нагрузка до 20 Н/см^2 не вызывает в конструкции критических напряжений. Величина эквивалентного напряжения – не более 2×10^{-4} Н/м^2, перемещений – не более $1{,}4\times10^{-4}$ мм, эквивалентная деформаци не превышает величину 8×10^{-6} мм.

Проведенные исследования подтверждают правильность принятых конструкторских решений и выбор материала конструкции.

UDC 681

MULTI DOF PIEZOELECTRIC MOTOR

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Piezoelectric devices are common in such areas were precise, fast and low energy solutions are needed, i.e. cameras, robotics, laser beam control, space industry. They are small, reliable and inexpensive [1–2]. Piezoelectric actuators used for piezoelectric ultrasonic motors (USM) are working in ultrasonic frequency range and can generate very precise motion.

Proposed novel and simple design of USM (fig. 1). This design has two ring-shaped piezoelectric actuators and spherical rotor inserted between them. All components are assembled using two flanges and three screws. Rotational motion of the spherical rotor is generated when harmonic electric signal is applied to one of electrode groups of actuators. 3D resonant vibrations of the actuator rotate the rotor in desired direction and 3DOF rotational motion of the rotor can be achieved with very high resolution.

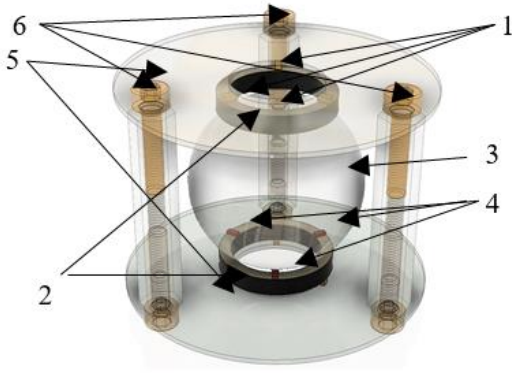

Fig. 1. Structure of the ultrasonic motor: 1 – elastic supports; 2 – piezoelectric actuators; 3 – rotor; 4 – contact elements; 5 – flanges; 6 - screws

Modal, harmonic response and experimental studies are performed and results of this USM are presented in fig. 2 and fig. 3. Conditions and limitations: applied voltage – 50 V. Measured range – 50-110 kHz; 5 N force to contact elements applied. All piezoelectric and dielectric losses were neglected in these simulations.

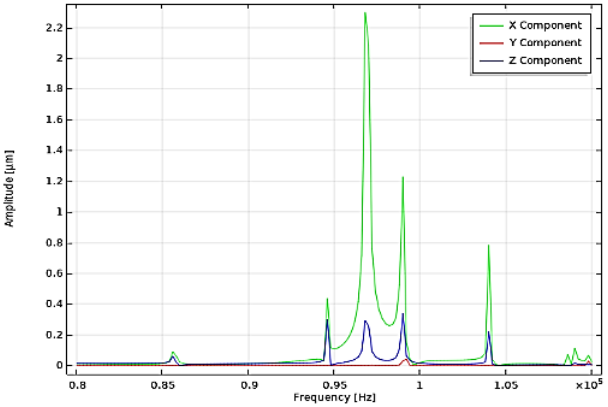

Fig. 2. Amplitude vs. frequency of USM. Harmonic response analysis (FEM). Operational frequency at 96.8 kHz

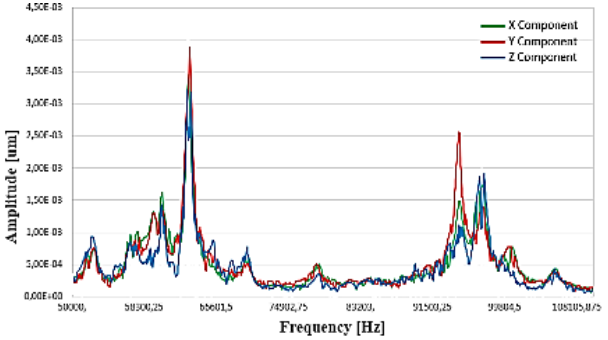

Fig. 3. Amplitude vs. frequency measured with Polytec 3D vibrometer. Operational frequencies of the USM are at 60.05 and 94.44

References

1. Kang, B; Lee, J; Won, C. Micro-Navigation Satellite Network Design and Analysis. Proceedings of 21st International Technical Meeting of the Satellite Division. USA, 2008. p. 867-876.

2. Jänker, P., Claeyssen, F. New applications for aircraft and space applications. Proceedings of 10th International Conference on New Actuators, Bremen, Germany, 2006, p. 324–330.