Use of Commercial Visualization and Modeling Software to Support Training of Cognitive Driving Skills

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ABSTRACT

Overview: This paper will focus on selection and application of a low cost virtual simulation environment configured to support both driver training and driver training research.

Background: Virtual Simulation and Training Inc. (VSAT) has, for many years, supported Independent Research and Development focused on training cognitive skills needed to reduce teen driver crash rates. VSAT seeks to exploit training techniques successfully used by the Air Force to train pilots through the Red Flag exercises, and through the use of Distributed Mission Operations. Such training is dependent on high fidelity simulation to create the training scenarios and provide the virtual environments required. A simulation system is needed that integrates the vehicle driven by the student driver, the external driving environment experienced by the student (visual, sound, force cues), and the authoring capability to rapidly build and modify the virtual environment. Training of cognitive skills requires simulation fidelity exceeding that needed to train students to simply operate their vehicles (to drive cars, fly airplanes, perform emergency procedures, etc.)

Technical Issue: The simulation technology and fidelity required to support VSAT's objectives has been available for many years, at a price. Until recently, that price was much more than the VSAT business model could accommodate. While military training and research organizations are often blessed with substantial budgets that support purchase of traditional simulation systems and technology, VSAT sought to develop a training capability that could be purchased and supported by typical teen driver training companies. Most are small businesses with limited capital. That implies a total sales price of well under $100K per system, to include the driving cab, image generation, displays, computation and authoring components, visual databases, all software, and the curriculum. VSAT also required that the simulated environment, scenarios, and all dynamic elements within the environment (vehicles, people, animals, weather, etc.), be easily created and modified without writing code, or depending on contractor/manufacturer support. These requirements were seen as difficult, in that traditional image generation and database development systems integrate many expensive components (hardware and software), each having a learning curve, and each requiring specialized skills. As an example, simulation of individual combatants or movement of crowds typically required purchase of specialized software for that purpose, and integration of those simulation elements. High fidelity simulation of vehicle dynamics typically required custom modeling of the vehicle, or the purchase of a vehicle dynamics model at significant cost. VSAT could not support such costs.

Approach: After considerable market research, VSAT adopted a simulation system sold as commercial, off-the-shelf, Windows-PC based software (COTS). This product was originally developed to support urban visualization; hence, it inherently provided user tools and capabilities needed to model new environments (roads, bridges, tunnels, lakes, buildings, trees, landscapes, traffic lights, signs, signals, embankments, railroads, headlights, street lighting, etc.). It also simulated high density vehicular traffic, pedestrians, animals, and crowd movement. The simulation included environmental effects (rain, wind, snow, fog, smoke, haze, water on roads, sheeting water on windshields, and the effects of windshield wipers, etc.). Sound simulation included road noise and Doppler effects of cars passing the driven vehicle. The user interface supported modification of vehicle dynamics. No software programming skills were required to author or modify these environments. Open interfaces enabled coupling the simulation to a vehicle cab, multi-panel visual displays, an instructor-operator station, and force cue mechanisms. This "all-in-one" simulation system package, with all authoring capabilities, was offered by the Forum8 Company of Japan for under $15K.

Progress: VSAT recently completed development of a virtual training environment we believe will support training cognitive driving skills. The environment is integrated with an automobile cab and displays, and a custom designed instructor-operator station. A curriculum and training scenarios have been developed to support proof-of-concept trials and demonstrations. Work is ongoing to integrate force cue mechanisms and enable driver performance metric data collection and analysis. We expect to start training trials prior to the end of the year.

Impact of Research: In Ohio alone, drivers aged 16-25 are involved in 179,000 crashes each year. Over 450 young people are killed, and over 45,000 are injured. Over 100,000 of these drivers are found to be "at fault" by the investigating officers. These crashes result in insurance company payouts exceeding $1.5 Billion annually. Our analysis shows that it takes approximately ten years, and 100,000 miles of driving, to make a safe driver. It takes THAT LONG to accumulate the experiences and develop the cognitive skills needed to avert serious crashes. The Air Force and the Navy have proven that aircraft crash rates can be significantly reduced by training cognitive skills using training environments like Red Flag and Distributed Mission Operations. VSAT believes that appropriate training of cognitive skills needed in driving could reduce the total crash rate by over 50% among drivers age 16-25. Many simulation companies and driver training schools have attempted to use simulation to augment state-mandated driver training programs. Unfortunately, these initiatives failed to demonstrate a significant reduction in crash rates. VSAT believes that low-cost simulation CAN make a difference in crash rates, if properly developed and deployed as part of a total training system. The task---is to deliver the training value of 10 years and 100K miles of driving ---- in a 16 week training course. We seek to demonstrate that this can be done. We believe the impact of this work, in terms of saved lives, reduced pain and suffering, and reduced societal costs… is well worth our investment in performing this work.