MASTER OF SCIENCE
IN
MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

VISUAL SIMULATION OF NIGHT VISION GOGGLE IMAGERY IN A CHROMAKEYED, AUGMENTED, VIRTUAL ENVIRONMENT

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As data from the U.S. Army Safety Center supports, a large percentage of Army Aviation human error accidents occur during Night Vision Goggles (NVG) flight. Despite this fact, there are very few simulation tools available to aviators at the unit level that aid them in learning or practicing NVG flight tasks. This thesis examines the potential for a Chromakeyed Augmented Virtual Environment (ChrAVE), consisting only of Commercial-off-the-Shelf (COTS) hardware, to be used as an NVG flight training platform. It also examines whether or not physically-based light calculations are necessary to produce adequate visual representation of simulated NVG imagery. Twelve subjects performed simulated low-level NVG flight navigation tasks in the ChrAVE. Treatments included questionnaires, vision tests, variation of the physics-based component of the NVG imagery, and performance of an evaluation task that compares standard thresholds between day and NVG navigation. Analysis of data and subject feedback suggests that the ChrAVE has potential as an NVG flight training device, and that physically-based calculations may not be necessary to achieve simulated NVG imagery that is adequate for training in all domains. The data also supports the existence of a substantial difference in the subjective evaluation standard between navigation performances based on flight condition.

KEYWORDS: Night Vision Goggles, Virtual Environments, Terrain Association, Navigation, Embedded Trainers, Chromakey, Augmented Reality, Mixed Reality, Helicopter, Mission Rehearsal, Route Rehearsal, Spatial Orientation, Human-Computer Interface, Flight Simulation

ADAPTIVE RULES IN EMERGENT LOGISTICS (ARIEL)-AN AGENT-BASED ANALYSIS ENVIRONMENT TO STUDY ADAPTIVE ROUTE-FINDING IN CHANGING ROAD-NETWORKS

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The delivery of supply in combat operations is very important and often results in the success or failure of a mission. This activity, as well as other transportation problems, has traditionally been modeled using global optimization techniques, such as linear programming. However, the goal of this thesis is to examine the feasibility of an agent-based solution to study the movement of material through a road network. The requirement is to build an agent-based system that finds the optimal route through a given road network and is capable of adapting to disruptions introduced to the network and then find alternative routes through the network. The agents act from a local perspective, and can represent more realistically the decisions being made throughout the delivery process. This thesis implements an analysis environment for road networks and develops an agent-based model to build truck-driver agents that are capable of delivering supplies through a changing road network.

KEYWORDS: Complex Adaptive Systems, Agent-based Modeling, Multi-Agent Systems, Optimization, Network-routing, Complexity Theory, Modeling and Simulation

AGENT-BASED SIMULATION OF ROBOTIC SYSTEMS

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A goal and behavior agent layer Java Model was developed to simulate cruise, correct, and avoid Control Modules in an autonomous agent (robot). The model was tested against a deterministic Figure of Merit (FOM) to predict a “best mix” of agents for the simplistic agent economy parameters given. Future work suggests validation of the model with real agents in a real economy.

KEYWORDS: Agent Based Simulation, Modeling and Simulation, Robotics, Self-organization, Behavior Based Robotics