Interactive Graphics

Labeling the Contestants

Figure 6.61 *Graphics technology continues to morph into new and more interesting application. Five years after the introduction of the Fox puck, the technology had advanced to the point that instead of just highlighting a single moving object, now multiple objects could be tracked and identified on the screen. In addition, information about that moving object could be displayed. Sportvision calls this system Race/FX and uses it in conjunction with NASCAR.*

In the last section, we looked at virtual graphics where the trick was to insert an object that appeared solidly affixed to a wall or the ground. In this section we'll look at a new twist, attaching a graphical label to a moving object.

A leading application for labeling objects is used for NASCAR racing. The system, known as Race/FX, is based on data acquisition and telemetry from race cars obtained through a data acquisition and positioning system, or DAPS, from Sportvision.

The DAPS contains a 12-channel dual-frequency GPS receiver, input interface electronics, a 900MHz spread spectrum radio modem and a 486 microprocessor (see Figure 6.64). The box is mounted in the car on shock mounts, as NASCAR stock or CART Champ cars can experience as high as 19Gs of vibration through the chassis. The race car regulatory authorities insist that the electronics package can't affect the aerodynamic or mechanical performance. They also insist that all cars run equal, so even when telemetry isn't being collected for some reason, the car must still run with a dummy box of the same weight and size. All cars must use the same wiring harness.

Whereas the hockey puck was tracked by infrared light, central to the Race/FX system is the use of GPS to determine the position of the car. The antenna on the car must be installed so as to see as many of the GPS constellation of satellites as possible and, once again, not affect performance. The GPS antenna employs a metallic "soap dish" that fits flush in a hole cut in the car's roof. A fiberglass plate forms an RF window. This recessed mounting reduces the antenna gain from signals of GPS satellite at low angles.

The sides of these triangles generally emanate from two or three reference positions used on most races. The track map is used whenever the car is on the track and is nearly equivalent to one additional satellite directly overhead. If the car knew its elevation before it lost view of the satellites, it knows it must be on a part of the track with essentially the same altitude it had just determined shortly before, near where it was last. Finally the car may have a six-axis inertia system, which can be integrated once to determine velocities along those axes, and integrated again to determine position. These systems together mean that a car can have gaps of up to 10 seconds where it sees no satellites and still report its position fairly accurately, or also stay fairly accurate on a continual basis with only one satellite. These last two approaches will let the car determine which track triangle it is most likely in.

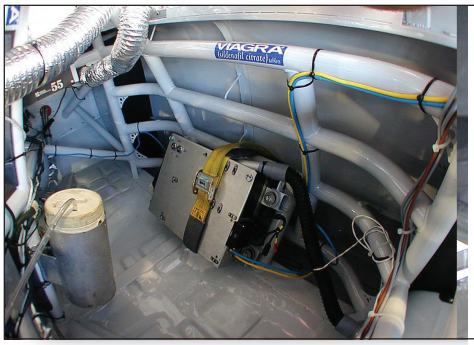

Figure 6.64 *All the race cars used by the 43 NASCAR teams have this data acquisition and positioning system (DAPS) installed against the roll cage on the "passenger" side of the vehicle (left photo). The right photo shows the antenna mount for telemetry transmit and GPS receive. Each team has about 10 vehicles, set up to run at various tracks. Most teams take a couple cars to each race. The box collects telemetry such as throttle position, steering, fuel consumption, braking and speed, among other items. (Source: Sportvision/GPS World)*

Figure 6.63 *The Race/FX system is built on the systems that came before it. It uses the same modified pan/tilt head with one addition: A gyroscope measures the vibration that the camera undergoes so that any "bouncing" video produced by these cameras using a very long focal length lens is recorded. This movement is used by the graphics computers to add bounce to the onscreen graphics, so that the keyed information moves with everything else in the picture.*

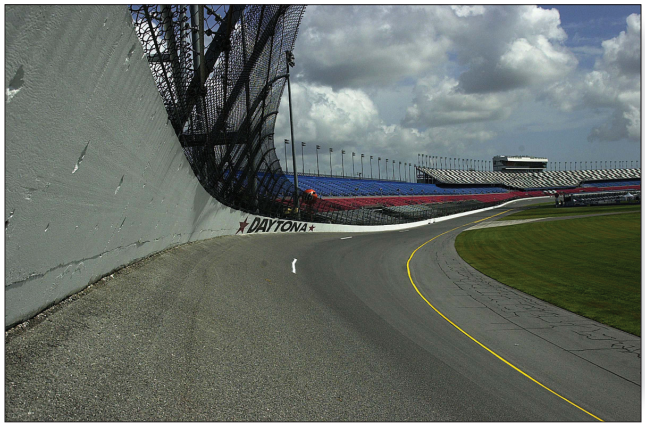

Figure 6.62 *Right: Many things conspire to limit the number of GPS satellites a car can see at any instant on the track. The minimum number of signals received from GPS satellites to know a car's position, and for that car to know the correct time, is four. Guardrails, fencing, bridges over the course and even the grandstands often lower or eliminate viewable satellites. (Source: Sportvision/GPS World)*

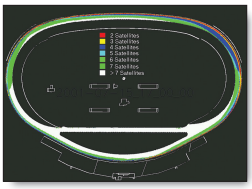

Figure 6.65 *Here is a map of the viewable GPS satellites at Daytona Speedway. To augment a car's ability to report its position with the required precision, a number of other systems work in conjunction with the car's onboard GPS receiver. The DAPS has its own accurate clock that allows the system to continue to work if only three satellites are viewable. (Source: Sportvision/GPS World)*

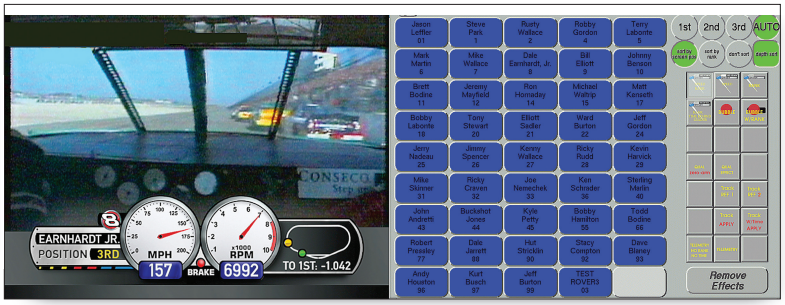

Figure 6.66 *The collected data offers some very interesting possibilities that might make for some compelling interactive TV. If all the collected data is sent to the viewer, an appropriately programmed set-top box or PC could allow the viewer to select only the cars or drivers they're interested in and have only the stats on those cars shown continuously and highlighted. Another use would be to create the ultimate car race game, where the viewer races from home against real drivers. With all the data collected, especially location, car and track data, software could let a computer render a telecast where the viewer could assume any point of view desired — inside a driver's car, any seat in the house or looking down from 500 feet up. Graphics up to now have been increasingly used to supplement the audio and video; soon graphics might be the main program component, with the audio and video playing supporting roles.*

Data collected from the cars are sent to a number of receive stations located around the track via a time domain multiplex RF system. This means that each car takes a turn transmitting. Each car's transmitter is assigned a 10ms window. In that time 120 bytes can be sent. Each car transmits data twice per second.

To sync data from the cars with video from the cameras, timecode is

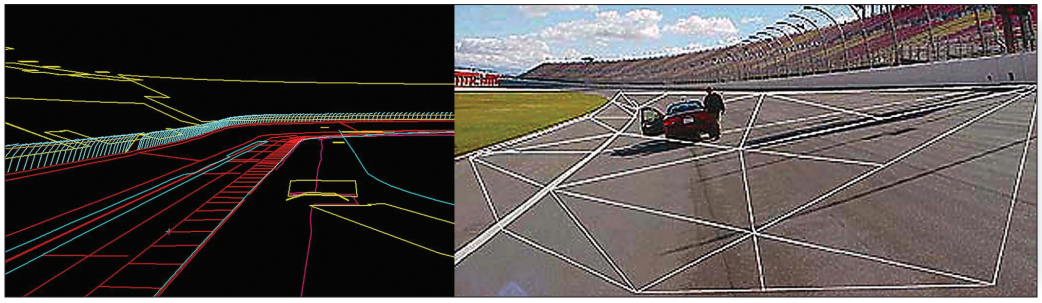

Figure 6.67 *The DAPS also has a map of the track in memory. This map divides the track into a few thousand contiguous triangles, each being five to 10 meters on a side. (Source: Sportvision/GPS World)*

Figure 6.68 *Inside the Sportvision operations truck*

inserted into the vertical interval of the cameras being used with the Race/FX system. Data gathering and processing takes two seconds, so the video must be delayed accordingly. Once the data is organized and ready for rendering it takes another three-fourths of a second to generate the graphics to be keyed over the camera video. This means that audio and video must be delayed almost three seconds behind the live race. ■