-frame animation would take half a year of VAX time at this rate; clearly this would not work. To speed this process I developed a more efficient filter for the program [described in article, p. ??] which cut the warping and filtering time down to 1 hour per frame. We also got a much-needed extension of the final deadline for filming: Cal could continue filming until late May, but after that the IMAX camera would be disconnected from the Dicomed and shipped to the South Pacific for another production! The project now seemed feasible, but there was no room for error; everything from here on had to be right the first time.

In the coming weeks Dick taught his ant to walk on uneven terrain, Ned began working on a labyrinth of vines, and Pat and I worked feverishly on our beam tracing program. Several of us had to skip the motion test for lack of time and go straight for the final animation. We lost all sense of the real world, other people, night and day; the only concern was THE DEADLINE.

Not only did Pat and I have to animate the metamorphosis of polyhedra but we were also in the process of designing a new hidden surface algorithm, implementing it for production use, and writing a SIGGRAPH paper. In the end, sadly, there wasn't time to do them all, and the technical paper received priority. This did not become clear until Tuesday, May 15, however, three days before Cal's deadline for contributions.

Hoping that there was a simple piece of animation I could complete and contribute in the remaining days, I called Eddie. He suggested a blastoff from an egg for the end of the film. While Eddie contacted Ron Resch about the use of the Ukranian Easter egg model he designed at the University of Utah, I located the egg database at NYIT (fortunately we had a copy) and hacked together a special-purpose egg rendering program. Wednesday night I finalized the motion and coloring, and at 4am started writing frames onto tape.

That ran through Thursday night. I read back the tapes and recorded onto videotape Friday morning (good thing there were no bugs!), and sent off the tapes to Cal that afternoon. Whew!

After we shipped our last tape in late May we all breathed a huge sigh of relief and caught up on much-needed sleep. Our job was over, but Eddie's was just beginning. During the coming months he took the film shot in Minneapolis to film labs in Los Angeles and edited the compilation down to 15 minutes. Meanwhile there were complex legal negotiations going on between ACM, the Science Museum of Minnesota, Garrick Films, and each of the contributing groups to establish rights to the work.

Finally, SIGGRAPH '84 arrived and we attended the premiere showing of *The Magic Egg* on Sunday, July 22, at the OmniTheater in St. Paul, Minnesota. As we sat in the theater waiting for the show to begin, our great anticipation was tempered by nagging doubts. Would the animation strobe? Was the contrast right? Were there glitches in the film recording process? But the showing brought peace of mind; happily and improbably everything had worked right the first time.

The film shown was only a work print with an interim soundtrack, but even disregarding the technical achievement it was impressive as artistically as a fantastic collage of computer animation. In the fall Eddie arranged for musician Michael Boddicker to record a soundtrack for the final, polished edit, and since then the film has begun playing in Omnimax theaters around the world.

Looking back at the project it is remarkable that about 80% of the animation sequences proposed were actually used in the final edit. The pieces came from computer labs scattered around the country, and spanned a variety of technical and artistic styles. Watching the final edit of the film it is difficult to imagine the lack of experience we had coming into the project and the haste with which it was put together. It was a risky experiment in cooperative animation, but it worked!

Although the film could not have been made without the contributors' energy and the resources provided by ACM and the corporate sponsors, it was Eddie Garrick's determination and infectious enthusiasm which brought the project to fruition. Despite the chaos it entailed, I'm ready to undertake such a project all over again.