

STRESS ASSESSMENT USING MODERN MEASUREMENT METHODS

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Abstract: *Stress is an adaptive and subjective reaction of an individual to the exposure to environmental factors. The main objective of this paper is to determine a methodology of assessing the level of anxiety/stress of aviation personnel by using state-of-the-art measuring equipment such as the GDV (Gas Discharge Visualization) device and the Rofes device. The second objective of this paper is to take a first step towards creating a stress resistance profile that could be useful in testing candidates for a career in aviation. This research aims to make repeated measurements on different people, in both laboratory conditions - using a flight simulator - and in real conditions – using a light aircraft. The working hypothesis is that no adjustment to stress can lead to diminished attention, which in turn can determine human errors with severe consequences.*

Keywords: *stress assessment, anxiety, GDV, aviation, pilot*

1. INTRODUCTION

1.1 Stress, general information, beneficial and non-beneficial aspects.

The current technical and scientific process requires a high level of adaptation of the organism. This is the first time in human history that we have access to so much information, that we have to “process” so much “new information” in so little time. We can foresee that this evolution will continue and will amplify in the future. However, there is a price to pay for the progress and the challenges that we are subjected to in order to keep up the pace and this price is mainly represented by stress.

1.2 Theoretical aspects regarding stress in aircraft pilots

Stress, which is sometimes defined as the “disease of the century” represents a manner in which the body adapts to the environmental changes. another definition is: “*stress is a complex factor that consists of both an emotional component (anxiety) and a somatic component that results from prolonged exposure to constant anxiety.*” [1].

A special aspect is represented by stress during aeronautical activities (maintenance, ground and air operation). In an interview for *Adevarul* newspaper, a pilot stated that:

“No matter how much you fly and no matter how used to piloting you are, the stress of flying is still there. Any pilot sitting before the steering wheel of an aircraft is aware of the fact that stress is there and will always be there, even if he/she does not realize it.” [2]

The pilot of the ultralight aircraft (motor-hang-glider/microlite, **Fig. 7**) used in the test flight stated that with this type of aircraft (and probably with all types of aircrafts) the hardest and most stressful part is the landing.

It is for this reason that the authors of this paper aim to measure/investigate the evolution of this important parameter through a new approach, using state-of-the-art equipment.

2. THEORETICAL CONSIDERATIONS ON THE METHODS AND INSTRUMENTS USED IN MEASURING THE LEVEL OF STRESS IN AIRCRAFT PILOTS

2.1. Methods of assessing stress

One of the classic methods used in assessing stress is *POMS (Profile of Mood States)*, a laborious method that involves filling in surveys and interpreting them from a statistical point of view. The instruments, techniques and methods used in measuring and investigating various parameter values of the human body have evolved in direct contact with the technical and scientific developments. New measuring methods and devices were developed using two resources: the principles of quantum mechanics and the rediscovery of Oriental medicine, namely the Traditional Chinese Medicine (TCM).

A new research approach was implemented once the Kirlian photography/effect was discovered at the middle of the previous century. The devices created based on the Kirlian effects enabled the visualisation and study of an “unseen” field, i.e. the human Biofield.

The definition of the biofield is no longer unanimous. Herein under are two definitions: the first one is provided by Prof. K. Korotkov [3], while the second, which we consider to be more comprehensive and explicit, is provided by Prof. PhD. Corneliu Moldovan.

Biofield Definition

- “a type of field that occurs as a consequence of the complex interactions between the physical body and radiations of known or unknown energy, including electromagnetic fields, gravitational fields, acoustic fields etc. It is distributed in space around biological organisms and it is created by the emissions of the body when it interacts with environmental processes. It represents an information exchange interface between a certain organism, the environment and other organisms”. [3]

“The human body is an assembly of cells that are constantly growing, developing, diversifying, regenerating and dying. In an adult person, 25 million cells divide in only one second and the blood cells renew themselves at a rate of 100 million per minute. During the cell division and growth electromagnetic waves are constantly emitted. These signals vary depending on sex, age, genetics, nutrition, health status or illness, pathological processes present or on-going.”[4]

The majority of authors that conducted studies on the Biofield (W. Tiller [5], Inyusin [6], Cornelia Guja [7][8][9], K.Korotkov [3][10][11]) consider it a communication interface between living organisms and the environment. Said interface is believed to contain many of or all of the information regarding that particular organism.

If we consider the above hypothesis to be correct, the study of the Biofield is the most recommended and fast method of investigating anxiety and stress.

We have conducted a research on PhD theses that study stress using GDV devices. According to the dissertations presented at Holos University in the USA [12],[13], in Slovenia [14], and in Romania, [1], [15],[16], various methods have been used to decrease this parameter, i.e. Art of Living Programme, dance therapy, music, sounds emitted by specially tuned crystal balls, modified states of consciousness, ingestion of colloidal solutions, etc.

An important aspect that needs to be mentioned is described in the thesis of Psychologist Manolea, M.D. This aspect represents one of the factors that led the authors of this paper to conduct their research. Following a statistical study, Manolea, M.D. found that in neither of the cases of stress analysed during pre-testing (also using POMS tests) “there was no homogeneity in the groups in what concerns the self-perception of the state of depression and the level of stress.” The conclusion was that the subjects – the students (and by extension other people that live in similar conditions) – *were not aware of the fact that they were living in a state of stress!*

3. EXPERIMENTAL CAMPAIGN ON THE STRESS OF AIRCRAFT PILOTS

The aim of this research is to assess the stress to which a pilot is subjected in simulated conditions and the stress to which a pilot and a passenger are subjected in real conditions, using a light aircraft. The assessment will be performed using various methods – video monitoring, pulse and cardiac rhythm monitoring, measurement of the Biofield changes highlighted by the *BioWell* and *Rofes* devices – that are described in detail herein under. The purpose is to assess the level of stress and the resistance to stress during a flight and to determine a set of reliable parameters that would help in assessing the pilot before flying.

3.1 Experimental conditions. Methodology. Eexperimental stages

All the measurements will be performed in the same location, by the same operator, with the same subjects and in the same order, in compliance with the measuring protocol considered optimal by the inventor of the device and procedure, Prof. K. Korotkov [2], in order to minimise the systematic errors.

Stress generates important changes in the energy field. *The images presented herein under are eloquent and have been taken from the article “Measuring Human Energy Field” [2]*

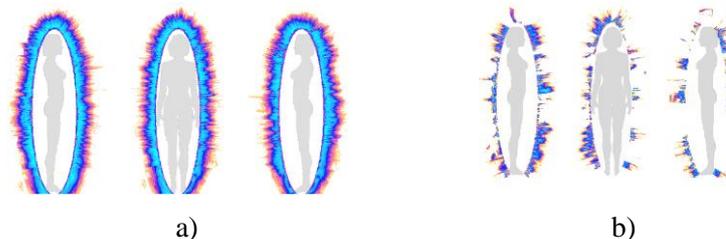


FIG. 1. Biofield distribution of a person: normal, healthy (a), stressed (b).

In Fig. 1 a) a healthy person has a uniformly distributed field, without any interruptions, holes, explosions or irregularities, while in Fig. 4 b) the person is extremely stressed.

GDV (Technique) – “The method used to visualise the biological emissions and optical radiations (living or non-living) by means of stimulating the amplified electromagnetic field through photographic capturing of the gas discharges (usually in the air), followed by processing using a computer”. [2]

The GDV devices are well-known by the authors due to their years of experience.

4. MOTIVATION OF THE CHOICE FOR MEASURING DEVICES

The measuring devices recommended for these tests are *BioWell* and *Rofes*. Both devices were created and developed in the Russian Federation, as stated by the investors and have also been used in the military field. The reasons for which said devices were chosen are the following: the devices enable the assessment of the emotional tension and the stress level; they are non-invasive, user friendly and the examination of a subject lasts less than 2-3 minutes; they take measurements using non-invasive, simple, painless and clean procedures, without risk of infection, without collection of bodily substances or fluids; they do not require injection of contrast solution or previous preparation (e.g. undressing) of the subject and do not require special conditions. Moreover, each device obtains a series of parameters, from only one measurement, that can be subsequently selected for comparative studies.

5. DESCRIPTION OF THE DEVICES CHOSEN/SELECTED FOR THE TESTS

5.1. The BioWell device

a. Description

The GDV (Gas Discharge Visualization) device called *BioWell* is the newest system created by Prof. Korotkov’s team and it is accompanied by a strong software that has replaced all the other models of GDV devices (compact, express etc.). The same as the other devices in the GDV series, *BioWell* is based on the Kirlian effect.



Fig. 2. The BioWell device Test procedure <http://www.the-colors.ch/gdv-biowell.php?view=12>

The method of use of the *BioWell* device is very simple (information taken from the device’s user manual). All 10 fingers of the hands are inserted into the device hole, which is protected from ambient lighting, one by one, in a predetermined order. Once

the tip of the finger touches firmly the positioning plate, the operator orders the stimulation of the high voltage field using the computer (for 10 milliseconds), which is linked to the camera that captures the brightness of the air discharge around each finger. Subsequently, the images obtained are sent via internet to the producer's website that includes the software that enables the quick analysis, almost the real-time analysis of the changes caused to the energy of the human body. Since the results are obtained so fast, this device can also be called an "express method" of detecting anomalies that require more detailed investigations.

b. The parameters that can be highlighted by the Biowell device

The images obtained show the distribution of the energy field in sections (front, back, lateral, 2D and 3D), the size and positioning of the chakras, a circular diagram of the energy level of each organ and system, a graphic (bar chart) showing the level of stress and the levels of energy inside the body.[17]

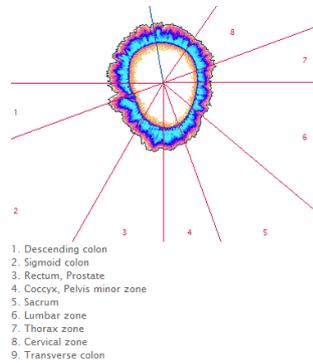


Fig. 3 The ring finger – the image of various organ sectors

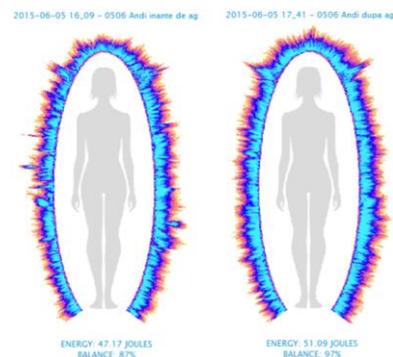


Fig. 4 Field distribution (2D) around the body.

The software enables the comparison of two (or more) measurements taken from the same person, at different times or from different persons. The software also enables the user to print a page of all the parameters measured for archiving purposes.

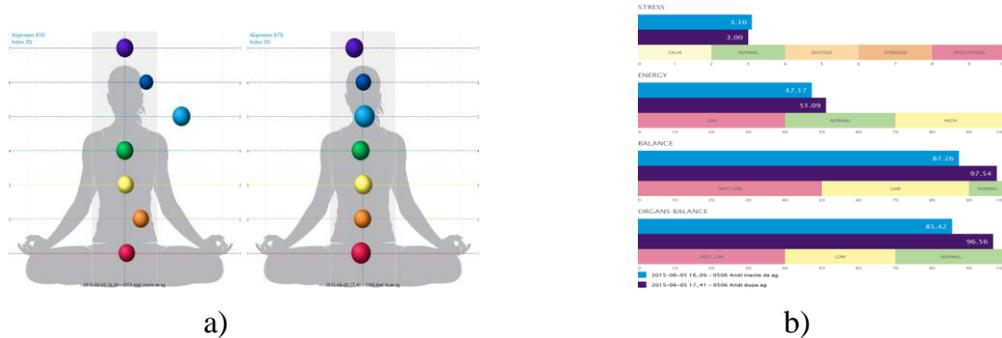


Fig. 5. The synoptic presentation of the main parameters that can be measured with BioWell GDV: the size and position of the chakras (a); the distribution and intensity of the energy field, the level of stress, the general energy balance and the organ energy balance (b).

The most important parameter that can be measured using the GDV devices is emotional pressure (the level of stress).

Emotional Pressure (Stress)

By using special software, it is possible to make a quantitative assessment of the anxiety and health index on a 10-point scale

- **0 - 2** - very calm, relaxed people; at the same time it may be the case of chronic depression

- **2 - 3** - normal calm quiescent state.

- **3 - 4** - the state of anxiety. The state of permanent anxiety without relaxation can cause serious problems.

- **4 - 6** - the excited stress state characteristic of active work, excitement, intense activity.

- **6 - 8** - at least four possible situations:

The reaction to a previous stressful situation (an unpleasant conversation, illness, failure in the training process, driving in stressful conditions, etc.), increased nervousness accumulated over long periods of time, stress, emotional stress, autonomic dysfunction, athletes in the moment of competition, actors during performances, students at exams, etc.

- **8 - 10** - a very high level of stress, the peak of emotional excitement. If a patient with activation level 8-10 appears calm, this could indicate a dangerous situation, i.e. the person is on the verge of a nervous breakdown, so be aware and exercise caution.

Important note by the official BioWell User Manual. [17]: Stress level assessment with the Bio-Well device gives you an indication of a stress level. This assessment should not be used as a medical assessment.

c. The advantages of the Biowell device and method

An important advantage of the BioWell device is its price, which is relatively low and the availability for fast delivery. Other advantages consist of:

- simplified use due to the software that includes an intuitive interface that is user friendly;

- the parameters that are to be highlighted are predetermined for measuring and are presented synoptically on the same graphic, i.e. emotional tension/stress index, energy and balance, organ balance;

- the software enables the comparison of the measured parameters obtained from the same subject or from different subjects;

- the software provides a .pdf document of all the measured parameters that can be printed or sent via email;

- the device can be equipped with a platinum sensor/electrode, that can be used for an energy analysis of various liquids.

d. Limitation of the Biowell device and method

The two main limitations of the device consist of:

- the work method requires internet connection in order for the electrophotonic images created by the device to be sent on a dedicated website where they are processed in order to obtain the results;

- access to the website for data processing is provided by means of monthly subscription. The device can also provide offline measuring, but the data will only be processed after the internet connection has been restored.

5.2.The Rofes device

a. Description

The *Rofes* device (registrar of the functional-emotional state assessment) was created during the early '70s when Soviet scientists were concerned with assessing the health status of astronauts during long orbital flights. The researchers at the Institute of Scientific Research in the field of medicine and biology of the USSR Scientific Academy, that dealt with all the medical aspects regarding spatial programs, started developing the idea of "prenosological diagnosis". The aim of this diagnosis was to identify health issues before the occurrence of the symptoms. This allowed them to provide medical interventions upon commencement of the disease and help the patient avoid serious problems by using fewer, cheaper and non-invasive means. Operating and Service Instruction Manual.[18]

Soon afterwards, this method was transferred from spatial medicine to army medicine. Here it was mainly used to assess the psycho-emotional state of soldiers and officers, to avoid suicides, the violation of the military discipline and various accidents caused by the level of stress of the managers and operators of military equipment.

ROFES is constantly improved based on the practical results of its application in medical and treatment centres in Russia. This device is at its fourth generation and it is also available in the civilian version, "for home use".

b. How does Rofes work?

The device is put on the left arm in order for the active electrode to be put on the active biological point Daling (MC-7) [19][20] of the left wrist. Once the device is started, it will emit a weak electrical signal and it will register the manner in which said signal changes/modifies. Afterwards, the software installed on the computer will compare the result obtained with the standard (what is typical for a healthy person of that age). The results of the comparison can be observed on the screen in the shape of figures, according to the scale graded in 5 steps. Five is excellent, while one is bad. For a better visualisation, the figures are coloured from dark green to bright red [18].

This is to assess the general health status and the 17 organs and systems, as well as the degree of exposure to stress, fatigue or nerve demand.

Generally, testing with the ROFES device represents an easy method of dynamic control of the health status that is aimed at maintaining health by creating the necessary conditions for a good physical, mental and social state.

The contradictions in the use of the ROFES device:

a. The electrical cardiostimulator (pacemaker).

b. Pregnant women. Since there was no research conducted to prove that the ROFES device is safe for pregnant women, for safety purposes, we recommend you avoid testing it on pregnant women.

c. Active oncologic diseases. In this case, if the patient is undergoing treatment, we shall not use this test. The research on the influence of the ROFES device on tumours has not yet been completed; therefore, we prefer to be cautious.

d. The absence of the left arm.

The entire testing algorithm was created for the PC-7 point of the left wrist. If a patient is missing his/her left arm, testing is impossible. If the left arm presents lesions, this does not represent an obstacle for testing.

c. Testing

The active electrode of the device will be placed above the active biological point PC-7 (named “Daling” according to TCM) (Fig.7) after the area has been wiped using a wet tissue. Then, the measuring will begin and the results will be available within 3 minutes. Said results will be presented in a table (Fig. 8) that can be printed or sent via email.

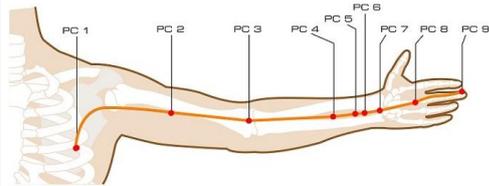


Fig. 6. Rofes device-Test procedure

Fig. 7. Daling (TCM) –PC-7 biological point

The advantages of the Rofes test (pre-clinical test of the organ and system functioning; test of the psycho-emotional state)

- *Fast:* lasts for only 3 minutes. The testing frequency should not exceed once every 20 minutes.

- *Easy:* only one point on the wrist is being tested. It does not require special preparation or training. The Rofes devices only needs to be connected to a computer or a tablet and then you press start.

Important: the date of birth and sex must be correctly filled in. The precision of the test depends on this data because the software compares the electrical point indicators of the patient to the standard database for the same age and sex. If the sex is filled in incorrectly, the results will be absurd. If the date of birth is filled in incorrectly, the results will be false.

The device tests the following: The general level of health, the psycho-emotional state, the functioning of the 17 organs and systems, the level of stress/fatigue/neurosis/the heart and the blood vessels/the immune system/the spine (Fig. 8).

Program Rofes 2.0.1.1		
Account nik nik (Male , 52 Years)		
Test 4/1/2017 9:13:17 PM		
General functional state:		
General functional state		5
High level of health. High energy resource, providing the mechanisms of body self-regulation.		
Organs and systems:		
	FS	RR
Immune system	5	4
Cardiovascular system	5	4
Cervical spine	5	4
Thoracic spine	5	5
Lumbar spine	4	4
Bronchi	5	5
Lungs	5	4
Liver	5	5
Stomach	5	4
Colon	4	4
Pancreas	4	4
Thyroid		
	5	3
Adrenals		
	4	5
Kidneys		
	4	4
Bladder		
	5	4
Prostate		
	5	4
<i>Functional state - FS</i>		
<i>Energetic resource - RR</i>		
Psycho-emotional characteristics:		
Stressful condition		2
Signs of fatigue / Internal emotional strain		4
Signs of nervousness, irritability		4
Attention! This rofogram shows the state of your organism only at present moment. Deviations from the norm on the rofogram may be caused by physical and emotional load, stress, influence of environment or food. In order to get the results, which are free from the influence of external factors, it is advisable to conduct not less than 5 tests during a week (in a relaxed atmosphere, better in the morning before breakfast, shower and medications). The results tendency should then be analysed.		
Software developer INFERUM, LLC www.inferum.ru		

Fig. 8. The synoptic presentation table of the Rofes parameters

The interpretation of the results is also simple: the higher the values (equal to or near 5) the better adapted the body and the better equipped to deal with environmental challenges.

6. DISCUSSIONS

The authors aim to perform several sets of measurements under various conditions. The first set of measurements will be performed in laboratory conditions, using a flight simulator. The main hypothesis is that even though the flight simulator (**Fig. 9**) enables the programming of extremely difficult conditions for the pilot, he/she will not perceive them as stressful.

For this reason, a second set of measurements is scheduled. As far as possible, the same subjects will be used for testing, but in this case, the measurements will be performed in conditions that are closer to reality, by using a ultralight aircraft. (**Fig. 10**)

On April 29, 2017, one of the authors took a first short experimental flight (22 minutes), as passenger aboard a two-passenger ultralight trike that took off and landed on Ilfoveni aerodrome, in Dambovită County. During this flight (**Fig.10**) no measurements were taken, the aim was only to assess the available space for the measuring devices of physiological parameters. The flight conditions were of low difficulty – light wind 8-10 km/h, with brief gusts over 250 m altitude, approx. 18°C temperature, partially clouded sky and rain here and there.



Fig. 9. Flight simulator



Fig.10. pilot accompanied by the take-off and landing assistant

The conclusion of this flight was that the measurements will be performed on the ground, before taking off and after landing due to the very limited space on board that does not allow placing and operating measuring equipment. Only small devices can be used to monitor the pulse and cardiac rhythm.

7. CONCLUSIONS

The parameter changes that can be highlighted using the devices described herein enable the assessment of the evolution of the level of anxiety (stress).[21] After the analysis and interpretation of a large number of measurements performed under various conditions we will be able to obtain some threshold values for the level of anxiety. Any value that exceeds the threshold would mean that any strenuous activity in the field of aviation, such as piloting or flight controlling, should be avoided (at least on that day). These tests are even more important, since according to Psychiatrist A. Manolea, M.D. [1] many of the people involved in these activities might not even be aware of or might ignore their own level of stress.

The aim of this research is to increase the level of safety of the people involved in the field of aviation.[22]

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