channels. The resulting performance should enable low-power, high-speed switching in a small device.

Possible materials include nonlinear glasses, semiconductor crystals, and multiple quantum-well semiconductors. The patents describe the necessary material parameters, including negative group velocity dispersion, nonlinear index of refraction, and wavelength of light, that are required in order for the light bullets to interact and selectively change each other's direction of propagation.

The figure shows the results of a computer simulation of two counter-propagating light bullets at four instants in time. As they collide with each other, they deflect each other through attraction. This deflection is the basis of a light switch, that is, where light switches light.

Point of Contact: P. Goorjian
(650) 604-5547
goorjian@nas.nasa.gov

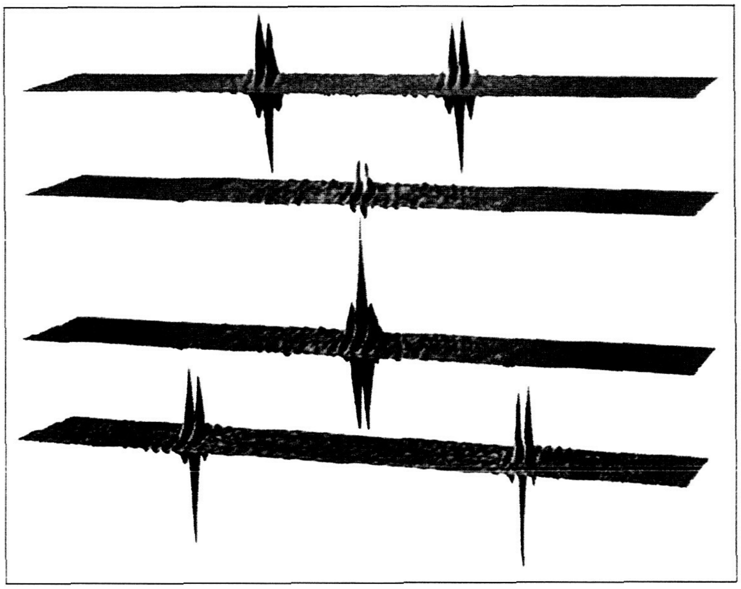

Fig. 1. Collision of two counter-propagating light bullets.

A Computational Model of Situational Awareness

Robert J. Shively

Situational awareness (SA) is a term that has great intuitive appeal, especially in aviation. Although often invoked in a descriptive manner, SA is difficult to precisely define. As a result, a computational, mathematically defined model of SA has been developed. The goal of the modeling effort was to enhance researcher communication and to advance efforts to improve pilot SA and performance through improved display design or aircrew procedures.

The Computational Situational Awareness (CSA) model is composed of two essential features: situational elements and situation-specific nodes. Situational elements (SEs) are relevant information in the environment that define the circumstances (for example, other aircraft, obstacles, way points, ownship parameters). The pilot experiences these elements through perception, experience, or a preflight briefing. Each SE has a mathematical weight based upon its importance in the situation and a mathematical value based upon one of four levels of awareness (detection, recognition, identification, and comprehension). These four levels of awareness provide a means of quantifying an operator's perception of the situational elements.

Situation-sensitive nodes are semantically related collections of SE's. The nodes are defined by the context of a given task and are weighted by the overall importance of the node in determining the level of SA. If the situation changes, then the weights on the nodes, or the nodes themselves, may change to reflect accurately the level of SA. SA is the weighted average of knowledge that the pilot has in each node, and thus is a measure of the pilot's perceived SA. The CSA model then subtracts an error component, based on misidentified SE's or unknown elements in the environment.

The computational model of situational awareness was designed to be embedded in an existing model of human performance, the Man-Machine Design and Analysis System (MIDAS). MIDAS has very detailed representations for the two major components of human-systems integration: (1) the human operator, and (2) the system, or environment under study. The human model consists of perception, and cognitive processes such as working memory, scheduling, decision making, and long-term memory. Output measures from the aggregation of models include task execution time lines, operator workload, and the aforementioned situation-awareness construct.

The systems model includes the cockpit, or workstation, the environment, and the human figure model. The environmental model consists of elements in the world with which the simulated operator or crew station interacts, for example, trees, other aircraft, tanks, or air traffic control. The human anthropometric model is Jack®, developed by the University of Pennsylvania.

The CSA model was developed, integrated into MIDAS, and tested in simulation. A recent study evaluated the validity of the CSA when compared with pilots in a manned simulation with very favorable results. As shown in figures 1 and 2, both subjective ratings of SA (Subjective Awareness Rating Technique: SART) and performance measures of SA (RMSE altitude) are highly correlated with the predicted SA levels.

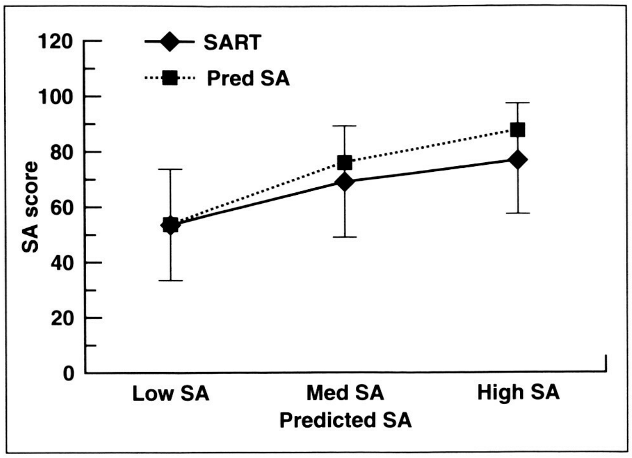

Fig. 1. SART versus predictions.

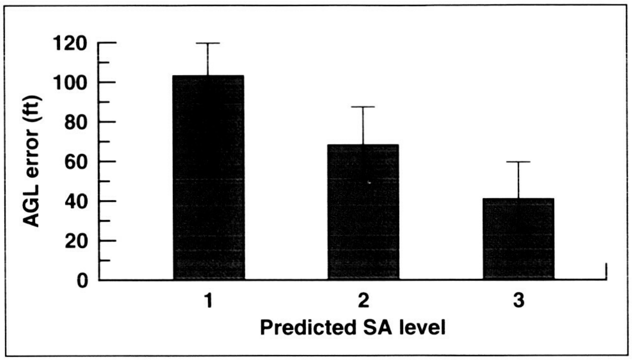

Fig. 2. RMSE altitude versus predictions.

Point of Contact: R. Shively
(650) 604-6249
jshively@mail.arc.nasa.gov