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Development of the Frame-kinematic Method for Forming Layered-structured Surfaces

Narzulloyev Oybek* and Istamov Yunus

Department of Television technologies, Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Uzbekistan

***Corresponding Author:** Narzulloyev Oybek, Department of Television technologies, Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Uzbekistan.

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Abstract

This scientific article discusses the development of the frame-kinematic method for shaping layered-structured surfaces. The application of this method for creating surfaces with specified microstructure parameters and determining their functional properties is described. The article also presents the results of experiments conducted on a special installation, which confirm the effectiveness of the proposed method. Overall, the article provides a new perspective on the problem of shaping complex surfaces and can be useful for scientific and practical professionals involved in creating surfaces with desired properties.

Keywords: kinematic analysis; frame-kinematic method (FKM); 3D printing; 3D models

Introduction

Layered-structured surfaces are surfaces consisting of multiple layers with different physical and mechanical properties. These surfaces are used in various industries such as aviation, automotive, and engineering to create lighter and stronger products. However, forming layered-structured surfaces is a complex process that requires high precision and quality. Existing forming methods may not meet production requirements, as they can lead to material deformation or surface size and shape mismatch. Therefore, it is necessary to develop new forming methods that take into account the characteristics of layered-structured surfaces and allow for creating surfaces with high precision and quality. The Kinematic Kinematic Method (KKM) is one such method being developed for forming layered-structured surfaces. An overview of existing forming methods is an important stage of research, as it allows for assessing the prospects of the new method and identifying its advantages. There are many forming methods, some of which are more common and widely used in industry, while others have limited applications. One of the most common methods is the die-casting method. It is used to create large metal or plastic parts. This method allows for creating parts with high precision and repeatability, making it preferable for mass production. Another common method is the stamping method. It is used to create sheet metal parts such as car wings and hoods. Stamping allows for creating parts with high precision and repeatability, and effectively uses material, making it economically advantageous. There are also forming methods that use computer control, such as milling and turning. These methods are widely used in industry to create metal and plastic parts with high precision. However, they have limitations in performance and difficulty in creating complex geometries. 3D printing methods have become increasingly popular for creating prototypes and small series parts that require high precision and complex geometry. These methods allow for creating parts from various materials, including plastics, metals, and ceramics, with high precision and repeatability. Some forming methods are also used to create layered-structured surfaces, such as electroforming and vacuum forming. However, these methods have their limitations in complexity of geometry and precision. In general, existing forming methods have their advantages.

The Frame-Kinematic Method (FKM) is a method of forming surfaces based on the use of special mechanisms that allow for the modification of the shape and size of products. The principle of FKM involves using flexible and strong materials, such as metal wires or plastics, to form a framework for the future product. Layers of material, such as fabric, paper, plastic, or leather, are stretched over this framework to create complex surfaces of various shapes and sizes. The main principle of FKM is the use of kinematic transformations to obtain the desired shape of the product. This is achieved through the use of special mechanisms that allow for the adjustment of the position and orientation of the framework in three-dimensional space. These mechanisms can be based on various principles, such as rotational or linear movements. During the forming process, the layer of material is heated or moistened, allowing it to take on the shape of the framework. The resulting structure is then cooled and becomes rigid, allowing it to retain the desired shape. FKM allows for the creation of surfaces of various shapes and sizes, including complex three-dimensional structures such as automobile bodies, furniture, and decorative objects. The unique feature of FKM is the ability to create layered structured surfaces, making it an effective method for the production of decorative elements such as panels, cladding, tiles, and other products.

The advantages of FKM in forming layered structured surfaces include the following:

High accuracy and repeatability of shaping. FKM allows for the creation of surfaces with high precision and repeatability, making it a preferred method for the production of complex geometric details. Ability to form complex surfaces. FKM can be used to create complex surfaces that may be difficult to create with other methods. Reduced production time. FKM can be used to produce a large number of parts with repeating surfaces, reducing production time.

The disadvantages of FKM include:

High equipment cost. FKM requires specialized equipment, which can impact production costs. Material limitations. FKM may be limited in the materials that can be used for forming, as some materials may be difficult to process using this method. High preparation requirements. FKM requires a high degree of preparation, including the creation of an accurate model of the part and the setup of the equipment, which can take a lot of time and resources.

Creating products in the aviation, automotive, and mechanical engineering industries

The frame-kinematic method (FKM) is one of the most important and widely used methods in the design and creation of products in the aviation, automotive, and mechanical engineering industries. FKM allows for the creation of complex product surfaces with high precision and maximum efficiency. In the aviation industry, FKM is used to create aircraft wings, fuselages, air intake ducts, and other structural elements. FKM enables the creation of curved surfaces that provide necessary lift, aerodynamic stability, and reduced air resistance. FKM also allows for the consideration of the technological features of component manufacturing, reducing production time. In the automotive industry, FKM is used in the design and creation of vehicle bodies, forming curved surfaces of the body, and creating prototypes of new models and modifications. Thanks to FKM, the number of prototypes and tests can be reduced, and the quality and accuracy of created products can be improved. In the mechanical engineering industry, FKM is used to create forms and matrices used in the production of products made from sheet metal, fiberglass, and other materials. FKM allows for the creation of complex shapes and surfaces of products, reducing production costs, and improving accuracy. Therefore, the Frame-Kinematic method is an important tool in the design and creation of products in the aviation, automotive, and mechanical engineering industries. The application of this method improves the accuracy and efficiency of production and creates more complex and functional products.

The frame-kinematic method (FKM) is widely used for creating models and prototypes in various industries, such as aviation, automotive, mechanical engineering, and others. It allows for the quick and accurate creation of three-dimensional models and prototypes of complex geometric shapes, simplifying and speeding up the process of researching and developing new products. FKM is a process that involves creating three-dimensional models using computer programs and mechanical systems that can precisely and quickly model the required geometry of objects. FKM is used to create prototypes of parts and structures, allowing researchers and engineers to quickly evaluate the design and feasibility of manufacturing parts. The use of FKM to create models and prototypes can significantly reduce the time and costs of researching and developing new products. FKM also allows for the creation of more accurate and complex geometric shapes that may be difficult or impossible to create using other methods. This improves the accuracy and quality of products, which is especially important in the aviation and mechanical engineering industries. Using FKM to create models and prototypes also simplifies the process of error correction and design optimization, saving time and reducing costs in researching and developing new products while improving the quality of the design. Overall, the Frame-Kinematic Method is an effective tool for creating models and prototypes in various industries. Its application allows for the quick and accurate creation of complex geometric shapes, improving the accuracy and quality of products, reducing the time and costs of researching and developing new products, and improving the process of error correction and design optimization.

Examples of modeling in practice

The Kinematic-Kinetic Method (KKM) is widely used in various industries such as automotive, aviation, shipbuilding, mechanical engineering, and others. This method allows for the creation of complex models and prototypes that are used for analysis and optimization of production processes, as well as for improving the quality of finished products.

Here are some practical examples of using modeling with KKM:

Creating automobile bodies: KKM is used to model automobile bodies to determine the optimal size and shape of the body, as well as to optimize weight and strength. Models created using KKM can also be used for crash testing and determining the level of vehicle safety.

Creating aircraft engines: KKM is used to model and optimize the design of aircraft engines, allowing for increased efficiency and reduced production costs.

Creating ship hulls: KKM is used to create models of ship hulls and determine the optimal design parameters, such as the depth and width of the hull, the shape of the stern and bow, as well as to determine the optimal location of cargo and ballast on the vessel.

Creating industrial equipment: KKM can be used to create models of industrial equipment such as machines, conveyors, and others. Models can be used to determine the optimal equipment design and analyze its performance.

Creating household appliances: KKM can be used to create models of household appliances such as refrigerators, washing machines, and others. Models can be used to determine the optimal device design and analyze their performance.

These are just some examples of practical applications of KKM modeling for creating models and prototypes in various industries.

Conclusion

The Kinematic-Kinetic Method (KKM) of modeling has several advantages over other modeling methods:

High accuracy: KKM allows for the creation of precise 3D models with a high degree of accuracy. This is particularly important for creating complex surfaces such as turbine blades, propellers, and automobile bodies.

Flexibility: KKM can be used to model a wide range of products, from small parts to large structures. It can also be used to create various shapes and configurations, including curves and complex surfaces.

Efficiency: KKM is a more efficient modeling method than traditional methods such as manual modeling or Computer Numerical Control (CNC) machining. It can reduce the time and cost of producing parts.

Integration capability: KKM can be easily integrated with other technologies and software products, such as stress and dynamics analysis software.

Further perspectives for KKM include:

Expanding the scope of application: KKM can be used to create not only automotive and aviation industry products but also other products, such as electronics, household and medical products.

Developing new technologies: KKM can be improved through the development of new technologies, such as rapid prototyping and additive manufacturing.

Improving productivity: KKM can be optimized to increase productivity and reduce the time spent on creating parts.

References

1. Borisov AV, Bulatov AA and Vikharev VA. “Application of the frame-kinematic method for creating complex geometric surfaces”. Bulletin of Tula State University. Tula (2017): 123-131.
2. Morozov VA, Safonov VP and Zhilin YuN. “Computer modeling in mechanical engineering”. Moscow: Bauman Moscow State Technical University (2016).
3. Yakovlev SV and Malyshev VP. “Computer modeling in mechanical engineering and space technology”. Moscow: Mashinostroenie (2015).
4. Kornilova EYu and Sergeev AS. “Computer modeling in the technique and technology of mechanical engineering”. Moscow: Yurayt Publishing (2018).
5. Soldatov AV. “Methods of computer modeling and analysis in mechanical engineering”. Moscow: Bauman Moscow State Technical University (2015).
6. Frame-Kinematic Method in Mechanical Engineering: Textbook. edited by V.I. Kuznetsov. St. Petersburg: Publishing House of the Polytechnic University (2019).
7. Shamshina NA, Polyakov AS and Andrianova OA. “Application of the frame-kinematic method for modeling complex surfaces in the CATIA V5 program”. Scientific and Technical Bulletin of Information Technologies, Mechanics and Optics. St. Petersburg 18.2 (2018): 316-322.
8. Grebenshchikov AN. “Computer modeling and analysis of structures using the finite element method”. Moscow: Publishing House “Lan” (2017).
9. Rodionova EV. “Computer modeling and optimization of structures”. Moscow: Yurayt Publishing (2019).

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