Graphically Speaking

Editors: Miguel Encarnação and John Dill

Thoughts on the State of 3D CG in Film and Video

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It has been two and a half years since I resigned my position as chief scientist of Alias|Wavefront (now Alias Systems). That time and distance has provided a certain vantage point from which to view the state of the 3D computer graphics industry. In this brief article, I want to share some of my thoughts on what I see from where I stand today.

One caveat, however, as one who too often errs on the side of the dogmatic, I have to qualify my comments, in advance, with the following paraphrase of Bertrand Russell:

> Wise men occupy themselves with doubts. Fools always deal with certainty.

I think. With that in mind, off we go.

Difficult and stagnant

Let's start with two observations that border on the obvious. The first is that 3D is difficult. The second is that the 3D market is stagnant from a business perspective. Neither observation is earth shattering. The first is apparent to anyone who has attempted to use any of the current 3D packages. The second is clear to anyone who has invested in a 3D graphics company, or seen the Siggraph trade show diminish in size over the past few years.

Now you might conclude that the two are related, and that the difficulty of current 3D packages (and their associated pipelines and workflow) is a significant factor constraining potential market growth. Consequently, one conclusion might be that the problem could be addressed by making these systems easier to use. However, as a user-interface expert, my professional opinion is that no amount of conventional UI design or usability engineering is going to pave the way to any significant breakthroughs in addressable market size. Something far more substantial is required.

Unless there is a fundamental change in how we think about things, the industry will continue to stagnate, with the key players (Avid, Alias, Discreet, and so on) just fighting for market share, rather than building and participating in healthy market growth. Without such a change, animation, postproduction, and VFX houses will continue to be under pressure, and the viability of new start-up companies will be limited.

For me, ironically, the roots of the problem lie to a certain degree in some of our biggest recent successes: programs like Alias' Maya and Softimage|XSI. Both of these products represent a huge amount of effort and investment. And both were significant improvements on what they replaced. The footage that has been made with them is a testament to this fact. On the other hand, both Maya and XSI are $n + 1$ products. Conceptually, Maya was the next generation of Power Animator, just as XSI was the same thing relative to Softimage|3D. While both were an improvement over what was there before, neither reflected a fundamental rethinking of what 3D CG could be.

What I mean by this is that around 1994 when Maya development started, or a couple years later when SoftImage started work on XSI, neither company took adequately into account the architectural implications of Moore's law. This forecast that by 2002, the power of a 1994 SGI Reality Engine was going to be available on the desktop for less than the price of a current PC. (The only thing wrong with Moore's law is that it was too conservative. This is clear from the improvement in the price performance that we have seen with the technologies from Nvidia and ATI.)

Editor's Note

With this issue, we begin a new department in *IEEE CG&A* called "Graphically Speaking." This department will provide a forum for contributors to present their own views, perspectives, and opinions on any aspect of interactive computer graphics—specifically on the past, present, and future evolution of interactive computer graphics research, technologies, education, applications, and markets. This department highlights the diversity of influences on interactive computer graphics and its impacts, the breadth of its technological and application challenges, and the promises and changes interactive computer graphics might hold for the future.

"Graphically Speaking" aims to offer detailed personal opinions, retrospectives, manifestos, prognoses, subjective comparisons, and impressions. We hope participants will describe and challenge the status quo of interactive computer graphics, predicting its many opportunities by learning from the past, questioning the present, and anticipating the future.

We also hope "Graphically Speaking" will provide a link between the pioneers of interactive computer graphics and the legions of contemporary researchers, practitioners, and application developers who redefine interactive computer graphics by offering a podium for provocative opinions and a medium for heated discussions.

—L. Miguel Encarnação

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It's a matter of time

So what is the impact of this on the user or the product? The obvious example is that, despite the computational and graphics power available on the desktop today, and despite the fact that film and animation are temporal media, none of the major 3D animation packages understand time. Frames, not a metronome, are at the heart of their architecture. One consequence is that something as fundamental as temporally accurate playback is simply not native to the architecture.

But it's more than that. As was forecast in 1994, today's systems let you interactively manipulate highly complex models in real time. Having that capability, ask yourself the following question: Conceptually, what is the difference between manipulation and animation? My reply would be, Do you have the record pedal down?

That is, with the appropriate, time-based underpinnings—the combination of real-time manipulation, temporally accurate playback, and the temporally accurate capture of the user's actions—the door is opened to what might be called *desktop motion capture*.

While I am not suggesting that the resulting capacity for "go" animation would provide the answer to all of life's problems, I do want to use this as an example of how the architectural decisions made around 1994 and 1996 can affect us today. In this case, the fact is that none of the major 3D animation packages have an architecture that enables desktop motion capture, or anything analogous to the real-time, interactive layering techniques that people in digital music and audio have used for decades.

But my purpose here is not to complain about the absence of features, flog dead horses, or disparage Maya or XSI. That would be as stupid as it is disingenuous. How could anyone look at *The Lord of the Rings* film trilogy, for example, and not have some pride in being part of the industry that enabled that vision to come to the screen? Rather, I am simply trying to paint an objective picture of where we are today in the hope that it might help us plan a path forward.

Here is the problem, and its roots lie perhaps more in business than in technology. Programs like Maya and XSI took a huge investment. To get a 1.0 version to market, each product took, I estimate, about 200 to 300 person years of engineering. Given the current economics of the industry, it's unimaginable that a comparable investment will be made again in the foreseeable future.

Looking back, therefore, I think that we missed an important opportunity (that is, when the money was there) to seize the potential of the moment and innovate. I understand why this happened. After all, I was there. Good people worked really hard to bring these products to market. Furthermore, the business, cultural, and human dynamics that caused things to play out the way that they did are understandable (and perhaps even inevitable). But that doesn't make me any happier about where it has left us. Nevertheless, this is where we are.

One of the positive consequences of trying to be objective about the situation is that it removes any delusion that the system will heal itself by magic. There will be no deus ex machina ending to this particular story. As an industry, we are going to have to work our way out of this in some other way.

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If we are not going to buy our way out of this through another huge investment such as was seen with Maya or XSI, where is the solution going to come from? From both the business and technology front, I believe that the only realistic hope hangs on the collective impact of a collection of smaller investments and projects. But for those initiatives to have any coherence or form a system or ecology requires a common vision to hold them together.

Need a vision

Far more than a lack of dollars or technology, I believe that it's the lack of vision within our industry that has brought us to this place. We just got complacent and lazy, which is ironic, given that we provide tools for, and work with, some of the most imaginative and creative minds in the world. Too bad more of it didn't rub off on us.

Am I being unfair? I think not. Let me put the question to the test. Consider your answer to the following: In 3D CG for film and video, do we do things the way that we do them today because it's the correct way, or because it's the only way that we knew how, and was technically feasible, in the 1980s when we started? For me (and I suspect, with today's eyes, to anyone technically literate and familiar with filmmaking and animation), the answer is obvious and clearly the latter. Yet, virtually all products from the major companies implicitly support the former. Why? Because, despite being only about 20 years old, our industry (like many others) is rooted in the inertia of the status quo. Our focus is on the proverbial buggy whip, despite the obvious emergence of the internal combustion engine.

Not only is there a better way conceptually, the technical and economic fundamentals that make such an approach viable are in place—as could have (and perhaps should have) been recognized much earlier. Sadly, however, whether for technical, economic, or cultural reasons, none of the major players seem to have shown themselves capable of changing their approach to take advantage of this potential or vision.

Of course, it's easy to criticize, especially when playing the role of Monday-morning quarterback. It's even easier when dealing in abstractions. So the least that I should be expected to do is give some indication of what an alternative model might be. Since ultimately all of this is about film, I will approach this by resorting to one of the tools of that trade, a tag line: Maya is a camera.

In this, I must make clear that I'm not trying to single out any particular product. Anything that I say about

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Maya is equally true about Discreet 3ds max, XSI, NewTek Lightwave, and so on. From this alternative perspective, all of these are simply cameras, with the particular attribute that they can only shoot images of digital assets.

Otherwise, they are like any other camera. The fundamental questions associated with their use are these:

- What are you going to shoot?
- When are you going to shoot it?
- From where?

If things are moving (such as the camera, props, or characters), then it is a cinema camera. Otherwise it is a still camera.

One consequence of thinking of things in this way is that it leads to incorporating one other attribute of conventional cameras—that is, the camera should not care what the things in the scene are made of. Just as a conventional camera does not care if what it is shooting is metal, cloth, wood, flesh, glass, and so on, the digital camera should not care if the objects in the scene are made of polygons, NURBS, point clouds, QuickTime VR objects, QTVR panoramas, 2D bitmap billboards, and so on.

Likewise, the camera should not care where these objects came from. The conventional camera does not care if your dress came from Chanel or the High Street. The virtual camera should not care if it came from Maya, Poser, a 3D scanner, or a digital photograph.

I spoke at the beginning about 3D being difficult. One of the hardest things in the whole process is modeling. There is, therefore, a real temptation for 3D CG companies to fall into the trap of believing that this means a key problem to solve is how to make a better modeler.

Yes, modeling is difficult. But it's also going to become ever less important in the CG production pipeline (except for specialists). To break the complexity barrier—and open up 3D to a larger population, rather than pouring resources into the more difficult (or maybe impossible) problem of making modeling easy—the better play is to sidestep the whole issue and take the lead from conventional filmmaking.

The example to draw on here is to get your actors from central casting. This can be done by exploiting the combination of enhanced browser technologies and the ever-improving libraries of 3D characters—which are emerging due to products such as Curious Labs' Poser. Running parallel to this is a whole other set of complimentary stories around "makeup," "wardrobe," "blocking," "directing," and so on.

Modeling does not go away. Rather, it's mainly done by a smaller group of specialists who create the libraries, and who can cope with the inherent complexity.

In some ways, the path I'm recommending is suggested in one of my favorite animated films, Chris Landreth's *Bingo*. What always blew me away about *Bingo* was not just that it was a brilliant animation. One of the most underappreciated aspects of the film was that all of the characters were the same basic model. It was a testament to what you can do with good (digital) makeup, wardrobe, direction, and actors. Sound familiar? Of course—it happens in traditional theater every day. Why shouldn't the digital universe parallel the physical?

The seed is already planted. Rather than building everything from scratch, in the future, the workflow is going to become one of

- going to central casting for actors,
- going to wardrobe and makeup to make them appear in character,
- going to the art department for sets and props,
- giving the actors direction and blocking so that they behave in character, and
- setting up the lights and cameras.

None of the major 3D companies seem to be working toward anything even vaguely resembling this type of vision. If they were, we would see things moving toward something akin to a virtual sound stage, where you could place characters, props, and sets; rig lights; set up cameras; choose lenses; and start shooting. And you could do all of this interactively, in real-time, stop or go animation, independently of what library or software package the assets came from. (Alias Systems' acquisition of Kaydara might hint at a step in this direction. However, Alias' Maya and Kaydara's MotionBuilder are mature technologies designed for different purposes. The inherent constraints of their legacy code create a substantial impediment to their making significant progress along the path I'm describing.)

If I am right, what is going to happen in film and animation is a lot like what happened in computer programming in the 1970s, with the development of Smalltalk at Xerox PARC and object-oriented programming. What occurred there was that the main tool that the programmer spent time in switched from the editor (where you write code) to the browser and related tools (where you search for, find, and modify code). Likewise, in CG we are going to see a transition from the modeler (where you create assets) to the browser and related tools (where you search for, find, and modify characters, props, and so on).

From the technological side, all of this presents a new way of looking at things. From the perspective of the user, however, it reflects a return to something familiar—and something that blends into the other aspects of production, remembering that the vast majority of CG films are not pure animation. Through a change in the conceptual model, we see one viable approach to addressing the first of our initial observations: the complexity of 3D.

Breaking free

But what about the second observation: the lack of growth in the market? My belief is that all of what we have discussed so far can feed into addressing that as well, especially if we change our frame of reference. So let's start with this: What if we could see our way to growing the addressable market for 3D CG by a factor of 10 or 20 over the next 5 years?

What would that do in terms of attracting investment and stimulating the business from all perspectives? Given what we have been living through for the past 5 years, it looks pretty good from here—if it can be done. So can it?

Here are a few observations for consideration:

- The CG market is stagnant.
- Postproduction and animation houses are also not growing.
- The number of feature films made each year is more or less constant.
- Only about 5 to 10 percent of feature films in production make any significant use of 3D CG.
- Over the next 5 years, the film industry is going digital right from the camera lens to the projector lens.
- Software will be a crucial part of the pipeline.
- Someone has to provide the software.
- Someone has to use it.

Someone has to fill the gap implied by the last two points. If, through the transition to digital, our industry can become relevant to every feature film made—from romantic comedy to a VFX extravaganza—then the addressable market has the potential to grow by a factor of 10 to 20 over the next 5 years.

For this to happen, however, these companies must break free of the mental constraint of seeing themselves as fitting in the narrow confines of the VFX/animation business. The potential is not only growth, but growth in a market that is close to what they already know, where they can exploit the value of their existing brand. In the process, they can open up growth opportunities for their key customers, the animation and postproduction houses, which also have been suffering from the effects of a stagnant market.

From what I can see, few if any of the major 3D CG players are pursuing this path. They seem to have focused their vision and competence around engineering, and refining a 20-year-old model of the pipeline. Current strategies tend toward mergers that give companies a larger piece of the existing stagnant pie, rather than taking over the whole bakery.

To break out of this stagnation, our industry has to understand that the expertise that they need to cultivate is not how to improve their existing products or the existing pipeline. Rather, it has to focus on cultivating a deep understanding of filmmaking and its history, processes, and traditions. We have to become masters of understanding technology's potential to help filmmakers achieve their primary objective, namely, getting their story onscreen—no matter what that story is.

Now I can already hear a chorus of objections and justifications chanting something like, Well what do you think we were doing for *The Lord of the Rings*? The answer is, You were addressing the needs of 5 percent of the potential market—features that make heavy use of 3D animation and VFX. If you are happy with that, then stop complaining about the lack of growth in your business, or the shrinking attendance at Siggraph. But if you want to expand your market to the other 95 percent of feature films being made, then collectively, as an industry, we have to change our thinking.

Yes, we have had an impact on storytelling, and there are many great films to attest to our successes. But some of that impact has been negative, and in the process we have taken something away from the filmmaker.

If you want to understand this, in one of the most enjoyable ways, just take a look at *The Invisible Art*.[1] Despite all of our technological advances, Alfred Hitchcock could do things when shooting *The Paradine Case* (1948) that none of our customers can do with our fancy tools: have what-you-see-is-what-you-get visual effects on set, in the viewfinder, during principal photography. Think what that means in terms of creative control to the director or director of photography.

We have the potential to transform the industry. We have it in our means to become relevant to every film being made. We have the opportunity to provide the catalyst that will enable the next George Lucas or Truffaut to find their way. And in the process, the door is open for us to create significant growth in both our industry and that of our immediate customers.

But for us to do so, we have to break free of the status quo. We need to know more about our customers than we do about transformation matrices. Another 5 years of stagnation holds no interest for me. But the alternative? Let me at it! ■

Reference

1. M. Cotta Vaz and C. Barron, *The Invisible Art*, Chronicle Books, 2002.

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