A.I. Cars for Speed Racer

Brad Herman
Dreamworks SKG

John Gibson
Digital Domain

Erik Gamache
Digital Domain

1 Introduction

The feature film 'Speed Racer' presented many interesting challenges for visual effects production. One which was how to animate forty race cars at speeds above three hundred miles an hour for several hundred shots on tracks that defy physics and most local zoning laws. Many ideas were proposed to solve this large problem. The first attempts were done with video game and driving simulation engines. The drawbacks of those systems lead to building a fuzzy logic based race car in Massive that could procedurally animate itself in the animation style approved for the show.

2 Testing and Design

Our initial approach was to use rFactor, a high end commercial car simulation engine. This same engine was used to control the motion base on-set used for the cockpits. It performed very well at that task, allowing the actors to drive the motion base with realistic car motion. A Maya pipeline was built to export the tracks to rFactor and we started driving. The highly accurate physics engine of the simulator that worked so well on set was its undoing for production work. It became apparent that neither our driving skills nor the A.I. built into the engine was capable of dealing with the speeds and types of tracks featured in this film. These issues extended to other dedicated car engines we looked at, a more flexible solution was needed.

Figure 1: Cars falling off the Racetrack in rFactor.

Massive, the award winning simulation software, is best known for A.I. crowds in feature films and commercials. It’s less known for generating procedural animation, but the tool set is very well suited to it. We designed a Massive agent around the concept of art directed car driving. It’s default behavior was to drive like a regular car and obey physics.

Figure 2: Information painted onto the track for the cars to read.

A layer of rules on top of that instructed the car how and went to bend and break those rules. The race tracks of ‘Speed Racer’ feature several inverted loops, which caused our rFactor cars to fall off the track while our Massive cars knew to stick to the track. The Massive cars could read data placed on the track and used that to help in their decision process. Information such as where to break and accelerate, passing zones, tightness and direction of upcoming turns. Each car could also react to the cars around it. Variables for aggressiveness, passing, drifting, acceleration, breaking, and speed allowed each car to have the appearance of distinct driver personalities and car capabilities. We often had very aggressive cars that would run others off the track causing them to crash. When crashing, the car would activate Massive’s dynamics system and allow it to take over from the A.I. output. The cars were built with very finite controls to allow us to tune the driving for shots. It was very important that this animation blend in with that of our animation team. It also allowed for artistic changes based on feedback from reviews.

3 Conclusion

We were able to match the stylistic driving look achieved by our animation team. Massive is able to drive a full grid of forty cars at near real time speed. The Massive cars were used to visualize some larger driving shots in the film. The extremely high efficiency of our animation and previz teams ended up negating the need to use the simulated cars in production. As with most Massive agents the finished A.I. is reusable, and may end up in another project.

Figure 3: Massive cars racing in an inverted loop.