

# 1121. Development of two modifications of piezoelectric high resolution rotary table

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**Abstract.** The aim of this paper is to describe two modifications of high resolution rotary tables with angular position control, based on the transformation of resonant oscillations of piezoelectric transducers into continuous or start-stop motion. Exact angular position of the table is achieved by application of integrated classical rotary position encoders and feedback system, related to the given position or angular velocity of the device. Dimensions and cost of the table should be dramatically reduced, thus ensuring competitiveness in modern markets.

**Keywords:** piezoelectric motor, high resolution, rotary table, photoelectric encoder.

## 1. Introduction

There is a great deal of researchers who are developing various piezoelectric devices, including rotary tables and motors [8]. However, only several companies managed to produce and supply such objects to the market. German company PI (Physik Instrumente GmbH & Co, Germany) developed piezotable M 660, characterized by angular resolution up to 4  $\mu$ rad and maximal angular velocity, equal to 2 rev/min [9]. Technical parameters of this product are excellent, but price reaches 1000 EUR and that limits the cases of its practical use. Nanomotion Ltd (Israel) commercialised its FBR060 model, which utilises the same way of motion generation, as that of previously described device [10] and the cost is nearly the same, although the main technical features are different. Another operation principles based on transformation of non-harmonic oscillations (stick-slip effect) are embodied by companies Attocube Systems AG (Germany) and PiezoMotor AB (Sweden) in the models ANR101/NUM Closed Loop [11] and Piezo LEGS WavePlate [12]. The prices of both piezoelectric tables are even higher compared to the ones discussed before. In addition, piezomotors designed by company PCB Motor ApS (Denmark) should be mentioned. These motors are manufactured on printed boards and have no outer covers (for example, PCB M 30-H25 [13]). Nonetheless, the latter positioning stages are of different precision class.

Information provided in this article mainly deals with the development of two versions of the novel table, based on the combination of standard photoelectric rotary encoders (A36-F-4000-5V and A58-F-10240-5V), produced by Precizika Metrology (Lithuania), and plate-type piezoelectric actuators, invented in Kaunas University of Technology (Lithuania). Both modifications act as prototypes for the industrial products that would be characterized by high quality and relatively low cost.

## 2. Optimal topology of electrodes

When designing a plate-type piezoelectric drive used in this work, a great attention was paid to optimal topology of electrodes on piezoceramic element. This issue was taken into consideration when performing R&D project PiezoAdapt [14]. During problem formulation for multi-dimensional piezoelectric transducers in terms of optimal electrodes configuration, the following constrains are taken into account: unification of excitation voltage, generation of reversal motion and achievement of maximum efficiency. The first requirement deals with voltage of the same frequency, constant amplitude and phase, supplied by power source. The second one