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WEARABLE ELECTRO-TEXTILES FOR BATTLEFIELD AWARENESS

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ABSTRACT

This summary describes efforts to develop wearable electronic textiles and connectors to support body worn networking, communications, and battlefield awareness for future service members of the U.S. Army. Products developed include textile-based Universal Serial Bus (USB) and radiating antenna, body conformal spiral bus, fastex connector, and universal snap fastener. All products have been tested and successfully demonstrated in a laboratory setting.

1. INTRODUCTION

The need for real time information on the battlefield has been well documented. Military combat clothing materials are passive and the ability to integrate electronics into textiles provides the potential to achieve revolutionary improvements in battlefield performance. A suite of materials has been developed for personal area networking including connector options to support configurability and interoperability of various combat applications.

2. MATERIALS AND MANUFACTURING SURVEY

A materials survey was conducted to determine the best performing and most durable materials to withstand the rigors of textile manufacturing and military use. Fine gauge, multi-stranded copper wire, stainless steel fiber, Aracon® metal coated Kevlar® fiber, and tinsel wire, which is a metallic foil wrapped bundle of fiber, were all found to support performance goals for conductivity and shielding. Narrow woven technology, used in the manufacture of industrial webbings, was shown to be one of the most promising textile manufacturing methods because the unique fabric structure allows for easy integration of conductive and optical materials. The double plain weave consists of two layers of fabric, one above the other and bound with binder fibers creating longitudinal channels. Stuffer components are inserted into the channels and traditionally are used to increase thickness and strength, but do not interlace with any yarns, lay flat, and are not visible from the face of the cloth. In our experiment we replaced the stuffer components with conductive and plastic optical fiber components.

3. RESULTS AND MILITARY APPLICATIONS

The first prototype, as shown in Figure 1., was manufactured in accordance with the industry standard USB 2.0 specifications prepared by the USB Implementers Forum. The components used in this narrow fabric version were similar to that used in the concentric design, except they were laid out in a flat arrangement. The electro-textile USB was tested in accordance with industry standard Group 6 Signal Integrity and shielding effectiveness tests. The cables passed all body worn related requirements initially, after

cyclic loading, and after laundering (Slade 2003). A similar electro-textile data and power transmission device was developed for the point-to-point personal area network for Future Force Warrior and serve as its electronic backbone.

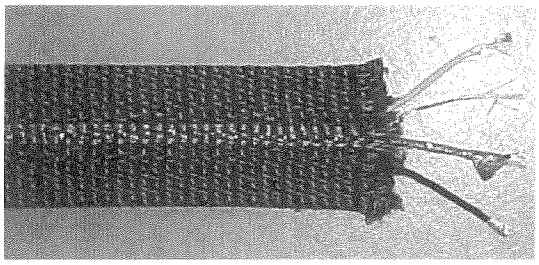

Figure 1. Textile-based USB

Narrow fabric technology was also used to develop a radiating conductor for body borne antenna applications. The antenna vest, as shown in Figure 2., met all permissible exposure level standards inside and around the antenna vest. In addition, communications ranges compatible with the Single Channel Ground and Airborne Radio System were achieved while standing, kneeling, and crouching demonstrating its omni-directional performance.

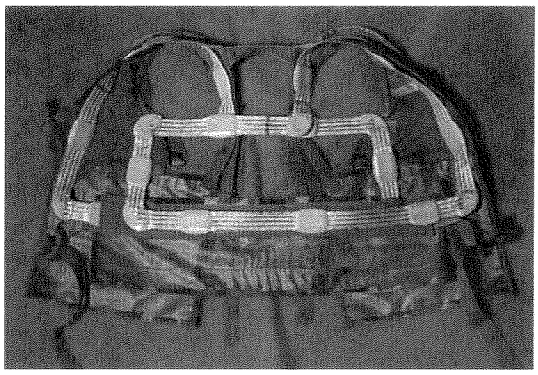

Figure 2. Double loop antenna integrated into MOLLE vest with ergonomic modules

Circular weft knitting was used to develop a body conformal t-shirt with an integrated spiral bus, as shown in Figure 3., that serves as a platform to support medical instrumentation and/or sensors.

Both fastex and snap connector configurations were developed to support a variety of military applications. The universal snap fastener, as shown in Figure 4, securely attaches to any textile embedded conductive network. The male connector also serves as a platform for sensor attachment.

Figure 3. Body conformal t-shirt

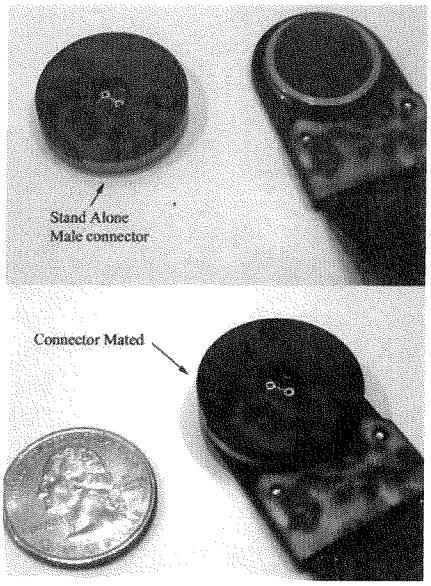

Figure 4. Universal snap fastener

4. CONCLUSION

Novel body worn clothing components with electronic capabilities have been developed that provide new opportunities for performance enhancements of military combat clothing.

REFERENCE

Slade, et.al. "Mechanical Testing of Electro-textile Cables and Connectors, "*Electronics on Unconventional Substrates – Electrotextiles and Giant area Flexible Circuits,*" Materials Research Society, Shur, Wilson, Urban, Ed., Warrendale PA, 2003.