Chapter 1. The Problem and Solution

1.1. The Problem

1.1.1. Speed Control

Speed and speed variance are related to the intensity and the number of traffic accidents. In the United States, speeding occupied a rate of 33% of all fatal traffic crashes. The Australian transportation experts' study indicated that under the premise that the vehicle speed is faster than 60km/h, the accidents' occurring rate approximately doubles while the speed increases 5km/h each time, and then the seriousness of the accident assumed the growth in exponential form. The study of American Federal Road Bureau showed that when the 85^{th} speed variance between neighboring road sections was smaller than 10 km/h, the rate of million kilometers vehicle accident was 0.46; While the variance between 10 km/h and 20 km/h, the accident rate was 1.44; when bigger than 20 km/h, the accident rate was 2.76; with speed variance increasing the accident rate doubles. Therefore, it is crucial to effectively control vehicle speed and speed difference to reduce the accident intensity and quantity. This urgently requests researchers to introduce new theory and method to deal with traffic safety problems.

1.1.2. Steering Behaviors

The driver fails to reasonably adjust lateral position of the vehicle is the main cause of frequent accidents at curves (according to accident statistics in 2011, 126893 accidents happened at the curve segments in China, which account for 43.55% of the

total number of accidents). At present, the concept of estimating the curvature of a curve based on internal tangent point of the curve and thereby adjusting lateral position is generally accepted, while the biggest issue lies in whether the information of internal tangent point is sufficient to influence the lateral position adjustment behavior and whether other visual information in motion scene also influences the lateral position adjustment behavior. When both sides of the lane are paved with continuous line markings, the driver can properly adjust the lateral position, indicating that the visual information at the left and right sides of a moving subject can also influence its lateral position in addition to the information of internal tangent point. An ingeniously controlled experiment showed that when one side of the artificially-designed corridor was moved in opposition to the bee's direction, the bees deviated from the side of the corridor. According to this phenomenon, a conjecture that "the bees may adjust its lateral position by balancing perceptual speeds at two sides" was put forward. Since the drivers on the curve segments have different visual features from bees (bees have compound eyes and its visual field is larger than limited visual field of the driver under high-velocity motion) and the vehicle speed is usually higher than the flying speed of bees (maximum speed of bees is about 24 km/h), whether the drivers adjust its lateral position by balancing perceptual speeds at two sides? As a psychological parameter, perceptual speed is difficult to measure, thus to directly analyze the relationship between the driver's perceptual speeds at two sides and its position adjustment behavior is hard to achieve. However, it is a simple and feasible way to indirectly study the relationship from visual factors influencing perceived speed.

1.2. New Solution

The main environmental information that a driver obtained is through visual. And then the driver does a series of judgments, decisions and actions to avoid accidents. Research show that the driver's visual perception is closely related to its subsequent manipulation. Accordingly, from the perspective of speed control and the lateral position control respectively, this book introduces the influence mechanism of visual

information flow on driving behavior, establishes a design model of the period length of the edge line markings, analyzes the influence of marking size on deceleration behavior based on structural equation model, designs the speed control facility in tunnels based on dynamic gratings; studies the influence of asymmetric edge rate line on the driver's lateral position at curves, puts forward and verifies the hypothesis of the driver’s “speed perception balance at both sides”.