Camera Tracking 101

When doing effects work, one of the things you'll encounter is to seamlessly combine a live action background shot with a computer-generated foreground element. Say you're doing a car commercial. The storyboard calls for a car driving, on two wheels only, along the edge of a ridiculously high parapet. You shoot a live-action dolly move along the edge, on a 14mm lens. Standing in for the car is a moveable rig with yellow tennis balls to provide "tracking points." The rig will be replaced by the effects wizards with a computer generated car, shall we say, a flashy Smart Car. How do they do this? And what if they don't know we shot the live action scene on a 14mm lens because the camera reports blew away while the crew was at craft service on the 110th floor? What if the effects wizards generate a CGI Smart Car that looks like it was shot on a 150mm lens? Well, compositing a telephoto shot onto a wide angle shot would certainly look weird and wrong. Here's some technology that can help out.

By Michael Lancaster, Product Director, The Pixel Farm (farming pixels, herding data: www.thepixelfarm.co.uk)

Camera Match Moving, or tracking, is the process of automatically calculating both the camera measurements and the camera motion by analysis of the sequence. This is achieved by placing a number of tracking points, or markers, within a frame and mapping their position from one frame to the next. It is repeated until either the tracking marker position on the sequence can no longer be identified or you get to the end of the shot. In the case of loosing a tracking point the software adds another point elsewhere and carries on.

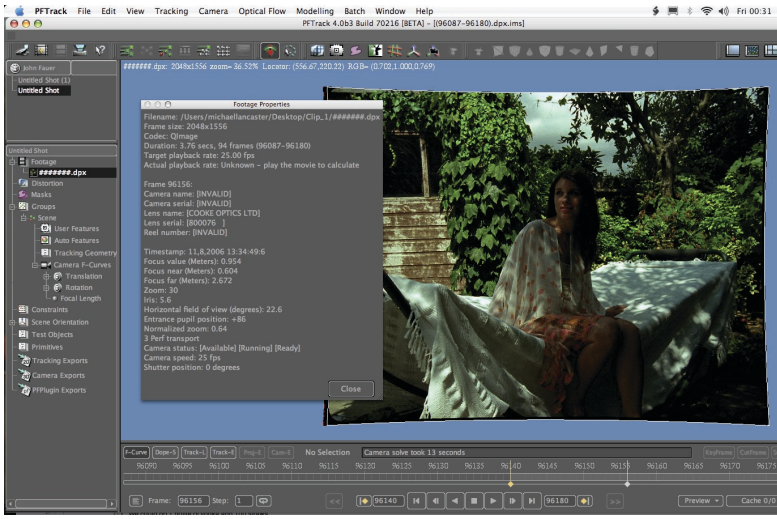
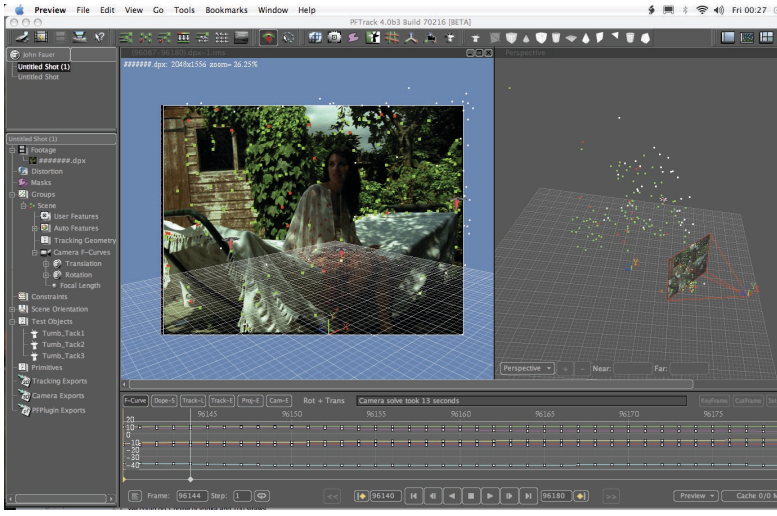
The next stage is to "solve" these points, which means to convert them from 2D into points in 3D space. This is done by working out the relative movement of points to one another using the principle of parallax. Once calibrated, the tracked points become a 3D point "cloud" that can be exported along with the animated camera data to a 3D animation application.

Within your 3D system you use the imported camera data to view your computer graphics or animation and use the point cloud as a guide to the placing of objects within the sequence. Once rendered and exported, your computer graphics can then be composited back together with the original footage. As all the camera's movement and optical properties have been matched from the original footage, the new elements should exactly match. This process, often called Match Moving, is the basis for many visual effects in feature films and television.

As you can imagine, this process is highly complex and requires many variables about the camera to be calculated: focal length, f-stop, lens distortion and film gate or imager information. Any means to aid this process or to make it more accurate will speed up these calculations and provide better end results.

Since its introduction, PFTrack has become one of the tracking tools of choice for high-end facilities due to its ease of use and its powerful toolset. It allows camera data to be entered, when known, to aid in the process. The problem is that this data can be wrong either because the camera data sheet was incomplete or just incorrect. Luckily the software can work without this information but at the cost of speed and pinpoint accuracy.

The release of PFTrack 4.0 takes things to the next level with the ability to import data collected during shooting using the Cooke Optics /i dataLink system. This provides the software with extremely accurate lens data on a per-frame basis and sidesteps the need to perform many of the internal calculations. Compensation can be made for lens optical characteristics by using the lens serial number and a database of distortion parameters. This is a holy grail: any distortions, no matter how small, can be allowed for in the final results.

The use of this data provides more accurate results in faster time, and removes yet another element of uncertainty from the set-to-post information transfer process. Its use will allow more complex shots to be completed and will also allow new types of shots. For example, it will soon be possible for a hand held camera move to be analysed and then used to program a motion control rig giving much more fluid and natural looking results than a standard computer-controlled move.

Not only that, but /i dataLink can help in motion control . You can shoot a complicated shot in real time, and then immediately hand the recorded data over to the motion control rig.