



Planar Tracking

an industry op-ed by Steve Wright

The Third Alternative

I have always been a great fan of motion tracking. To me, it is one of the most wondrous things a computer can do. I may be prejudice because I have had to hand track shots in the days before tracking software and know what a pain in the arse it is, not to mention how wobbly the results are. The computer, however, can lock onto a feature and hold steady in a way that the human eye cannot. I have tracked hundreds of shots using point trackers and 3D camera trackers, but I have recently discovered a third alternative - planar tracking.

The back-story is that a long-time colleague was setting up a roto shop in India (what a concept!) and wanted me to develop a Mocha rotoSCOPE training program for the staff. So I had to learn Mocha. What I discovered is that Mocha has a really cool tracking technology called planar tracking which is totally different than a point tracker or a 3D camera tracker. Point trackers lock onto small rectangles (see Figure 1) containing interesting features and tries to follow them around the screen. It does a good job unless the feature changes shape, such as the corner of a rotating cube, or size or brightness or focus or motion blur. Any variation in the appearance of the feature will flummox the point tracker and make it break lock. And of course, the grain in the frame causes the tracking data to “chatter”.

Since camera trackers start with point tracking it suffers from the same limitations. But the important difference is that the camera tracker has locked onto dozens if not hundreds of interesting features so if some of them become unusable it can make up for it with tonnage - it has lots of other points to work with. The camera tracker then performs Herculean calculations on the good tracking points to derive the camera motion data and the point cloud.



small point trackers

big chunk planar tracker

Figure 1 - comparison of trackers

The planar tracker, however, takes a completely different approach. It looks at a big chunk of the picture as a single texture (see Figure 1) which it locks onto and follows around the screen through transformations (translate, rotation, scale, shear, and perspective changes) and is not flummoxed by appearance changes



such as brightness, motion blur, and depth of field. How is this possible, you ask? Because it uses a completely different principle for the pattern matching on each frame called “projective geometry”.

Projective geometry can be thought of as projecting the tracking region of a frame through a camera lens like a slide projector, then finding the transformations required to line it up to the next frame. Because the planar tracker is comparing adjacent frames rather than a reference frame from the beginning of the shot it adapts to frame-by-frame differences as it goes. And since it is tracking a large swath of the image instead of a little rectangle, grain does not introduce chatter into the tracking data.

One very nice feature of the planar tracker is that it can track on long panning shots with ease. With a point tracker you have to keep offsetting the trackers as the features move into and out of frame. Because the planar tracker is tracking from frame-to-frame rather than comparing the current frame to the first frame it can collect tracking data for a very long shot without any offset tracking or killing and spawning new trackers. Just track and go.

One of the most astonishing things I found that the planar tracker can do is track a whip pan. This is virtually impossible with point or camera trackers because there are no sharp features to lock onto. Not a problem for the planar tracker because it locks onto large swaths of the image as a single large texture to track. Because it uses very large pieces of the image for tracking the tracking drift is minimal.

The planar tracking data from Mocha can be used two different ways. First, it can be exported to a great many compositing programs, thanks to a robust list of output formats. Second, roto splines can be linked to the tracking data to assist in the roto work.

While a lot of man-made things are made of flat planes (walls, floors, trains, etc.) there are a lot of things you want to track that are not. Most noticeably, humans. Incredibly, the planar tracker still provides very useful assistance. It can track a moving head or hand, then this tracking data can be applied to a roto shape which then follows the action quite nicely. Of course, the roto artist will still have to go in and adjust control points to change the shape when required, but the machine has done a lot of the work which cuts down on the amount of human work. Also, because computers track objects much better than humans, the roto is smoother and has less chatter.

To learn more about the planar tracker in Mocha you can view my free tutorials on the Imagineer Systems website (www.imagineersystems.com). Tracking is such a core technology for visual effects shots that you will definitely appreciate having that third alternative.

Steve Wright