Using Eye Tracking to Train Obstacle Avoidance

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Eye placement is a critical issue in controlling a vehicle during obstacle avoidance. Visual fixation is a normal response when presented with an unusual or unexpected object or event, and if vehicle movement is produced as a result of visual fixation, the movement tends to be toward the object or event. However, in many vehicle-related circumstances it can be detrimental if the object of fixation is an obstacle in the vehicle's path or an object to be avoided.

The Army Cold Regions Research and Engineering Laboratory (ERDC-CRREL) has teamed with Vehicle Control Technology and Team O'Neil Rally School in a three year project called S.A.V.E. (Synthetic Automotive Virtual Environments). The objectives of the S.A.V.E. project are to determine the most effective methods for training people to avoid accidents in diverse environments and develop basic simulation capabilities that reflect those specific conclusions. The majority of simulators teach situational awareness and procedural tasking, but the S.A.V.E. simulator aims to teach control of the vehicle during unusual or evasive maneuvers such as accident avoidance. One of the primary lessons in avoiding a collision is—*look where you want to go and not at what you might hit.*

During the first year of the S.A.V.E. program, the team developed a first generation simulator capable of moving in reaction to simulated road surfaces and driver inputs. The simulator provides a safe teaching environment while students are presented with a realistic sense of how driver input affects vehicle control in challenging, high-speed situations. The S.A.V.E. simulator allows students to gain muscle memory, making motions and reactions automatic. Eye placement, effective braking, vehicle weight transfer and accident avoidance are key vehicle control concepts taught through the use of the simulator.

To teach and track eye placement, the ASL (Applied Science Laboratories) Mobile Eye system is used. The Mobile Eye system consists of lightweight goggles, similar to eye glasses, equipped with two mounted cameras; one camera tracks the movement of the pupil and the corneal reflection, and the other camera tracks the scene viewed by the participant. Software is used to merge the images to a single view of the scene with a cross-hair indicating the eye gaze direction. The system is portable and versatile and is used in both the S.A.V.E. simulator as well as in the live driving environment.

The eye tracking system has recently been integrated into the driver training sessions conducted in the S.A.V.E. simulator. Five students have participated in the simulator training with the eye tracking system. An instructor emphasizes eye placement as a key technique to effectively maneuver through obstacles or around objects. In addition to using the eye tracking system in the simulator, preliminary naturalistic driving field trials have been conducted utilizing the eye tracking system; the maneuvers learned in the simulator were duplicated in real vehicles where the Mobile Eye system was used to assess how well the drivers learned the eye gaze patterns taught in the simulator. Eye placement was recorded while a participant drove on a moderately traveled road. Initial field observations show that the eye tracking system is efficient in tracking eye placement and can effectively be used as a tool to teach eye placement in the natural environment.

Further naturalistic environment and controlled course field testing will be conducted utilizing the eye tracking system during which comparisons between drivers that have been trained in eye placement will be compared to untrained drivers. By implementing the eye tracking system into the simulator, the S.A.V.E. team aims to demonstrate how simulator-learned skills—especially eye placement—transfer to real-life situations.

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