

Converging Technologies and Newton's Third Law of Motion

By Dominic Case

This is not a paper about engineering hardware — it's about the way hardware is used. The points I want to make are relevant when any new technology is introduced, but I'm looking specifically at the recent massive changes in film production and post-production. Nonlinear editing has been adopted in the film and video industry faster than any comparable innovation, and I believe that it has had an even greater effect on production and post-production methods than the introduction of video. The implications of these changes have been more far-reaching than I suspect the designers of the equipment ever dreamed of, and I think that is an important area to be discussed at a conference such as this.

Parallel Technologies

We've heard a lot of talk recently about converging technologies; but what about parallel technologies?

Parallel technologies are going in the same direction, but they never meet or even approach each other, a bit like the parallel universes of science fiction. Similar but not identical events occur in similar universes, but the inhabitants of each universe exist in complete ignorance of the others. This has been the case for many years as computers, cinema, TV, and phones have all developed, using (sometimes) similar technology in slightly different applications. Each industry and technology uses different language to describe or define similar ideas. Each has a different set of priorities, and even where another industry has developed an application outside its normal area, or imported a bit of equipment normally used in another industry, there has been surprisingly little sharing of ideas.

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For example, film and video color graders use similar equipment to color-correct images. But they use different ways of controlling and measuring their corrections, and different terms (gamma, for example, has a subtly different meaning to different people). The operators have job titles and command substantially different salaries, and I'm not aware of anyone who has successfully switched from one system to the other. The professional stills business uses similar equipment, but again there is little sharing of developed knowledge between the industries, and attempts to cross the gulf between them have generally been unsuccessful.

Again, domestic TV sets and computer monitors are essentially the same bits of equipment. Specialized standards have developed for the computer data display application, and these are quite independent from the colorimetry, scan rate, and line structure of broadcast television. However, starting with things like Atari and Nintendo games, computer people discovered that they could manage pictures on their screens as well as lines of text.

Now, in an ever wider range of technologies, people are discovering that they are indeed set on the same course as others in previously unrelated areas. In many cases, what is remarkable is not so much the similarities but the differences that have evolved in the cultures of these parallel industries, which so often interfere with any successful communication between the universes.

So much for parallel technologies. But we are hearing more about converging technologies. Simple geometry tells us that for parallel lines to converge, something must change direction.

Action and Reaction

Convergence implies that — sooner or later — there has to be a collision. It's unlikely to be head-on, but there still has to be an impact. That's where Sir Isaac Newton comes in with his

Third Law, and the title of this paper. To every action there is an equal and opposite reaction.

In fact, the principle is well illustrated by Newton's cradle. There is a row of stainless steel balls hanging next to each other. The one at the left is swung into the row, and when it collides with the others, it stops dead; the balls appear to have come back together without any long-term effect. But way out at the other end of the cradle, another ball goes flying out in reaction.

This is how the collision between computer editing and film editing has happened. Linear systems of video editing never really compared with film editing for convenience, quality, or accuracy. If nothing else had changed, it is doubtful whether the two ways of editing would ever have come any closer to each other. But with the evolution of digital imaging and large-capacity storage, computer programmers have altered the course of editing a little bit and come up with nonlinear editing systems. Where video editing was merely a parallel technology, digital editing has converged — and merged — with film editing, resulting in a change of direction in both. Action leads to reaction.

Only the most fervent Luddites would claim that this is a bad thing for film editors. Nonlinear editing has demonstrated a number of great advantages for the editing process: editors find that the time to a first assembly is dramatically shortened; that they can try out different cuts with great flexibility; and they can show the director several different versions of a sequence straight away, one after the other, without losing the first cut. Editors say that nonlinear editing doesn't necessarily lead to a quicker cut, or a cheaper cut, but it certainly can lead to a better cut.

Of course, as far as the editing process is concerned, there have been some real teething problems. The greatest of these is the amount of memory that's available, even for

compressed images. But let's remember a few years ago. There was a unit the size of a large suitcase mounted into the racks at video houses and TV stations; it was the framestore, that is, *the single* framestore. So current technology, storing half an hour's worth of image on one disk drive the size of a paperback book, seems to have the situation well under control. Memory is growing as fast as we can learn to count the bytes. A few years ago, talk of gigabytes was just that — a bit of a giggle. Now there is serious talk of terabytes — that is, a thousand gigabytes. Watch out for horror bytes!

The Close-Up, the Cutaway, and the Freeze Frame

So far, we have concentrated on a brief close-up view of the main action, the new methods of editing. And we are seeing great things.

But while we are watching nonlinear film editing and noticing the smooth absorption of energy and momentum, what else is happening? Where is the equal and opposite reaction actually taking place? Some where, Newton's cradle must have another ball flying away. And the laws of physics are just as true here. There are deep and serious concerns about what is happening in production. Let's look at a few instances.

The Vanishing Work Print

Producers and accountants have discovered that one of the biggest technical costs in a production is the cost of the work print. Now telecine houses, editors, and computer software developers all tell them that nonlinear editing can proceed without a work print. The result has been dramatic. Atlab reports that the percentage of negative they process without making a work print has risen to 80 or 90 percent for 16mm, and not much less for 35mm. Atlab is adapting to this situation, with a return to the business of video transfers, and their Digital Courier system. And certainly, if they are successful, they will have plugged one of the gaps left by the disappearing work print, as far as business for the lab is concerned, and taken advantage of the digital revolution at the same time.

But way at the other end of Newton's cradles, digital nonlinear

editing has produced a disastrous reaction for the camera department. The film work print had a second, important function, as a feedback and check for the cinematographer. Is the image sharp? Is the lighting contrast OK? How was the exposure, and will the close-ups grade in with the wide shots when the answer print comes up?

With the best will in the world, a video or computer image simply can't provide these answers. No TV system can really test the sharpness of a 35mm image, and of course, a compressed digital image isn't even a starter. TV and computer monitors don't have the brightness range to match a projected print, and can't handle the image from a contrasty image without changing it. There's no such thing as a "one light transfer," and a graded transfer comes without the easily understood report of the printer lights that tells the cinematographer how the exposure was.

Cinematographers are seriously concerned that they can't see the quality of the work they are shooting. I haven't met one who isn't. Some of the most experienced award-winning DOPs are feeling the pinch; and if they need the work print, consider the young, inexperienced cameraperson struggling with a complex lighting problem and new types of rawstock. How much more does he need the feedback? I could name many productions that have discovered serious problems at the answer print stage because of the lack of checking at the work-print stage.

The director's team and the cast are also disadvantaged. The traditional rushes screening in a theater at the end of the next day's shoot simply doesn't work on a video monitor, or even a video projector. There are many reports of crews simply not bothering to attend rushes screenings any more, with the resultant loss of morale on the entire production.

Of course, nonlinear editing is not to blame for this. I'm not suggesting that we should forego the advantages gained in editing in order to resolve difficulties in the camera department. The industry has to find ways of keeping the baby as it throws out the bath water. More enlightened telecine transfers, with reports on the grading corrections applied in a language that makes sense to cinematographers,

would be one step. I know this has been tackled, but without really satisfactory resolution yet. And this doesn't resolve the sharpness or resolution problem.

Overseas, the experience is different — I understand that most Hollywood productions still use work prints in conjunction with nonlinear editing systems. The initial work print satisfies the need for "rushes," and a quick first assembly allows a substantially reduced footage to be digitized, saving on expensive memory and reducing nonlinear editing time. It seems to be only in Australia that the new systems are adopted primarily as money-savers.

Training Issues

Back in the editing room, another side effect has arisen. In nonlinear editing, as with most systems, the computer does all the housekeeping, leaving the editor free to concentrate on creative decisions. Fine. There's work for an assistant editor at the start, logging and digitizing the material into the system. Because nonlinear editing systems are mounted on a personal computer, there's only room for one person at a time, so the assistant has to come in at night to do this. But after digitizing, there isn't much for an assistant editor to do, and so very often his employment comes to an end just as the edit is getting interesting. But this isn't just the classic effect of computers replacing people — it goes beyond the simple matter of employment or unemployment.

One of the important functions of an assistant is to learn the job. It's not just a question of getting the editing skills; after all, the beauty of computer editing is that you can try a recut without upsetting the original version. The assistant could try a cut during a lunch break — if there was an assistant — and if he had a lunch break! But the assistant is only there at night and has finished at the end of the shoot, so there's not much chance of that, and no opportunity at all to learn the politics of the editing room: how to argue with the director, how to calm down the producer, and how not to lose your job!

Let me make a comparison. Some years ago, color-grading systems in laboratories were computerized. There

is still a grader, making the creative color judgements that no machine can do; but the grading assistant, who had the humble job of writing down numbers, punching tapes, and rewinding negatives, no longer assists. The machine does it all — far better and more reliably. So there are no trainee graders. Back in those days, every grader had once been a grading assistant. It's how they learned the job, and how they got to be so good at it. Today, there isn't a single film grader that I know of who hasn't been a grader for at least 15 years. There are no newcomers — there isn't a training path, it's a dead-end job, and before long, with no one to pass them on to, the skills will be lost.

So when leading film editors complain about the loss of assistants, there is good reason to share their concern. The vision of a generation of graying film editors with no up-and-coming replacements is perhaps too fanciful; after all, nonlinear editing systems are very successful at demystifying the editing process, and so people can learn, they can teach themselves how to edit. But the mechanism of passing on the skills, of inheriting the culture, is compromised by the computer, and there is, I think, a genuine concern that film editing may thus devolve to the hands of the less skilled and less experienced (and so, probably cheaper) operators.

And this is the point of my third edit — the freeze frame. It provides wonderful detail of a single moment in time; but while we are studying it, the world is moving on. There's not much of a story if we don't consider what is going to happen in the next few frames.

Getting It Right

Of course, nonlinear editing wasn't adopted in film production in isolation of other developments. The introduction of Keykode™, and of computer software to correlate film edge numbers with video time code, made the actual matchback possible. But in actual practice, negative matching to video or computer edits is a headache. In theory it's simple: film is measured frame-by-frame in key numbers, video is measured frame-by-frame in time code; it shouldn't be any harder than

converting feet to meters, or grams to ounces. The trouble is, a lot of odd-ball techniques have evolved in video editing and in film cutting that don't really take account of the other side; few film people really understand the techniques of video and computer editing, and even fewer video people are aware of the tricks of the film business. Following my theme, they've been parallel but separate technologies all along, and moving from one to the other still involves traveling through some kind of a dimensional warp or time tunnel.

Curiously, the ones caught in the middle of the warp are the negative matchers. They are becoming the sole custodians of the arcane skills of traditional film handling. Yet they find themselves now in the role of the ferryman, bridging the technologies, having to learn the mysteries of edit decision lists (EDLs) and computer systems and to explain and account for the intricacies of film editing and printing. Managed properly, the matchback from EDL to film works well. Unfortunately, the consequences of confusion are quite dramatic and can lead to miscut negative and the wrong pictures on the screen. This has happened on a number of productions and, of course, negative cannot be "uncut." There are always other solutions, often involving editorial compromises and always costing a lot of money.

Negative cutters all know about the dissolves that can't be done because the shot doesn't last long enough. They know about the cut-back shot that the editor didn't mention; it's easy to run the same shot twice in video but a little harder in film, where a dupe negative has to be made before either shot is cut in. And they've all suffered from the speed change, where the EDL turns out to show two seconds of film filling four seconds of time. Somehow, it seems to take the editors by surprise every time.

Now, I'm not arguing against nonlinear editing for any of these reasons. I don't want to be cast as a Luddite — that's not the point I'm making. I'm fully in favor of nonlinear editing, for the reasons already given. But, in adopting the new methods, we have to take care of the side effects. For example, there are obvious techniques that

can guard against the miscut. One involves making a work print — at least of the selected takes, camera stop to camera stop — and matching that instead of the negative. That gives the director a chance to see the cut projected on a cinema screen, in film quality and dimensions, and the editor a chance to see that the cut is correct. Then, after final adjustments, the negative can be matched to the print. The Hollywood system, using the tried and tested rushes work print, provides for that method automatically.

It's true that work prints cost money. But nonlinear editing isn't really about saving money, it's about improving the edit. And that's wasted if the cut goes wrong. Ultimately, the labs may have to review their work print rates, to make the point clearer. After all, labs also suffer from a lack of work print — there's less business, and they don't have an immediate check on the quality of their processing. One possible consequence of current trends may see the further demise of film laboratories, replaced by a small chemical department out at the back of a couple of video houses. With the greatest respect to the video engineers around town, I doubt if that scenario would be welcomed by anyone in the film industry, or by many on the video side, either.

These are some of the physical reactions to the impact of nonlinear editing. Shakespeare's Hamlet sums up the position well: "*There are more things in heaven and earth, Horatio, than are dreamed of in your philosophy.*"

The film industry has evolved over the span of a complete century, and the many layers and dimensions of the technology are all interrelated. Introducing a new technology to one area will have noticeable consequences in many other areas. Consider all the implications before you decide on a production plan. There are more alternatives now than ever before, and the more alternatives, the harder the choice. But consider all the uses of a work print before you cross them off the budget, consider all the values of training before you sack the assistant, and consider all the consequences of error before you commit to new techniques. And consider the potential expenses before you commit to the false economy.