



## **SBIR Commercialization Assistance Program**

### **Tactile Situational Awareness System (TSAS)**

#### **Engineering Acoustics Inc.**

##### ***Business Opportunity:***

The Tactile Situational Awareness System (TSAS) is an advanced flight instrument that uses the sensory channel of touch to provide situational awareness information to pilots. TSAS improves pilot performance in a number of critical tasks including maneuvering in degraded visual environments, thereby improving safety. Vibrotactile feedback has associated markets that include research, military, industrial and medical applications (such as balance rehabilitation).

The TSAS primary market is military aviation. Rotorcraft present the highest value-add for the TSAS technology with a market size of \$100 million. For military applications, Engineering Acoustics Inc. (EAI) is looking for a strategic partner (preferably a prime defense contractor) to integrate TSAS within new or aircraft refurbishment programs. For associated vibrotactile medical applications, EAI is looking for medical services partnerships and any investment opportunities that will help accelerate these solutions to market.

##### ***Company Background:***

The company was founded in 1991 as a privately held corporation and has a staff of 12 full-time employees. It is a high-tech R&D and low volume manufacturing company specializing in acoustic, vibrational transducers and systems for defense, biomedical and geophysical applications. The company has engineering, software development, new product design, manufacturing, and applications development operations in Casselberry, FL. The company is profitable. Over the past decade, the company has pioneered the development of wearable vibrotactile actuators, controllers and system software.

##### ***Industry Problem:***

Spatial disorientation (SD) and the subsequent loss of situational awareness account for a significant percentage of fatal mishaps in aviation. In particular, rotorcraft are susceptible to SD as they may spend a high percentage of operational airtime in close proximity to the ground and can be expected to operate in degraded visual environments (DVE). The cost of SD is estimated to be \$1M per day to the military. SD is also similar to a medical condition referred to as "vertigo". Approximately 1/3 of people over age 65 fall each year. A principal cause of falls is impaired balance. Impaired mobility due to balance deficits and fear of falling often leads to a diminished ability to perform activities of daily living and eventually a transfer to dependent living. Increasing level of care from informal to formal becomes a potential \$36 billion annual

cost to Medicare and other payers. The technology promotes balance rehabilitation and improves patient functional mobility, reducing the need for formal care.

### ***Technology:***

The sense of touch is intrinsically linked with reflex and movement – think of how one automatically responds to a tap on the shoulder. Touch, therefore, represents an intuitive communication channel that is closely linked to spatial orientation. Vibrotactile spatial cues therefore can alert a user to the location of a specific threat, or be used to augment sensory information and thereby reduce workload. The TSAS system consists of a controller and an array of vibrotactile actuators that are integrated into flight garments. The controller accepts data from various aircraft sensors, interprets and presents various modes of information via the tactile stimulators to the pilots. Other associated technology includes wearable vibrotactile belts that are used as a communication display for dismounted soldiers. Medical applications such as balance rehabilitation consist of a force plate sensor, controller and vibrotactile belt. Vibrotactile postural feedback is provided by the system to patients. This approach facilitates the training of patient movement and limits of stability.

### ***Advantages and Differentiating Feature:***

- Vibrotactile feedback is an untapped channel and not subject to the same cognitive resource limitations of vision and audition – thus tactile feedback is highly effective in situations involving high stress.
- TSAS improves the performance and reduces the workload of pilots.
- Vibrotactile feedback improves functional mobility in patients with balance deficit and is more effective than conventional therapy.
- Vibrotactile feedback is intuitive and well-liked by users.

### ***Stage of Development:***

The vibrotactile technology is highly advanced. The technology has been available commercially for several years and has evolved to include complete turn-key systems. TSAS will reach Technology Readiness 7 by Q1 2010. The balance rehabilitation application is in clinical testing and undergoing regulatory approval.

### ***Competing Technologies:***

There are a number of competing technologies aimed at addressing DVE in aircraft. Most of these use visual displays to provide the pilot with information regarding the spatial orientation of the aircraft. Despite significant improvements in cockpit displays, there has been no significant reduction in the SD accident rate.

Direct competition to vibrotactile actuators includes systems based on pager motors. However these are prone to the effects of loading and seldom produce enough vibratory output to be effective in practical (noisy) environments.

### ***Applications:***

- Aviation: military and commercial rotorcraft and fixed wing platforms
- Dismounted war-fighter: covert communication, spatial awareness, navigation, threat localization

- Commercial: lane departure avoidance alert in motorcars, haptic feedback for mobile devices
- Biofeedback: balance rehabilitation

***Benefits:***

- Aviation: improve pilot performance and thereby reduce spatial disorientation, improve safety and meet mission objectives
- Vibrotactile communication augments the existing sensory pathways without adding cognitive loading
- Vibrotactile threat localization has been shown to be much more rapid than visual and audio cues
- Vibrotactile feedback in medical applications is an effective therapy with proven retention and translation of learnt skills to new tasks

***Intellectual Property:***

Engineering Acoustics Inc. has five pending patents directly related to vibrotactile hardware and two pending patents related to biomedical applications using vibrotactile feedback.