Weight measurement platform based on a double current supplied circuit and the load cells

Wojciech Walendziuk[1], **Adam Idzkowski**[2]

[1, 2]Bialystok University of Technology, Wiejska 45D str., Bialystok, Poland
E-mail: [1]*w.walendziuk@pb.edu.pl*, [2]*a.idzkowski@pb.edu.pl*

Abstract. The article presents a weight measurement platform in which the original supplying circuit of strain gage load cells is applied. The signal conditioner enables, in a simple way, transformation of the measurement device into a stabilographic platform. The paper discusses construction of the supply system, the way of strain gage transducer connection, the measuring procedure and the analysis of the measurement uncertainty.

Keywords: strain gage transducer, stabilography, weight measurements.

Introduction

The purpose of this paper is to present an alternative switching circuit supply of the resistance strain gages which were applied in the patient's weight measurement device. Moreover, the use of the presented weight transducers supply system enables conducting measurements that, after the appropriate processing, can represent a sought mass. Thanks to this solution of the measurement circuit it will be possible to implement this system into a stabilographic platform [1÷4].

Measurement system

The measurement system was implemented in the platform, in whose corners the one-sidedly fixed beam was placed (Fig. 1). For each of the cantilever beam, on which the strain gage was placed, the strain was examined. Thanks to that it was possible to calculate the applied load.

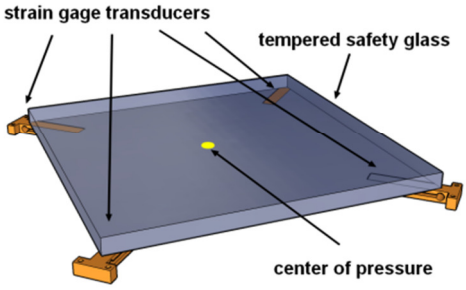

Fig. 1. General view of the measurement platform

Strain gage transducers T_1, T_2, T_3, T_4, were supplied by the circuit in which electronic keys K_1, K_2, K_3, K_4 were used. As shown in Fig. 2, the opposite arms of the bridge power supply include two DC current sources J_1, J_2 and auxiliary resistors R_1, R_2. The complete bridge system consists of the two current sources, two resistors, four strain gage transducers and four electronic keys.

In each measurement cycle, with the use of suitable enabling or disabling state of the electronic keys, it is possible to measure voltage values for determining the expected patient's weight. For example, to determine the mass applied to the platform, firstly a proper combination of enabling electronic switches should be used. First step is to calibrate (tare) the platform with

the use of serial sequence from switch K_1 to K_4. Then it is possible to determine the arithmetic mean value of the applied force, which can be easily converted to mass, while working through the measurements of the voltage drops at each strain gage sensors.

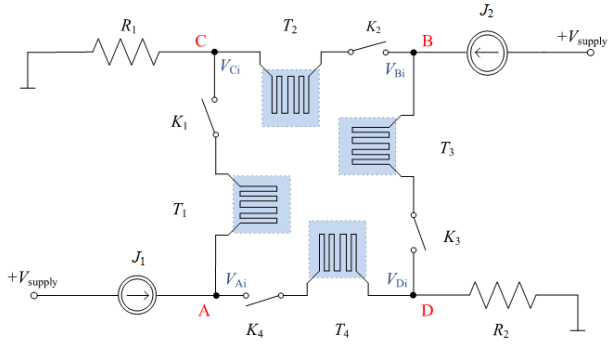

Fig. 2. The way of the strain gage transducers supply and voltage drops measurement

Research and achieved results

During the research, a series of measurement experiments was completed. The aim was to examine the repeatability of determining the mass value at different values of force F applied at the central point of the platform. In order to do it, weights of 2, 5 and 10 kg (which correspond with $F = 20$, 50 and 100 N force values) were placed in the geometrical centre of the plate. There were 5 measurements in each series of experiments followed by evaluating the uncertainty of measurements. The evaluation was conducted through calculating the value of standard deviation, which was done according to the following formula:

$$\sigma(\bar{m}) = \sqrt{\frac{\sum_{k=1}^{N}(m_k - \bar{m})^2}{N(N-1)}} \tag{1}$$

where m is the mass and N is the number of samples.

Conclusions

The results of the experiments were satisfactory. The maximal value of standard deviations for $m = 2$, 5 and 10 kg do not exceed 5% of the applied load. The following stage of the research will be examining the uncertainty of measurements for greater loads (such as 100÷150 kg). It is also planned to work out a stabilographic platform integrated with a PC with the use of the LabVIEW system.

Acknowledgements

The work has been done within the Bialystok University of Technology project S/WE/3/08.

References

[1] **Winter D.A.** Biomechanics and Motor Control of Human Movement**,** Fourth Edition, Wiley & Sons, 2009.

[2] **Walendziuk W., Idźkowski A.** Evaluation of the Static Posturograph Platform Accuracy. Journal of Vibroengineering, Vol. 11, Issue 3, 2009, p. 511–516.

[3] **Augustynek M., Penhaker M., Sazel P., Korpas D.** Stimulation Parameter Testing and Verification during Pacing. IFMBE Proceedings Vol. 29, 2010, p. 533–536.

[4] **Bobbert M., Schamhardt H.** Accuracy of Determining the Point of Force Application with Piezoelectric Force Plates, J. Biomechanics, Vol. 23, No. 7, 1990, p. 705–710.