Olena Bezvesilna, Doctor of engineering, professor,
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"
Andrii Tkachuk, Ph.D,
Zhytomyr State Technological University
Valeriia Ruban, student,
University of Opole, Opole, Poland

EXPERIMENTAL INVESTIGATIONS OF A PRECISION SENSING ELEMENT FOR AN AUTOMATIC STABILIZER SYSTEM

To increase the effectiveness of fire on the move, all modern combat vehicles are equipped with a special automatic device referred to as a weapons stabilizer system (WSS). Providing the accuracy improvement of measuring the mobile object's acceleration, such as those used in a weapons stabilization system (WSS), is a great challenge. WSS effectiveness is mostly dependent on the accuracy and performance of the sensitive stabilizer elements and accelerometers.

The modern stabilization systems, using spring, string, quartz, magnetic, and gyroscopic accelerometers cannot provide the required speed of response and accuracy.

Therefore, the urgent scientific and technical challenge is to improve the accuracy and speed of response when measuring the acceleration values by experimental investigations of a piezoelectric sensor (PS) for the automatic weapons stabilization system.

Experimental device was created for experimental investigations of the sensing element (SE). Its schematic diagram is shown in Figure 2, and its photo is presented in Figure 3. The test stand includes the following devices: a mechanical vibration generator GMK-1 (vibration table) with two on-board induction transducers converting electrical signals into mechanical displacement; an SE placed directly on the vibration table; an input/output module; an SE output signal amplifier unit; a personal computer (PC); an AC generator and voltmeters for logging voltage levels of the generator and of the induction transducers.

A piezoelectric accelerometer AHC 114-08, with its natural frequency ω_0 = 0.1 rad/s, achieved by increasing the total resistance ($\tau = 1/C_\Sigma R_\Sigma$), has been chosen for experimental research. The investigated frequency range was chosen based on the sensor's natural frequency and typical vibration range experienced by automatic weapons stabilizer systems.

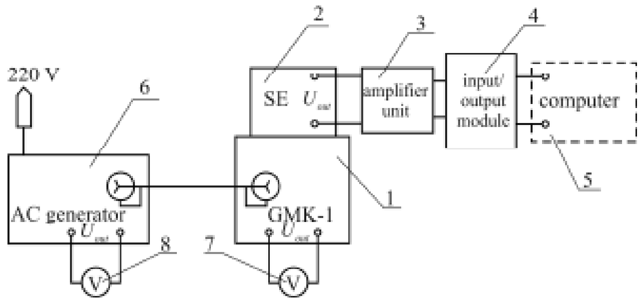

Figure 2. Schematic diagram of the test stand for the experimental investigation of piezoelectric SE: 1—GMK-1; 2—SE; 3—SE output signal amplifier unit; 4—input/output module; 5—PC; 6—AC generator; 7—voltmeter for logging generator voltage; and 8—voltmeter for logging induction transducer voltage

Dependence of the SE *U* output voltage amplitude on the vibration table oscillation frequency *ω* for the generator's voltage amplitude Ugen = 5, 7 and 8 V was investigated. The 7 V signal amplitude of the generator was equivalent to the mean amplitude of vibrations experienced by APCs in normal conditions. Lower and higher amplitude was checked for comparison purposes during the sensor's frequency dependence characterization. The experimental data are shown in the Table 1.

Table 1

ω, rad/s		0.01	0.03	0.05	0.10	0.15	0.20	0.25
U, mV	Ugen = 5B	52.4	56.7	74	121.9	53.8	87.0	89.6
	Ugen = 7B	71.0	75.5	107.1	174.1	70.7	125.0	113.0
	Ugen = 8B	79.0	81.3	118	192	77.8	155.0	143.0

Table 1 show that the maximum output voltage amplitude of the SE investigated takes place when the vibration table oscillation frequency values is ω = 0.1 rad/s for Ugen = 5, 7 and 8 V, which equals the frequency of the natural oscillations of the investigated SE ($\omega = \omega_0$ = 0.1 rad/s). This is a case of the so-called "main resonance". This finding coincides with the findings of analytical studies and PC simulations.