**4 Electronic Design Requirements Of The System-Integrated Soldier**

***By Clinton Shaffer***




Perhaps most famously portrayed in Robert Heinlein's *Starship Troopers* (1959), the idea of the "future soldier" has been around for decades. As rehashed in countless science fiction films and video games, the stereotypical future soldier is equipped with a protective exoskeleton, enhanced sensory equipment, seamless communication systems, and advanced weaponry. While the concept once seemed implausible, there are many real-world projects under way focused on realizing those seemingly fictitious warfighter capabilities — by integrating a plethora of diverse electronic subsystems into a cohesively operational suit.

One such project is the U.S. Special Operations Command's (SOCOM's) Tactical Assault Light Operator Suit (TALOS), which is slated for completion by July 2018. An ambitious project with collaborators across many military, academic, and commercial organizations, TALOS is a prime example of a warfighter technology that will require tremendous effort to integrate its individual subsystems and attain its lofty functionality goals.

The primary objectives of the TALOS project and similar programs include improving soldier capability, lethality, and survivability. What follows are some of the key capabilities that are driving the development of those projects.

1. Enhanced Situational Awareness

A major driver for future soldier systems is the need for improved situational awareness — a concept contingent on improving and integrating sensing and imaging technology. The TALOS system, for example, will incorporate an intuitive cognitive interface to provide users with easily accessible information from across a broad network of monitoring and sensory systems. Accessible information could include anything from the warfighter's medical status to data from various threat-detection and environmental sensors. Different types of imaging, like thermal and infrared, and shared-vision capabilities will also play a major part in improving warfighter situational awareness.

2. Net-Centric Communications

In order to access and share the rapidly expanding amount of sensory information, future soldier systems will require comprehensive, multimodal communication capabilities that coincide with onboard computers for data processing and storage. Essentially, that means the system will need a sophisticated, secure way to integrate the commercial Internet of Things (IoT) concept into the battlespace — creating a network-enabled military force of soldiers interconnected with operating

bases, drones, and remote sensors. Battle management systems (BMSs) have already started incorporating datacentric communications with video, picture, and chat functionality for more effective communication and better decision making across groups of connected soldiers.

3. Autonomous Vehicle Support

Another major initiative is to provide improved support to warfighters through the use of unmanned aerial and ground vehicles — not just for better surveillance and improved lethality, but also for protection and to aid with more mundane tasks. These projects include bringing total autonomy to currently manned systems, like the Blackhawk helicopter, and aiding soldiers with robotic assets for off-loading equipment. In order for human-to-robot cooperation to be successful, however, more intuitive communication systems will need to be developed for natural and effective man-to-machine collaboration in the field.

4. Exoskeleton Integration

For future warfighter technologies, the protective exoskeleton can potentially serve as the platform for integrating the various capabilities of the total system. While early versions of exoskeletons, like those in DARPA's Warrior Web project, are under development to prevent musculoskeletal injury and reduce the overall workload of the individual warfighter, more sophisticated versions will incorporate technologies like improved protective glasses with advanced vision capabilities, bullet-stopping armor, and the communication and situational awareness functionalities discussed previously.

There are, however, some daunting obstacles to overcome before warfighter systems like TALOS see widespread use — some of which include the dwindling defense budget; the complex nature of integrating multiple, complex subsystems; and the challenge of training soldiers to use these sophisticated suits effectively.

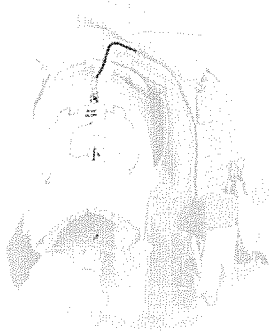
The articles in this year's edition of *Electronic Military & Defense* address some of the engineering and design issues encountered in trying to deliver the aforementioned capabilities to the future soldier — like designing wearable antenna systems (page 32), avoiding electromagnetic interference hazards (page 20), selecting the right sensor technology (page 38), and developing nanosensor technology for the battlespace (page 26).

## Developing Wearable Antennas For Military Applications

*By Smail Tedjini, Pierre Lemaitre-Auger, and Tsitoha Andriamiharivolamena, LCIS Laboratory – Grenoble Institute of Technology; Franck Tirard, Safran Sagem; and Christophe Mercier, Ardeje*

*Design considerations for wireless body area networks*

Wireless and wearable technologies have been continuously evolving since the beginning of this century [1]. Commonly known as wireless body area networks (WBANs), they have numerous applications in a variety of domains — especially in military communications.



There are various categories of WBANs, including the offbody link that aims to connect wearable clothing, such as a vest, to another item of wearable clothing or

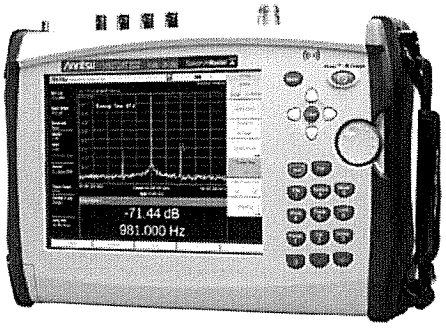
a base station. In both situations, the integration of an antenna into the clothing is required. It is worth noting that the proximity of the human body must be taken into account for the design of the wearable antenna. Moreover, the requested radiation features of wearable antennas are closely related to the type and properties of communication they will provide.

**Detecting And Locating Hidden Signals And Interferers In Military Operations**

Contact The Supplier

*By Eric Hakanson, senior product manager, Anritsu*

*Spectrum analyzers can be used to neutralize electronic warfare threats.*



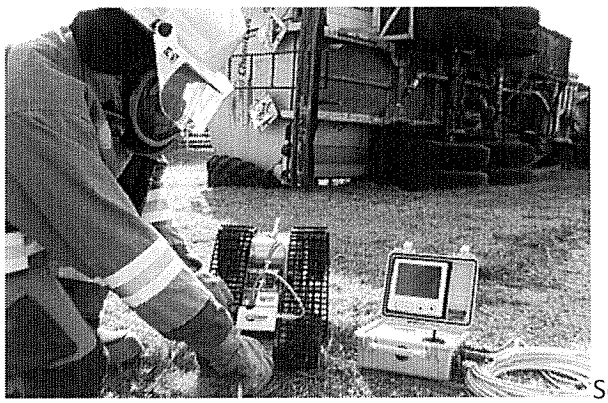

Today's warfare depends on wireless technologies for successful military deployment and operations. This reliance has created a wave of tactics that focus on disabling signal transmissions through the use of GPS, radar, and other types of jammers, as well as bugs and various interferers. Additionally, militia groups and terror organizations continue to utilize hidden signal techniques to communicate with each other covertly while coordinating their military actions.

This era of electronic warfare has led to arming soldiers with more than weapons and radios. Interference-hunting and spectrum-monitoring tools, such as handheld spectrum analyzers and directional antennas, are now standard defense tools. The armed forces rely on these instruments to detect and locate jammers that may interfere with essential commands as well as eavesdrop on hidden conversations between terror cells.

**Advances In Optical Sensing For The 21st Century Battlefield**

*By Yvette Mattley, Ocean Optics, Inc.*

*The evolution and utility of Raman spectroscopy*



Soldiers risk exposure to unseen, life-threatening hazards with each deployment. They rely on portable, field-ready instrumentation to detect hazards in the harsh battlefield setting without the luxury of a controlled, laboratory environment. It is difficult to imagine a more challenging measurement environment than the battlefield. Extreme weather conditions, unknown hazards, and the risk of imminent threats create a hostile environment for soldiers and the equipment they carry. The challenge of finding trace levels of hazardous materials in this setting is intensified by the critical size, weight, and power specifications

that portable, battlefield instrumentation must meet. These compact, lightweight handheld instruments must be accurate, fast, and easy-to-operate, whether the soldier is wearing fatigues or bulky, life-saving protective gear. Field-portable devices must also provide clear, reliable, and accurate warning against unknown hazards ranging from explosives to biological warfare agents — all while minimizing false positives.

After decades of technological advances and innovation in measurement techniques, optical sensing has evolved into a powerful enabling technology for the design of compact, reliable instrumentation to protect soldiers from unseen hazards on the battlefield. The continuous miniaturization of spectrometers, lasers, and other optical components at the heart of today's portable instruments has come without sacrificing the performance critical for force protection. Modern, miniature spectrometers and wavelength stabilized laser diodes pack high performance into instruments that fit into the palm of your hand. The combination of compact size and low power requirements makes these components ideal for the development of field-ready instruments that meet the size, weight, and power requirements for use on the battlefield. These portable systems enable the rapid detection of hazards in the battlefield setting where larger benchtop instruments cannot be used.