Ilona KARPIEL[1], Mirella URZENICZOK[1], Ewelina SOBOTNICKA[1], Stefan GAŹDZIŃSKI[2], Łukasz DZIUDA[3]

[1]*Łukasiewicz Research Network – Institute of Medical Technology and Equipment, Zabrze, Poland*
[2]*Department of Neuroimaging, Military Institute of Aviation Medicine, Krasińskiego 54/56, 01-755 Warsaw, Poland*
[3]*Department of Psychophysiological Measurements and Human Factor Research, Military Institute of Aviation Medicine, ul. Krasińskiego 54/56, 01-755 Warszawa, Poland*
corresponding author: ilona.karpiel@itam.lukasiewicz.gov.pl

THE USE OF GIFT TOOLBOX IN THE PROCESS OF ASSESSING PHYSIOLOGICAL CHANGES IN THE BRAIN BASED ON LBNP TRAINING - PRELIMINARY STUDIES.

Keywords: Lower body negative pressure (LBNP), MRI, preprocessing, GIFT toolbox

An important element of aviation training is the training of aviation personnel in increasing overload tolerance. Overloads can be simulated on a human centrifuge or by means of a device called Lower Body Negative Pressure (LBNP). In the latter case, the gravitational displacement of blood towards the lower extremities is simulated by applying negative pressure to the lower parts of the body. This procedure affects also how the brain works.

Functional MRI at rest allows to observe fluctuations in activity in different parts of the brain over time. The use of an appropriate analysis allows you to obtain information on activation, correlation or, for example, volume. However, attention should be paid to the methods, as their selection was shown to affect the results. The aim of the study is to learn how the LBNP test affects the physiological changes observed in the brain, immediately before and after LBNP training, using MRI imaging. Subsequently, a comparison of selected methods based on the analysis of independent components using GIFT toolbox is provided.

MRI examinations were performed on a 3T field scanner (GE Discovery 750w) as part of a Polish National Centre for Research and Development funded program within the framework of the Program for National Defense and Security under Project DOBR/0052/R/ID1/2012/03: (PI: Ł. Dziuda). A sequence of 190 EPI images (TR / TE / TI = 2000/30 / 2025ms) was used to measure the brain function at rest. MRI examination for one person was performed both before and after training. Preprocessing was performed in MATLAB with GIFT toolbox. The following methods were used: Infomax and FastICA. The number of independent components has been appropriately selected, i.e.: 20, 40, 60 and 75.

The analysis made it possible to locate all active areas and compare the values as well as to juxtapose selected analyzes. For example, using FastICA, for ICA-20, some of the higher correlations occur for components 8 (BA46, Left Cerebrum) and 10 (BA40, Right Cerebrum) (study after training (~ 0.9) compared to the analysis before training (~ 0.8) value 14 (BA10, left Cerebrum) and 16 (BA40, right Cerebrum). These findings will be evaluated in a larger cohort.

ICA analysis is a quick and available method and the obtained results emphasize the advantages of using ICA and provide new information in relation to correlation or information about processes such as stimulus evaluation. Selected comparative analyzes allow to shorten the preprocessing time and in the future may be the basis for standardization and optimization of data. The obtained results made it possible to locate the active areas in the brain area in relation to the selected number of independent components and methods.