УДК 67.05

THE DEVELOPMENT OF TOOL MOTION OPTIMIZATION ALGORITHM FOR A PROCESSING MACHINE

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Processing accuracy in instrumentation technology has always been of great importance. In the world, there are a large number of fields, where the precision of manufactured devices is not just important, but necessary. Moreover, the reliability and performance of most devices depend highly on the accuracy of manufactured parts.

For example, in space technology, if any part of a spaceship or space equipment is made with inaccuracy of at least a few microns beyond the permissible limits, it can lead to an emergency situation on board, which will entail massive monetary losses, fall of prestige for the country and, worst of all, human casualties. The similar situation is in medicine, where there are strict accuracy requirements for the parts of, for example, prostheses and pacemakers. There are standards for high-precision manufacturing even for high-tech consumer devices that we use every day, like smartphones, laptops etc.

Also, the requirements for accuracy are continuously growing nowadays. It happens since devices today tend to become more complicated and to decrease in size.

High precision in manufacturing can be achieved with high-quality materials and measuring tools, but the most critical aspect is the ability of processing machines to achieve performance with minimal deviations. High accuracy can be achieved with the improvement of software algorithms, used in machines for converting the given part program into tool movements. These algorithms can be roughly divided into two steps: calculating instrument’s path and determining its speed at any given time. Both of these steps reflect the resulting accuracy because the inefficient trajectory construction will lead to processing error and on the other hand, abrupt change of velocity will result in increased vibration which has a negative impact on product quality. So it is essential to improve both speed and trajectory generation.

The marketing and scientific research shows that most of the algorithms in use result in high vibration and consequently the low quality of obtained surface during processing. New high-speed algorithms result in inaccuracy directly proportional to the speed. Thus, the improvement of software algorithms for processing machines remains a relevant task.

It should be noted that even though most of the machining systems on the modern market include software which allows an effective high-precision and high-speed processing, it is a part of a proprietary, i.e. closed code, inaccessible to third-party developers. So the goal of the work is to create and implement an open source algorithm.

The research aims to create trajectory optimisation software, including speed control and trajectory generation technique, which will allow an effective high-speed and high-precision processing. The proposed method of speed control is based on a cosine function to achieve a smooth change of velocity that allows vibrations reduction. To achieve minimal divergence between the resulting and desired path the calculation with the use of unique parametric curves is suggested. For example, such parametric equations will achieve smooth processing at corners so that the user of the machine will be able to adjust both the size and shape of the rounding to satisfy the required precision.