TransLumen Technologies
Applying STEGC to Perceptual Training

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Company Background
TransLumen Technologies, LLC ("TransLumen" or "TTL") is a Service Disabled Veteran Owned Small Business company (SDVOSB). The company was incorporated in February, 2000. TransLumen spent its early years developing its technology inventions, filed for its patents at the beginning of 2000 and was awarded US patents #6,433,839 and #6,580,466 with international patent applications filed. TransLumen has also been awarded a Homeland Security grant, NASA grant and an Office of Naval Research grant.

TransLumen Technologies, LLC creates proprietary and patented visualization technology and tools for software, firmware, and content. TTL's data and image visualization technologies automatically manipulate images, seamlessly and continuously in a stream, below the level of human perception. The image streams retain the integrity of a still image, but are, in fact, continuously evolving dynamic images.

Technology Application for Perceptual Training in Warfare and Overall Security
Perceptual training is critical to improving a soldier's ability to identify subtle temporal environmental changes and adapt quickly to changing information obtained in combat through TransLumen's Subthreshold Extreme Gradual Change (STEGC) algorithms for improved scene perception and minimization of change blindness effects. The solution entails training the user's cognitive processes to locate relevant information in visual scenes controlling scene management for more cohesive training simulations. Subthreshold Extreme Gradual Change (STEGC) is an unobtrusive form of visual data delivery. This provides an image display that can allow display-to-display images without introducing distraction. The transition images are displayed in sequence over a sufficiently long period of time, so that a human observer cannot perceive a change in display from one image to a succeeding different image, yet over time, the display transitions from the first image to the second image. Used in perceptual training STEGC can be used to both test and train observational skills.

TransLumen's technology provides methods/systems for producing images along a transition path wherein sequential images are imperceptibly different from each other. In one aspect, the resultant display of such an image series or set is an appearance of a "still" image that evolves unnoticeably over time. In Figure 1.0 below, a scene representation of a sniper is revealed. In video this image would appear over time, but for this representation, there are three images representing three screen captures taken from an example of a stream of video. This provides an image display that can allow display-to-display images without introducing distraction.

A simulation can be designed to enhance warfighter anomaly detection, as well as providing the basis for improved training of perceptual skills to mitigate insurgent efforts to adapt their tactics.

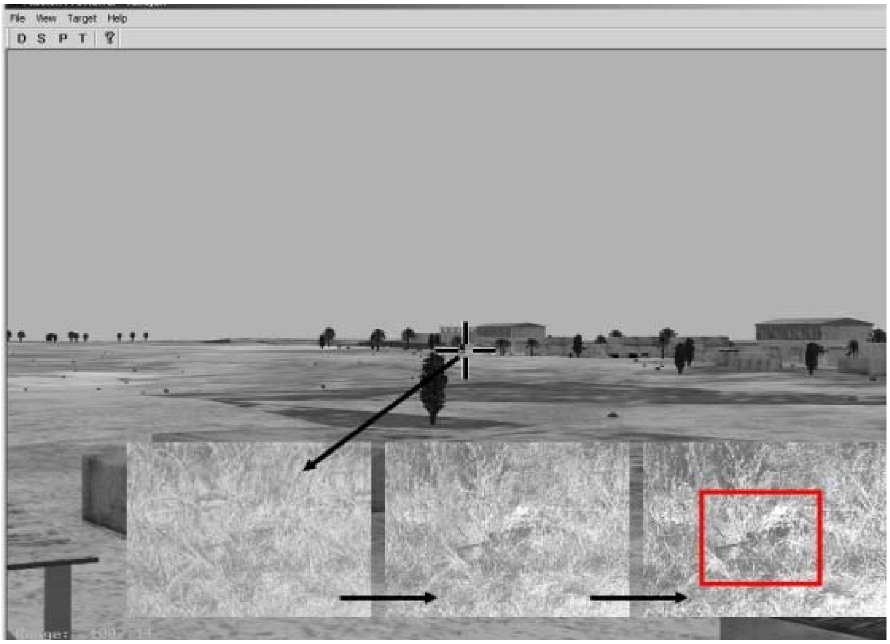

Figure 1 – TransLumenized Sniper in the Grass

The goals for using STEGC will be accomplished by applying principles similar to those found in gradual change blindness and incorporating advanced scanning strategies. Training for subtle changes in simulation scenes such as weather changes over time, natural ambient light and man-made terrain changes can create more granularities for observational interpretation and for managing attention and concentration on the most critical and/or threatening information. The technology is based upon changing a graphic object at the fastest rate possible without change being perceptible as it occurs. Perceptual learning refers to performance changes, brought about through practice or experience that improves an organism's ability to respond to its environment and includes four mechanisms of perceptual learning: attention weighting, imprinting, differentiation, and unitization.[1]

The temporal visual spectrum extends from sub-threshold cueing or priming, through normal real-time display to sub-threshold extreme gradual change, as shown in Figure 2. Sub-threshold cueing or priming, on the left in Figure 2, where cueing or priming imagery is interweaved with the motion/video is what was previously called subliminal imagery (popcorn in the movie theater). Here change is not “seen”, but it registers in the brain then through the center part of the spectrum - where, when a change is detected it is both “seen” and registers in the brain, simultaneously for all intents and purposes, such as waving a hand.

Sub-threshold extreme gradual change on the other end of the visual spectrum, on the right in Figure 2 is where the change is visible, but does not register in the brain as it is occurring. This is where the TransLumen Technologies STEGC technology applies. Some naturally occurring examples include, paint drying, grass growing, and glacial and tectonic plate movement.

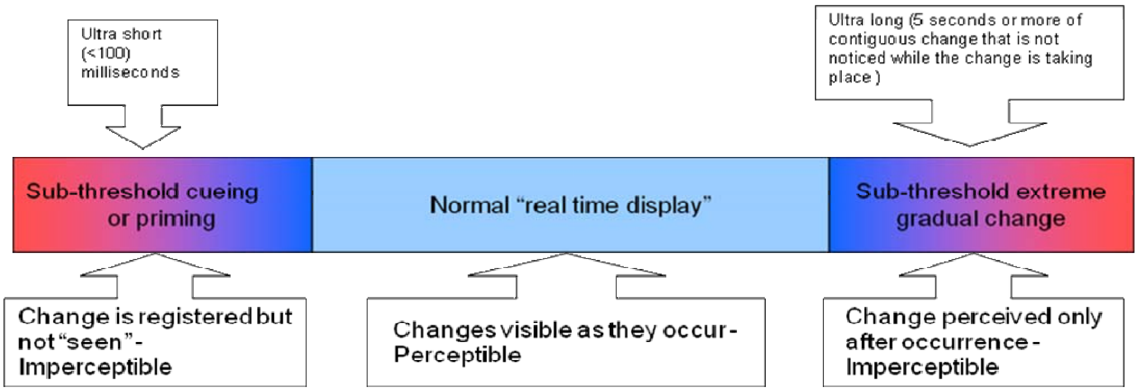

Figure 2 - Temporal Visual Spectrum

Theory of Scene Perception

It is now generally thought that observers use covert visual attention and overt eye-movements to orient the high-resolution parts of the retinas (the foveas) towards salient parts of their visual environment. The conventional view is that processing related to recognition of objects then 'takes over' in a serial manner after this exploration. Despite the apparent separation of these attentional and recognition processes, they are still critically dependent on one another, especially in the context of the perception of a complete scene.[2]

Three main visual phenomena; change blindness, gradual change blindness and subthreshold extreme gradual change are observational principles with which to deal. Warfighters routinely encounter circumstances similar to these when they are distracted or interrupted while scanning areas of interest by movements of people and objects such as a truck momentarily obscuring the object of interest or when dust or fog slowly envelope an area. When returning to their scans their minds compensate for the distraction by creating an understanding of the scene using expected images. This internal mechanism is especially powerful in areas that have been patrolled by the warfighter multiple times in changing weather conditions and ambient light.

Applying TTL technology to simulations will allow warfighters to establish a finer granularity of perception in identifying physical threats. Developing and honing advanced scanning abilities will improve the warfighter's abilities to anticipate and accurately discern relevant information from observations made. The STEGC algorithms are cross platform compatible, capable of running on all common DoD operating systems, and have low CPU and bandwidth usage requirements.

Full custom implementations allow virtually any desktop or screen object to be used. It is scalable and portable for mobile and desktop computers, command and control installations and simulators. It may be augmented in the future by neurophysiologic monitoring and feedback and combined with other technologies including subthreshold priming if needed.

Recognition of Attentional Variances and Tasking to Mitigate Observational Errors

Gradually changing parts of a simulation will assist in the detection of image anomalies by training the warfighter's mind not to insert expected mental images into their field of view when conducting multiple scans of an area or when mentally compensating for distractions such as movements of objects or people.

The amount of information that can be held by attention is extremely limited (four to five images in an image can be accessed at a time).[3] With this inability to attend to a larger number of objects, it is imperative that attention is focused on the highest priority objects. This can be accomplished through improved scanning patterns including temporal spacing from object to object. Improved attentional based training tools should reduce visual bias in perception mitigating the incorrect interpolation of scenes that are not consistent with the environmental reality.

The "gist" or original perception of a scene can be misleading due to scene manipulation. Improve attentional observation can mitigate the failure to recognize anomalies in their perceptual space.

The hypothesis for developing advanced perceptual training with imperceptible change in vision related simulations (STEGC) is built upon the following:

1) People perceive scenes differently from one another. For example an individual's capability to discern such visual attributes as a) color (color blindness), b) motion/change detection and c) ability to attend to objects in their field of view.

2) Training applied to existing environments will demonstrate that imperceptible change imagery driven by the STEGC can be used to a) screen for the ability to detect minimal temporal changes, b) be used to develop attentional abilities, c) be used to increase dwell times where desirable and d) mimic real world dynamics.

3) That a) static scenes (Find Waldo) lack real world type changes, b) scanning can be ritualized and c) attention can be directed at an object indefinitely for analysis.

Full motion video scenes provide stimuli that may capture observer's attention and determine observers scanning pattern due to saccades.

Predators have used visual noise (camouflage) and slow temporal movements to stalk their prey. Terrorist/enemy combatants are predators and exhibit the same characteristics. Applying STEGC to simulation training effort will be used to show that people can be better trained to detect these changes by using subthreshold extreme gradual change rendered video streams.

Applying STEGC to simulations can further training levels in other security areas as well as any training that requires better observational skills to perform their job. This training will decrease first response times and identification errors. The outcome will be a decrease capital costs and most importantly save to lives at risk.

References

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2. Burmester, A., New Investigations into the Visual Representation of Objects and Scenes, St. Lucia, Australia: University of Queensland PhD Thesis, (2005)

3. Rensink, R. A, Internal Versus External Information in Visual Perception, 2002, pg4