

Ludger Pfanz

# 3D stereoscopic

**A new technique challenges TV and cinema producers**

**3D is the future of television and cinema. But for the future to be bright, film and TV makers need to re-learn their craft. The author shares interesting insights on this new technique, including all the challenges 3D brings.**

If you happen to go shopping in the city in the next few days, you will see new 3D TVs, 3D laptops, and 3D game consoles popping out from almost every shop. 3D has been the major force behind the digitisation of cinema, with a massive upside on profits amounting to an average of 19%, and it will be the main force driving the development and distribution of new TV equipment. In cinema there was a time “before *Avatar*” and one after, and every smart producer is willing to rethink his or her strategy as soon as he or she learns about a figure like 2.8 billion in grosses.

## 3D – an emerging market

While Hollywood productions are skyrocketing, cultural and alternative content demonstrates a demand for 3D broadcasting. Live 3D sports is considered to be a major force to push 3D TV development. The World Cup in South Africa kicked off this trend: the Sky 3D channel started broadcasting in Germany and the UK. The same holds true for live concerts. For example, there was a live 3D transmission in Germany with the hip-hop

group Die Fantastischen Vier [Fantastic Four], shown in 120 cinemas all over Europe. Another major driving force will be young kids getting used to playing video games in 3D and expecting it later in all media.

New equipment like auto-stereoscopic monitors, cinemizers and 360-degree projectors are looming around the corner. Recently, Apple announced a US patent on autostereoscopic monitors (3D without glasses).

### *Through digitisation good 3D is possible*

You may say 3D is a mayfly. There were 3 waves already, but each time the trend died as quickly as a rat in Brooklyn. Why should it be different this time? Digitisation is the answer. Up to now, it was impossible to synchronise the 2 camera-eye channels with analogue techniques, leading to headaches and “eye-bleeding”. But now, all the technological solutions are in place. Good 3D is possible.

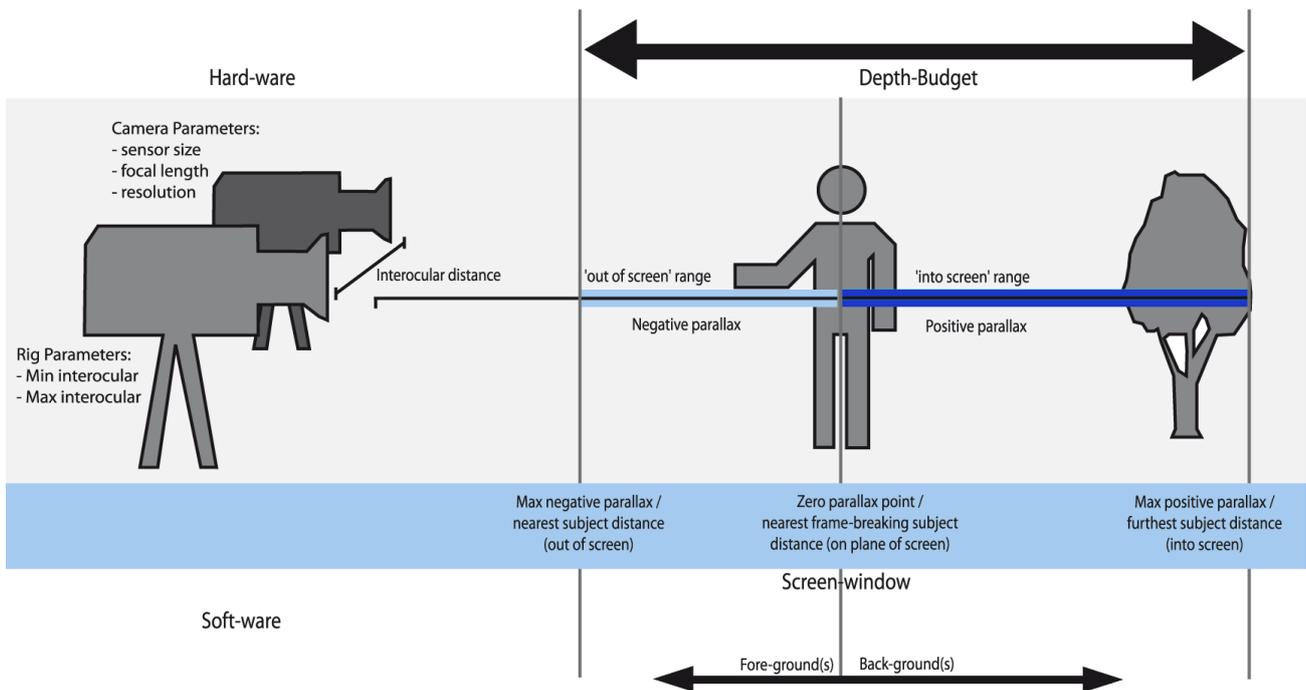
3D will be the key to growth in TV set sales. But have we not just sold them Full HD Flat Screen TVs? At the 3D Masters conference in London in June 2010, John Bird, Principal Consultant of “Futuresource”, presented a survey on who would be interested or very interested in owning a 3D TV set and came up with 71% of the population

in the US and 70% in Europe. That is huge. Asked whether they were willing to buy soon, 38% of the respondents in the US and 45% of the respondents in Europe still answered “yes”.

According to this study, the prices of 3D TVs will fall dramatically, and will amount to a third of the normal price of a normal flat-screen TV set by 2014. At the same meeting, Charlotte Jones, Senior Analyst Cinema at “Screen Digest”, estimated that 25 million households in Europe will be equipped with 3D TV sets by 2014. John Bird’s prognosis: by 2015 there might be 60 million TV sets in Europe in use, which adds up to 40% of the European households.

### *3D is the new goldmine for the media technology industry*

3D will come because it is the new goldmine for the media technology industry. However, there is still a serious lack of content for cinema, but even more so



Ill. 2: 3D stereo production requires 2 cameras; the distance between them determines the depth effect

of new 3D TV formats. At the moment there are no more than 130 Full HD 3D movies available on the global market; there are less than 20 full HD 3D Blu-rays on sale. Nobody can show or watch *Avatar* for 24 hours.

### 3D stereo basics

The basis of spatial vision is a “binocular perspective”, that is, one’s left eye sees virtually the same thing as one’s right eye. If you alternately close one eye by blinking and then the other, you have already grasped the basic principle.

The brain sets these 2 pieces of information in relation to one another and thus produces our spatial image. For this reason 3D stereo is also recorded using 2 cameras. The distance between the 2 cameras determines the depth effect (see ill. 2).

When making recordings in 3D stereo, these 2 camera eyes have to be set in such a relationship that the desired depth is achieved and so that one is also able to define what should take place in front of, behind, and on the motion picture screen.

Previously, the theory was that this

was best achieved when the 2 cameras – like our interocular distance – were placed 6.5 cm apart. In practice, however, it has been shown to be the case that this distance is too great for achieving an agreeable 3D. A distance of between 2 and 4 centimetres is in most cases felt to be agreeable and sufficient. The closer the object to be filmed is to the camera, the less this distance has to be if one is to achieve an agreeable 3D. The further away the object is, the greater the interocular distance has to be in order that camera A can also actually see something different from camera B. If you wanted to film the moon in 3D, the cameras would then probably have to be placed several hundred kilometres apart.

These 2 camera images are then shown together (either parallel, above-below, or interlaced, etc.) and then separated again, (usually) using glasses, so that the left camera is seen by the left eye and the right camera by the right eye (see ill. 3). This is achieved through colour separation, polarisation, or shutter glasses.

The point in the projection where both

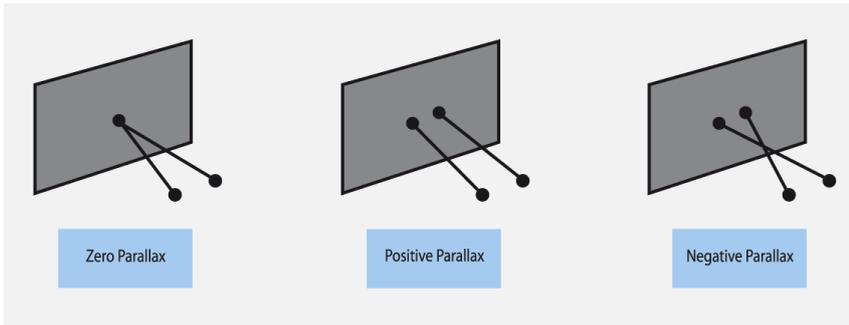
images overlap precisely is called the “screen-window”. If the left eye looks at the screen or monitor somewhat to the left of the right eye, the result is a positive parallax and the object appears in depth – in the background. If the viewer’s eyes cross in front of the monitor, a negative parallax results and the object appears in front of the screen or monitor. It “pops out” (see ill. 4 and 5).

3D stereo is, in other words, not a space projection but rather a space illusion. In reality, the image is of course on the screen or in the monitor; the depth perception arises solely in our brain.

This leads to a situation that does not



Ill. 3: 3D glasses help separate the intertwined picture which the 2 cameras have produced



Ill. 4: Stereoscopic monitors produce a disparity in the eyes (caused by producing a parallax) which outwit the brain and cause depth perception

occur in normal perception: the eye is always focused on the screen, but the viewer's attention separates itself from the sharpness and is able to move towards the front or towards the back.

It would be a naïve illusion, however, to equate 3D stereo with the perception of reality. 3D stereo is an aesthetic illusion and it is more like looking at a wall through a window that opens out onto the outside, or like looking at (into) an aquarium than anything else.

And this is as it should be, since the enjoyment of art always entails the spectator filling in the gaps in the work of art. Like the visualisation in your head that occurs during reading or listening to music, it is this active integration and comparison that constitutes the real experience of art.

### *How to budget 3D?*

Most people in the business say, "just add 25% and you're fine", but this is not true – not at the moment. If you were to have an experienced team, it would be 25% or even much less, but as your team makes mistakes and needs time for the first productions, you can easily say you have to budget 100% more – at least in the beginning. With experience it will go down to an almost normal level.

### *Space is a new creative way of storytelling*

But producers and commissioning editors have to go much further: they have to start 3D-ing from the very beginning, from the very first idea. From project development, from the

synopsis, even from the title and so on, project developers and screenwriters have to re-learn their craft. The first and main question development teams have to ask themselves is: what would be the surplus value of this specific project if it were (re-)made in 3D? A good exercise is to imagine your favourite projects and ask if anything would be enhanced if it were in 3D.

### **Opportunities and risks**

Producers of children's TV always were and had to be innovative, because their clients are the future.

And not only Disney and Pixar 3D reach their (young) audience. Constantin's *Conference of the Animals*, based on Erich Kästner's children's story, quickly made over 1.3 million euros at the box office in 7 weeks. Now it is time to develop high-quality 3D content and pilots for television – and it is now little short of the last minute to start training your staff.

Doing a quick SWOT analysis shows that 3D productions for TV will have new international future markets, encounter almost no competition, present new opportunities for fresh narrative strategies and the possibility of totally new TV formats.

The risks are clear. Public TV stations especially (still struggling with HD) will demand 3D/HD in the future, but do not want to pay more than for SD. "Fake 3D" (2D converted to 3D) will confuse the audience. "Hybrids", which have to work in 3D but should also be able to be marketed in 2D, hinder the development of real 3D art. A lack of standards will annoy consumers and unsettle investors. For example, if you buy a 3D TV set, your glasses will not work with your neighbours' 3D TV if they did not purchase their set from the same company. For producers, investments are now higher, but recoupment will take longer until saturation with 3D channels and TV is reached. The biggest problem, however, is that no real



Ill. 5: A negative parallax (viewer's eyes cross in front of the monitor) makes objects "pop out" in front of the screen

3D content exists and there is almost no experienced staff on the market. There is a prognosis from Korea that by 2013 “technical awareness” concerning 3D will switch to a “content awareness”, meaning that we will not ask ourselves “How can we do 3D?” but “Why?”. I head the world’s first institute for research and development of 3D content, the “Expanded 3Digital Cinema Laboratory” at the Center for Art and Media Technology ZKM in Germany. In my understanding, we still have, for the most part, 2D films enhanced with space at the moment, but not really developed 3D movies, just as a silent movie with added sound does not make for a real sound movie. Most filmmakers do not use the space as a new creative tool of storytelling, but merely to enhance the optical pleasure and the physical response of the audience towards the screen. One reason for this is money, as every 3D producer tries to offer 3D but still wants to milk the cow on the 2D market; another reason is that the art of 3D storytelling has yet to be developed.

### **We all have to re-learn our craft**

3D needs new stories, new formats, and a new way to direct them and act them. My theses are:

- 3D has to start with the writing. If space is not considered in the screenplay, no director will be able to carve it out later.
- In 3D, every image “frame” is a “stage”.
- The space and its coordinates need a specific “meaning”.
- 3D needs an additional dramaturgy of depth.

*The director of photography* has to know what kind of depth budget he or she is creating. How deep is the image going to be? The depth budget is usually controlled by the intraocular distance or “offset” of the 2 cameras. The director of photography also

has to know where in the picture the screen-window is going to be. What is at the back (behind) (positive parallax) and what pops out in the front (negative parallax) of the screen?

All this can be learned quickly in theory, but you need experience to arrive at the point where you really get what you want.

*Stage and early film directors* knew how to move actors: Who enters the stage from where? Who is behind whom? Who is in front of whom? Who blocks the view of whom? Who overshadows whom? This set-up is important for expressing emotional relationships and inner character situations. Since the 1960s, movie directors do not move actors, they move the camera or cut. Now in 3D, every single shot has to be considered carefully, not only as a frame but also as a stage. Directors have to learn to direct the space and give it an emotionally and intellectually significant meaning. Another thing is to get rid of some old habits. Breaking up a dialogue in over the shoulder images is not appropriate in 3D, because a single shoulder would stand out in front of the screen – something the audience, from experience, will not accept. These new phenomena are called “screen violations”. In order to direct 3D, you have to think about not looking at reality but out of a window into reality. The image composition is very focused on the centre.

As soon as the audience has seen enough spears and stones flying towards their faces, the next generation of 3D directors will have to learn to produce 3D without too much effect, but rather to make it more meaningful and to keep it comfortable.

One new tool is what I call the “Idefix effect”. Anyone who has ever read *Asterix* comic books would first scan the picture for what is happening and only afterwards read the bubbles and search for the little dog Idefix.

In a 3D landscape, the audience likes to search for something if the directors give them enough time to wander

around in the space. What we definitely need is a new timing.

### *The audience wants enough time to explore a 3D landscape*

A depth budget strategy has to be planned not only for dramaturgical reasons but also for reasons of contrast and for relaxing the eyes and brain of the audience.

*3D editors* struggle with all the “not thought throughs” of 3D productions. One of them: Jump cuts in depth. This is something they have never experienced before, because there is no depth problem if there is no depth. But they also gain new opportunities, such as cutting into the depth-layers. You can have an explosion pop out towards the audience while you cut on and behind the screen-window, using the exploding elements like a wipe into the new scene.

But professionals also have to find a new editing rhythm. In 3D, spectators first scan the space of the 3D image and then return to the subject and action; therefore, edits should be slower to allow time for orientation and a depth continuity to keep the action within a special range, so that the eye does not have to jump too much from the background to the foreground and so on.

Computer automation helps to cut costs and avoid mistakes, but we should be really careful and avoid throwing away new creative 3D tools before we have even found them.

### *3D “mistakes” offer creative opportunities*

3D “mistakes” could be some of these new creative tools. For example, if you edit a very sweet scene in a way that one eye sees the picture of one frame before the other eye does, it will add a very disturbing undertone to the image. You can use that for creating emotions, especially heavy

ones like vertigo – but only for a very short time and in low doses.

### A new story architecture

We need to go one dimension further: just as we are used to organising time in a movie to create suspense, emotions, and meaning (film is life without the boring parts), we also have to learn to organise the space in terms of suspense, emotions, and meaning: 3D is space without the boring parts. Aristotle in his *Physics* was the first to distinguish between space (topos) and time (chronos). He claims that space has its own power, creates its own effects, and that it emanates its own energy.

When you use depth budgets, you should learn to administer the 3D effect. One aspect for this is to allow the eyes some relaxation once in a while. In day-to-day perception there is no difference between what your eyes are focusing on and what your attention is concentrating on. In 3D, the eye is always focused on the screen, but attention might often be directed in front of or deep at the back of the screen. Therefore, it is important to have a depth dramaturgy overlie the normal dramaturgy in order to avoid eyestrain and headache – and this is the whole fuss about why 3D might be dangerous to your health.

Another reason for depth-budgeting is that the depth effect works better in contrast when it comes and goes. For storytelling reasons, depth budgets should be related to meaning – to meaningful metaphors for life. This is one of the easiest ways to establish “2 worlds”. In Tim Burton’s *Coraline*, for example, the normal world was almost 2D. The fantasy world, however, was not only enhanced 3D (super space), but was, at the same time, shifting very quickly between different depth-layers to emphasise the intensity of the sequences and to make the fantasy world more vivid. In models of dramaturgy like “the hero’s journey”, this could correspond to the

concepts of “day world” versus “night world”, reality versus fantasy, individual versus society, etc. In psychological terms, “2 worlds” could mean: consciousness and unconsciousness, sub-consciousness, collective sub-consciousness, and so on. Hence, screenwriters have to consider what it means for the “mind-space” in “time-space” when “things” shift from the underground to the background and from there move slowly into the centre and the foreground.

Another tool for screenwriters to create meaningful relationships between depth and narration is what we call the story molecule. It is like an onion with various (but a minimum of 3) layers consisting of (1) the inner conflict, (2) the emotional network or relationship conflict, and (3) the outer plot – the conflict within society or societies or conflict with or within the natural world.

We developed a 4-act 3D model at the “Expanded 3Digital Cinema Laboratory”:

*In the first act* you fully develop the outer plot story red thread and embed the relationships in the background and the inner conflict in the underground or subtext.

*In the second act*, up to the midpoint, you add and fully develop the emotional network – the relationship conflicts. Get the inner conflict in the background and put the outer plot in the underground, but use “reminders” to interweave and sometimes make the outer plot pop out in the foreground.

*In the third act* you fully develop the inner conflict in the foreground, interwoven with reminders of the relationship network and the outer plot line.

*The last act* leads to a ripple climax, where the questions of the outer plot, the relationship, and the inner character (or the other way round) are answered by using and going through all the different depth budgets and meaningful layers of the story. The last act of our model looks like the double helix of the DNA.

This model helps intertwine the 4 different tensions – the temporal tension in time, the horizontal, the vertical, and the parallax-tension – and the 6 main directions – above, below, left, right, in front, and behind – and helps create a meaning of space that ranges from “scope”, the range of space available, “gap”, the space in between things, and “free space”, the space to do things. More space means more opportunity to create something fresh and new.

With these simplified examples I want to open your mind for the new (story-) spaces. And I would like to remind those who are afraid of all the new stuff peeping around the corner of what the founder of the Center for Art and Media Technology, Heinrich Klotz, once said: “We don’t throw away the piano just because we now have a synthesizer. We go on using the piano – and the synthesizer.” ■

### REFERENCES

- Mendiburu, Bernard (2009). *3D Movie Making: Stereoscopic Digital Cinema from Script to Screen*. Burlington, MA: Elsevier.
- Mendiburu, Bernard (forthcoming May 2011). *3D TV and 3D Cinema: Tools and Processes for Creative Stereoscopia*. Burlington, MA: Elsevier.
- Tauer, Holger (2010). *Stereo-3D*. Berlin: Schiele und Schön.

### THE AUTHOR



Professor Ludger Pfanz teaches at the University of Arts and Design at the Center of Art and Mediatechnology (ZKM) in Karlsruhe, Germany. He is the Head of the “Expanded 3Digital Cinema Laboratory” and the “3D Alliance Karlsruhe” and author, director, and producer at Planet Films.