MADS

by Dr Jason Braithwaite

ASSAP recently bought two laptops to form part of the new MADS system for measuring magnetic fields in reputedly haunted locations. This article is extracted from the original proposal for the system. It outlines why the equipment is necessary and what it will do.

There is now considerable evidence that magnetic (and electromagnetic) fields (MFs) can, under certain circumstances, induce strange and somewhat exceptional human experiences in controlled laboratory conditions. Many of these experiences mimic those reported spontaneously in more natural everyday settings by individuals. Examples of this include instances of temporal-lobe epilepsy, migraine attacks with aura (visual hallucinations), and even the perception and experience of apparitions in normal waking adults. In the case of apparitions, researchers have argued that perhaps some aspect of these MFs could be present at locations that seem to produce multiple instances of these experiences spontaneously. Based on this evidence, many researchers are now searching for the spontaneously occurring, natural, environmental equivalent of these artificially induced experiences. Indeed, it still remains to be demonstrated whether these fields are actually available naturally at such locations and that they are indeed causally related to reports of strange experiences. To summarize, the MF / brain account, as it has become known, remains to be systematically field-tested in a serious and scientific manner.

The essence of the MF / brain account is a simple one: that the experience of apparitions could represent an instance where an observer has been exposed to potentially brain-stimulating, complex MFs that may, for whatever reason, occur naturally in the field. The account is attractive as it provides a testable framework for the occurrence of such spontaneous experiences in the field. For instance, one way to field-test the MF / brain account is to take regular field measurements from environments that have been reliably shown (by serious investigation) to be associated with repeated, spontaneous, strange experiences. These measurements should then be compared with appropriate baseline locations (where nothing unusual has been reported) for an indication of natural variance. Perhaps there are constant differences in background MF characteristics between test sites and baseline locations. Perhaps any important field characteristics are more transient in nature. If this is the case, then it would be important to analyse fields that occurred prior to, during, and after an individual reports their strange experience. Such a setting could demonstrate (in principle) the MF signature that may induce, or be associated with, the nature of the experience spontaneously occurring in the field. This framework is directed purely at environmental variances at locations; however, with the appropriate technology, we could also address the usefulness of using portable EEG brain signal measuring equipment as well. Here, we may be able to demonstrate changes in the internal brain signals that are associated with the external changing MFs. If it ever happened, it would indeed represent a hugely important contribution to contemporary apparitional research. The potential methodological frameworks are legion, but all depend on an appropriate system for measuring MFs in a valid and accurate manner.

Many systems currently being used by researchers are totally inappropriate to test the MF / brain account in the field. For instance, some popular devices claim to measure small deviations in the magnetic and / or electric field. However, such devices often don't sample changes anywhere near fast enough to detect many of the fields that could be important. Furthermore, many simply detect 'changes' and do not quantify such changes in any detailed or useful way (increments / decrements). Furthermore, performance curves indicate that none of the cheaper commercially available meters reliably go down to the important low frequencies implicated as crucial in the laboratory studies (down to 5Hz and preferably 0Hz). These machines are simply not accurate or sensitive enough in the way which researchers need them to be. Furthermore, a single device is of little use without a baseline recording also being taken simultaneously in order to ascertain how localised such transients may be. Finally, few systems interface with any data-logging system (eg. a computer) for detailed analysis away from the field.

It seems logical, if not a necessity, to base any MF detection system on the findings from the laboratory studies themselves. These studies do provide a guide for what sort of fields we need to look be looking for, what field strengths could be important, what field frequencies, the role of DC (static) and AC (varying) magnetic fields, etc. The system outlined here is based purely on the findings from neuroscience and consultations with various experts outlining the MF characteristics known to be important for inducing hallucinations. The approach has been to look at the experimental studies and see what they have identified as being 'experience-inducing' fields, and then try to find a sensor / system that could cope with measuring these important aspects in an appropriate and interpretable manner.

The pioneer in this area is Dr Michael Persinger. Most of Dr Persinger's research has used weak, complex electromagnetic fields to induce strange experiences. The field frequencies used are typically less than 30Hz. The intensity of the fields used is generally in the range of 0.1 – 1.0 microTesla (1-10 milligauss), though as much as 5 microTesla have been used in some cases. The amplitudes can be varied and then can be pulsed to create other complex fields. These fields interact with and stimulate the natural temporal processing patterns within localised neural systems. Other researchers have experimented with DC fields, varying the amplitudes, or using steady-state fields, and there has been success here with inducing strange experiences as well.

Using these studies as a guide, we can say that any appropriate system should be able to do the following (i) measure both AC and DC fields, as both have been implicated as being important for different types of experience, (ii) measure the magnetic field strength, and (iii) measure field frequency at a given strength (for AC fields). The measuring of strength and frequency combined is particularly important for quantifying the fields in a detailed and meaningful way. Measurements should also be made in a multi-axis (3-way) manner that would make measurements more comprehensive and informative. A fast sample rate (real-time) is absolutely crucial in order to tap into the types of highly variant fields that could be present. It is also crucial that the system can accurately cover a frequency spectrum from around DC - 100Hz (the brain generally operates at 1-50Hz and these very low-frequency fields have been implicated in brain stimulation studies). Sensors should also be interfaced to computers so that all data can be logged for further analysis away from the field. The system would also need to have some form of frequency analysis software for a detailed assessment of field frequencies and harmonics.

The MADS system is based on a design consisting of two separate high-speed, 3-axis digital fluxgate magnetometers from Applied Physics Systems, USA. The specific sensors chosen are the 540 digital fluxgate magnetometers. These are the fastest sampling, most accurate, and most sensitive magnetometers available in a reasonable price range (indeed, they are better than many sensors considerably more expensive). These sensors are capable of measuring magnetic field changes right down to 0.5nT (the Earth's magnetic field is around 40,000 – 50,000nT, thus this is very sensitive). The 540 digital sensors are ideal for situations where high-speed magnetic measurements must be made. The sensor measures both the AC and DC fields separately. It also measures all three (x, y, z) planes simultaneously (for both AC and DC), and samples each separate plane 250 times a second (slower rates can be selected if needed). Note that here there is no need for a separate system for static DC and changing AC fields, since the 540 measures them both at the same time with the same degree of sensitivity and accuracy! This is a big advantage. The use of a digital sensor eliminates the need for any analogue to digital (A to D) conversion board (as this is done by the sensor) and complex programming. One problem with analogue systems is that once the signal has been digitised it is very difficult to program the computer to sample rapidly and accurately enough to fulfil the sensitivity requirements of the sensor. At the very least this can mean the frequency range will be reduced, and at worst researchers unaware of this problem could misinterpret results. The 540 system carries out the A to D conversion within the sensor itself. The 540s also have a gain control that can be used to detect extremely small changes in the field even in the presence of a large static field (eg. changes of 0.5nT in the presence of the Earth's own magnetic field).

These sensors will interface directly with a computer and are supplied with their own free data acquisition and display program (run on the accompanying laptops). The net result is an extremely well thought-out sensor system, as good as any we can find, at a reasonably affordable price.