DEVELOPMENT OF THE MEASURING CHANNEL OF THE PRESSURE DISTRIBUTION SYSTEM ON THE SURFACE MODEL OF THE AIRCRAFT DURING THE EXPERIMENT IN THE AERODYNAMIC TUBE

R. Marchuk , P. Nosko

National Aviation University, Kyiv

Scientific adviser - Bashta OV, Ph.D. tech. Sciences, Assoc.

The development of modern aircraft construction is impossible without accurate aerodynamic tests (weight, drainage, strain gauge, flutter, bench, calibration), because they: allow to determine the aerodynamic properties of all aircraft and their parts; provide an opportunity to study the basic characteristics of the flow, especially when they are combined with methods of theoretical analysis. At the same time, the statistical analysis of the wind tunnel operation mode shows that the main disadvantages of drainage tests are the outdated and cumbersome system for determining the pressure at points with the help of liquid manometers.

The expediency of using a strain-resistive semiconductor sensor HoneyWell Ultra Low Pressure Sensors, which has indisputable advantages among others, namely: compactness; the measurement range is 0.01% of the atmospheric pressure. To reduce the temperature error of strain-resistant transducers, the efficiency of using analog compensation devices based on the method of using temperature-dependent resistors is substantiated.

The method of digital error compensation and the possibility of its use during modeling of the measuring channel are investigated. The structural scheme of the measuring channel is developed.

Based on the research, a simplified scheme of a measuring transducer with a system of digital continuous correction of the systematic component of errors was developed [1]. The advantages of the proposed scheme are: high noise immunity (the frequency signals of the functional generator are almost not affected by electrical noise); transmission of a useful signal over long distances almost without errors; the generator has a linear conversion function; the output signals of the generator can be measured directly by the microcontroller.

Developed multipoint computerized IMS to measure the pressure distribution on the surface of the model during the test, the block diagram of the measuring channel is presented in Fig.1.

The main component of IBC is its implementation on the basis of a centralized type system with high metrological characteristics, ie, the developed multipoint computerized IBC is not inferior to analogues, which are implemented on the basis of decentralized type architecture.

The process of measuring pressure is based on the principle of time distribution of channels.

A feature of this scheme is a more complete correction of errors compared to existing counterparts and the ability to increase the number of measuring channels of the system.

Simulation of analog interface for remote measurement [1]. Using the NUMERY software environment, the regression equation of the measurement channel

conversion function was determined, which allowed to determine the systematic and random components of the measurement channel error, without taking into account the sensor error.

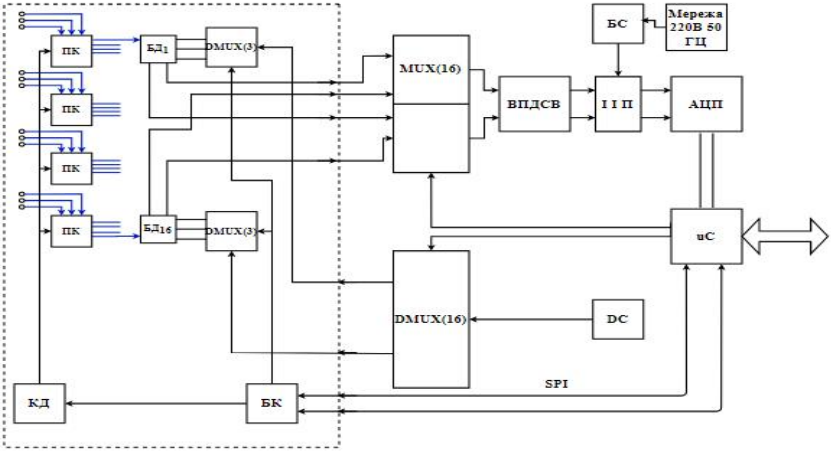

Fig. 1. - Block diagram of the measuring channel

The following symbols are accepted on the scheme:

- ПК pneumatic switch
- БД1-16- block of sensors (is in MLA)
- КД - stepper motor (located in MLA)
- DMUX - Demultiplexer (located in MLA)
- БК- Control side (located in MLA)
- MUX- differential multiplexer
- ВПДСВ- measuring amplifier with differential current inputs.
- ІІП-iterative integrating converter
- БС-Synchronization unit
- АЦП-to-analog converter
- uC - microcontroller
- DC - current source

Analysis of the simulation results showed that the dominant component is multiplicative [2], which does not exceed 0.02%, which is 5 times better than analogues. Since the only random component in modeling is the quantization error, the use of a differential method of measuring the output voltage will significantly improve the metrological characteristics; noise immunity (80 dB) is an order of magnitude higher than existing analogues, with twice the speed (60 ms).

The measuring channel of the pressure distribution system, designed on the basis of strain gauge sensors, can be offered for use not only for testing aircraft models in the wind tunnel, but also in other areas of machine building where it is necessary to know the value of flow distribution.

References

1.Tenzorezystornyi vymiriuvalnyi peretvoriuvach. UA 7279A

2.Implementatsiia zmin zakonodavchoi metrolohii u diialnosti subiektiv hospodariuvannia / V.M. Mokiichuk, O.O. Redko, Marchuk R.M // Standartyzatsiia, sertyfikatsiia, metrolohiia ta menedzhment: Tezy dop. III mizhnar. Nauk.-prakt. Konf., 22-23 travnia 2017 roku, m. Kyiv. – K.: DP «UkrNDNTs». – S. 44.