

## **Machine Intelligence Approach for 3D Shape Packing**

### **Abstract**

This paper presents a machine-intelligence nonlinear optimization framework for tackling the 3D irregular packing problem with arbitrarily translated and rotated objects. The interactions between geometric shapes are represented through phi-functions and quasiphi-functions, providing an analytical formulation of containment and non-overlap constraints. A mathematical model of the packing problem is constructed, and its structural properties are examined. Building on these insights, a multi-stage heuristic initialization strategy is combined with a local optimization algorithm to obtain feasible solutions. Computational experiments demonstrate that the proposed approach is efficient and robust in optimizing the packing of complex 3D shapes, highlighting its potential as an intelligent computational tool for geometric modeling and engineering applications.