AIAD #10963

Research Opportunity (Cadet)

ORGANIZATION/PROJECT SPONSOR

Organization: ARL
Organization POC: Dr. Charles Hummer, Dr. Casey Uhlig
Organization POC email: hummer@arl.army.mil, casey.uhlig@arl.army.mil
Organization POC Phone: 410-278-5680, 410-278-3997
Organization POC FAX: 410-278-9969
Location of Sponsoring Directorate or Division (City, State): Aberdeen Proving Ground, MD

PROJECT

Title: Concealable Magnetic Field Sensor Systems

Description: The goal of this research is to develop a small cheap device that can detect minute changes in the local earth's magnetic field. Since these new detectors are to be unmanned and easily hidden, a suicide bomber, for example, could walk by one or more and not know that he had been identified and was being tracked. This offers an advantage over the metal detectors that are commonly used today, which are overt and must be manned. These new detectors could also be placed at key positions around the perimeter of a protected area. If insurgents, carrying metal that disturbed the local magnetic field, gather near one of these detectors, the detector may then send out an alert of a possible attack by a radio signal.

Giant Magnetoresistance (GMR) materials that respond to small changes in the magnetic field are well developed and are commonly used to read information from hard disk drives: the read head. These read heads are already very small, but their use for this proposed application has yet to be evaluated. If GMR materials cannot be used, then there are other devices that may be employed instead, such as nuclear magnetic resonance detectors or magnetic fluxgate detectors. Fluxgate magnetometers are currently the most sensitive room temperature devices and range from 10-11 to less than 10-12 T/Hz1/2. However, they are typically much larger than solid state devices and require larger power consumption. It is not known how small these devices can be made and still maintain the required sensitivity. Recently, attempts at using GMR and related magnetoresistive devices, in conjunction with flux concentrators, have shown some promise, and continued investigation remains necessary.

Additionally, the required sensitivity to detect items of interest (including firearms, explosively formed penetrators, or vehicles) needs to be characterized as a function of potential conditions and relevant distances.

Magnetic signatures of typical items of interest need to be measured.
This project would involve a literature search, basic calculations, and possibly some very simple measurements if time permits, to determine feasibility of this concept.

ARL/Army Benefit: These devices are intended to be an aid to secure an area by detecting possible hostile activity. Such detection would obviously help protect our forces that are occupying the area.

Background Required: Junior level Physics major

Security clearance required: Secret

Capacity: 1

Duration: As much as we can get

Block Preference: All 3 blocks would work.