

## AUTOMATION OF 3D MODEL CREATION BASED ON THE R-FUNCTION METHOD

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The modern development of three-dimensional printing technologies significantly influences engineering, manufacturing, and scientific processes, creating a demand for fast and accurate methods of 3D model construction. Most existing software solutions used for creating 3D objects are based on polygonal or parametric modeling, which require considerable user experience and time. This limits the accessibility of technologies for a wide range of specialists and reduces the efficiency of the design process, especially when creating complex or multi-component shapes. Therefore, it is relevant to develop a software system that automates the process of generating three-dimensional models based on mathematical descriptions.

The purpose of this research is to optimize and simplify the process of 3D model construction by developing a software system that automates the formation of geometric shapes using the R-function method and prepares them for 3D printing in STL format. The R-function method, developed by V.L. Rvachev [1], is based on the idea of constructing complex geometric objects through logical operations over basic primitives, which allows formalizing the modeling process and ensuring analytical precision of the results. Unlike polygonal methods, R-functions enable the creation of continuous surfaces and smooth transitions between elements, which is crucial for technical design, biomodeling, and the production of parts with high surface quality requirements.

In the course of the research, a software system with a graphical interface was developed that interprets the mathematical description of an object, generates its 3D model, provides interactive visualization, and exports it in STL format. The system allows model parameterization—changing the main geometric characteristics with automatic shape updating. A model integrity checking module was also implemented to prevent common errors during file preparation for 3D printing. The developed system ensures a reduction in modeling time, improved precision and reproducibility of results, and enables the application of a generative approach to model construction.

The obtained results confirm the efficiency of using the R-function method for automated 3D modeling tasks. The mathematical approach allows the formalization of the object creation process and provides a foundation for further system development toward integration with CAD environments and cloud-based platforms. The proposed approach has significant potential for application in industrial prototyping, medical modeling, as well as in educational and research projects, where high accuracy and flexibility in creating three-dimensional objects are essential.

### References:

1 Rvachev V.L. *Theory of R-functions and Some of Its Applications*. Kyiv: Naukova Dumka, 1982. 552 p.