

# Measuring of the human electromagnetic emission in the ELF band

JAROSLAV CECHAK  
Radar chair, Faculty of military technologies,  
University of defence,  
Kounicova 65, 612 00, Brno,  
CZECH REPUBLIC

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*Abstract:* – Submitted report is oriented to the area of detection of signals emanated by Man in the ELF – Extremely Low Frequencies range. Designed and applied antenna system suitable for signal reception in the ELF band is presented here. Results of digital signal processing in the ELF band are presented in the report in the graphic form together with the photographic material provided in the course of signal recording. Finally, there is discussion of possibilities of the ELF band signal analysis for detection of men – for example under the snow avalanche, in cave-in in underground mines, etc.

*Key-Words:* – ELF, Distance detection, Schumann resonance

## 1 Introduction

Every living organism on our planet is surrounded with an energy in form of the signal environment. This energy is produced either by him as result of essence of his living and survival, or the energy occurs in form of natural and artificial signals of the terrestrial origin and further of extraterrestrial origin, signals coming from the near and deep space. If Man has the option, the gift to see far broader spectrum, so not to be limited by visible part of the spectrum only, he would be surprised, for sure, how dense spectrum exists on our planet. That magical word "energy", which is cause of everything, the word quoted in any form and connected with every living or dead form, is playing important part. There is no doubt that Man itself is emanating energy. However, it is necessary to remember how weak this field is. Signals emitted by the brain constitute one component of this energy. It concerns Extremely Low Frequencies – ELF [1].

## 2 Electromagnetic field of human body

A cell is the basic, very small unit of the living substance. It measures about 10 microns, i.e.  $10^{-5}$  m. But, it is still enormous to compare with particles carrying electrical charge (electrons) – there is place for at least 10,000 for them on the cell length and about 30,000 for them on the cell

circumference. To create electricity in the cell, the cell needs capacity to process certain chemical materials, which the cell absorbs. The cell makes free chemical energy by chemical decomposition of the material and is using it for protein building, for its own work and for creating *electricity* in presence of oxygen. The electricity is the most important thing for some cells, for nerve cells for example. Communication between nerve cells (neurons) depends on the parameter called *resting membrane potential* – *RMP*. Cell interior is negative in respect to its surface and potential across the plasmatic cell membrane is reaching values between  $-20$  mV and  $-200$  mV. RMP of the nerve cell is in range  $-40$  mV to  $-90$  mV, the sustained value is  $-70$  mV. We call such cells *polarised*. Aforesaid voltage values are really negligible; currents reach orders of magnitude of microamperes. Nevertheless, those values are not insignificant.

### 2.1 Schumann resonance – connection of Man with the nature

It concerns the state on boundary of beta and theta levels, at 7.83 Hz more precisely. Brain waves have no constant frequency, but their frequency is changing. The whole control system is buried deeply in the brain, in the thalamus. The *thalamus* is switching and integrating centre of excitements coming from

sensors, from the spinal cord and the brain stem to the cerebral cortex. The system is called *thalamic rhythmic generator* or "pacemaker". Calcium ions are seeping slowly to particular *thalamo-cortical neurones*, which are oscillating 1.528 sec and are triggering brain waves. Then, the brain waves propagate up to the cerebral cortex. If those neurones are *saturated* with calcium ions, the thalamic oscillations stop. The brain waves are "idling" during this "*silent phase*", lasting from 5 to 25 seconds. The thalamic oscillations start again, when the calcium level in cells drops to the value allowing the neurone to oscillate again. EEG has shown that waves do not expand to the brain only, but through the whole nervous system (through the perineural system) and to every part of the organism. So, the brain waves adjust sensitivity and activity of the whole nervous system. The time domain, where the brain waves are not thalamus controlled is the most interesting part of the system. Then the *brain field* can be affected by electrical and magnetic *rhythms from outside*, natural or artificial. Magnetic field of Earth (geomagnetic field) is reason for magnetic needle of a compass pointing to the North Pole. But, if you look to the needle under the microscope, you see its minute movement due to *geomagnetic microscopic pulses*, which are reason for the unique geophysical mechanism – *Schumann resonance*. German atmospheric physician W. O. Schumann brought in the idea that the space between the Earth surface and the ionosphere behaves as the *resonance cavity* – energy for this cavity is supplied with thunderbolts. The Schumann theory was accepted in sixties. So, thunderbolts generate *electromagnetic standing waves* propagating around the globe. Those waves are reflected from the ionosphere back to the Earth surface and then back to the ionosphere. So, value of the Schumann resonance depends on the distance of the ionosphere from the Earth surface, which is subject to the *Sun activity*. This value is subject to the magnetic storms disturbing the ionosphere above all and the Schumann resonance trails off, so it is created by *terrestrial activities* and modified or *modulated by extraterrestrial activities*. The following correlation is interesting as well, resulting from that all – *wave length*. We can find out by calculation, that  $\lambda = c/f = 2.997\ 924\ 580.10^8/7.83 = 38.3$  thousand km. This number is

not accidental and it is close to the value of the *Earth circumference* [2],[3].

## 2.2 Measurement of the human body emission in the ELF band

For measurement of the human body emission in ELF band, we can use the loop antennae of the type used in bands ranging from ELF to UHF from the very beginning of radio communication. Their small dimension is their main advantage to compare with the wavelength for which they are intended and the source distance. Big volume of the copper wire needed for winding is their main disadvantage. They are working with the magnetic field entirely, to compare with their counterpart – electric monopole.

For this purpose, the loop antenna was designed and constructed, its picture is in Fig.1.

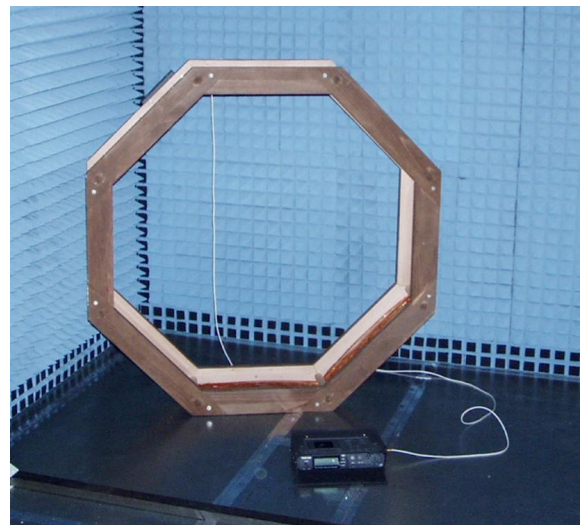


Fig.1 Picture of the loop antenna for ELF band in the anechoic chamber

The antenna has following electrical parameters:

- Antenna effective aperture:  $118.3\text{m}^2$ ,
- Loop resistance:  $5.98\ \Omega$ ,
- Loop inductance:  $31.2\ \text{mH}$ .

Low limiting frequency: 30.5 Hz. Signal from the antenna goes to the current/voltage converter and then to the subsequent amplifying stages. The amplified signal goes through the low pass filter. To filter out the all around present industrial interference in the 50 Hz band, the low frequency value of the filter was

chosen of 30 Hz. Filter output signal was digitised with the 16-bit A/D converter with the sample frequency of 44.1 kHz. The whole measuring installation was supplied from a battery and placed into the grounded anechoic chamber. The signal in ELF range was registered without a person and with a person, alternatively.

### 3 ELF band signal analyse

There are an examples of time records of the signal 60 seconds long in the Fig.2,3,4 respectively where the first two parts was recorded without presence of a person in the anechoic chamber and the second two parts was recorded in presence of a person. Even when the records were made in the shielded anechoic chamber, it is obvious from the time diagrams of the recorded signals that there is strong industrial interference present.

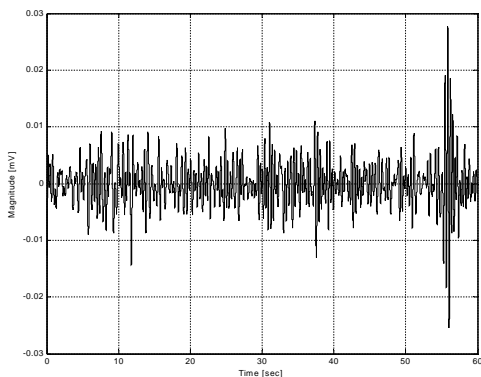


Fig.2 Time record of ELF signal in the anechoic chamber without a person

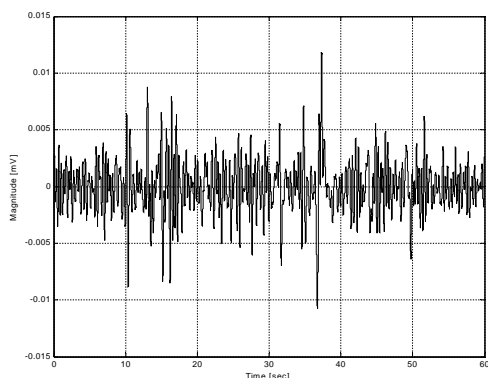


Fig.3 Time record of ELF signal in the anechoic chamber without a person

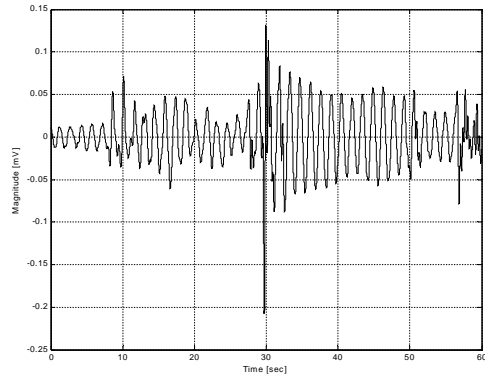


Fig.4 Time record of ELF signal in the anechoic chamber with a person

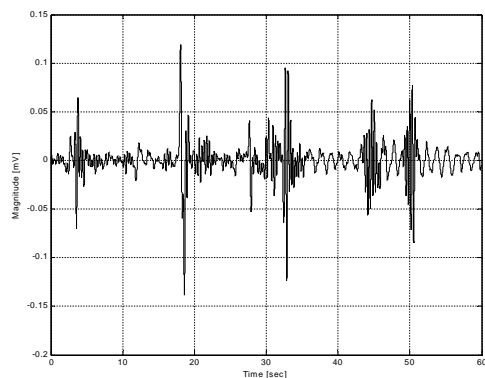


Fig.5 Time record of ELF signal in the anechoic chamber with a person

The sporadically emerging harmonic signal on frequency 16.87 Hz 8 to 39 periods long deserves special attention. It is highly probable that this signal comes from the near trolley line. This signal did not appear in the record made during measurements in the night.

The spectral analyse gives us more information about recorded signals. The PSD - Power Spectral Density diagrams of the recorded data are in Figure 6,7,8,9 respectively. There is the Schumann resonance on frequency of 7.1 Hz in diagrams, but it is interesting fact that there is the resonance of the Schumann frequency with the person – distinct splitting and amplification of the spectral peak on frequency of 7.1 Hz. There is the second distinct frequency peak on frequency of 6.7 Hz, too. Hereinafter, there were the other, albeit less distinctive harmonic components on frequencies of 2 Hz, 3 Hz, 4.2 Hz, 16.8 Hz and 21.3 Hz incidental with the cardiac, breathing and cerebral human activity.

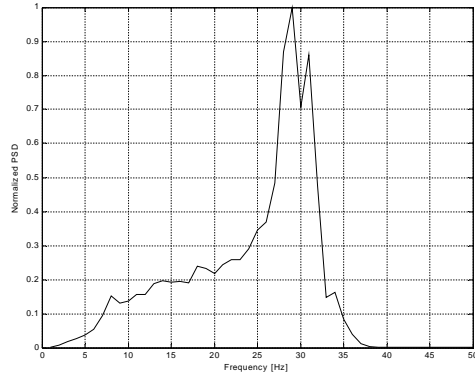


Fig.6 Diagram of the PSD of the analysed signal without a person

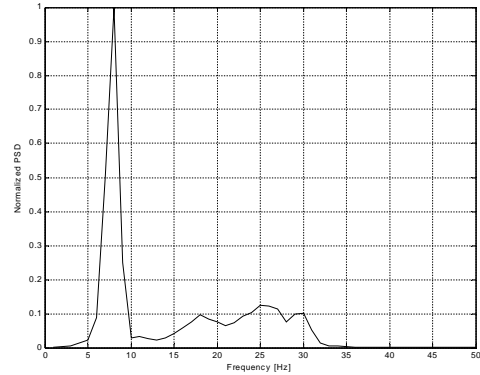


Fig. 9 Diagram of the PSD of the analysed signal with a person

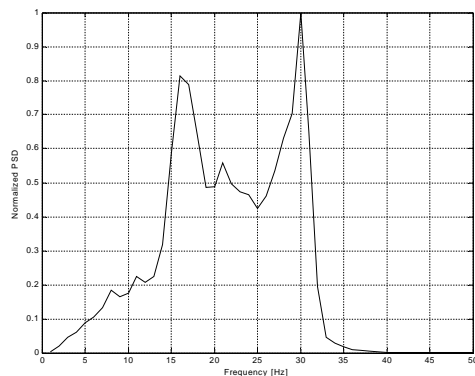


Fig. 7 Diagram of the PSD of the analysed signal without a person

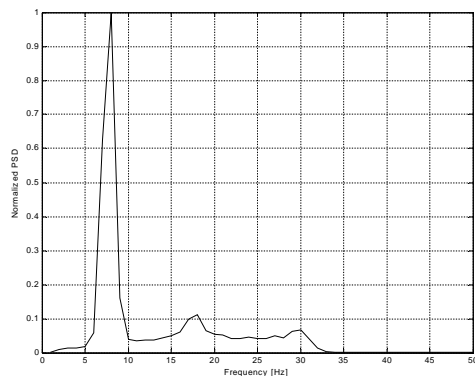


Fig. 8 Diagram of the PSD of the analysed signal with a person

## 4 Conclusion

It is evident from provided measurements and their analyse so far, that Man is emitting electromagnetic energy in the band of interest. This band was situated deliberately to the frequency interval of 0.5 – 50 Hz.

In following works, it is necessary to optimise antenna aperture size from the point of view of reasonable dimensions and to carry on set of measurements allowing detection of the human body imprisoned under the snow avalanche, for example. However, design and construction of ELF band antenna with the distinct directional characteristic is the necessary assumption, in order that other people in vicinity do not influence measuring results.

Design of antenna system form is subject of research of this problem as well. Question arises, too, if it is advantageous to design the dedicated loop antenna with the free resonance frequency on 6 – 7 Hz approximately.

Considering supposed applications, only magnetic component of the emission was recorded and analysed yet. Nevertheless, works on measurement and recording of electrical human body emission component are in stage of already designed dedicated measurement devices.

Results of future research of this certainly interesting problem will be presented.

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