A NEW COMPUTATIONAL METHOD FACILITATES THE DENSE PLACEMENT OF OBJECTS INSIDE A RIGID CONTAINER

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Abstract: Spectral Packing is a 3D algorithm that efficiently packs 3D objects into a known container, ensuring they fit without overlapping. This problem is known as NP-hard, as it is considered "at least as hard as the hardest problems in NP." The algorithm uses Fast Fourier Transform to perform calculations quickly, making it a speedy and intelligent way to pack 3D objects in a box. However, even approximate solutions are challenging due to the difficulty of handling interactions between objects with arbitrary 3D geometries and vast combinatorial search space. Additionally, the packing must be interlocking-free for real-world applications.

Index Terms – 3D objects Spacing

I. INTRODUCTION

Packing can be a tedious task, requiring careful planning and the efficient use of space to fit all the necessary items into a container. However, a new computational method has emerged that is revolutionizing the way we pack. This method allows for the dense placement of objects inside a rigid container, making the chore of packing faster and easier than ever before. With this innovative approach, individuals can maximize the use of space, saving time and effort in the process. The new computational method's ability to efficiently pack objects inside a container has transformed the packing experience, providing a solution to the age-old problem of fitting everything in.

a novel packing algorithm to search for placement locations within a given object
I. RESEARCH METHODOLOGY

II. The first step in SSP is ordering of a solid 3D object for placing it into a fixed container. The easiest way to start this is to start with largest objects and end with the smallest. Then place each object into the container. To make this process easier the container is voxelized. The grid shows which part of container or an empty space is filled and which are vacant. The packed object is also voxelized. To figure out the available space of the object, the algorithm then computes a quantity called the collision metric at each voxel. It works by the number of occupied spaces the object overlaps or collides. The object can only be placed in locations where there are no collisions or almost zero.

III. The main goal of this project is to minimize gaps between the objects that can be done by putting the object where the metric value is the lowest.

IV. RESULTS AND DISCUSSION

In this work, the researchers first introduce a novel packing algorithm to search for placement locations given an object. This method leverages a discrete voxel representation. The researchers then formulate collisions between objects as correlations of functions computed efficiently using Fast Fourier Transform (FFT).

To determine the best placements, they utilize a novel cost function, which is also computed efficiently using FFT. Finally, the researchers show how interlocking detection and correction can be addressed in the same framework resulting in interlocking-free packing. They thus propose a challenging benchmark with thousands of 3D objects to evaluate the algorithm.

the new technique allows ultra-dense packing of stackable objects for 3d printing at unprecedented speed
Conclusion: In one demonstration, the new algorithm efficiently placed 670 objects in just 40 seconds, achieving a packing density of about 36 percent. “The densities we’re getting, close to 40 percent, are significantly better than those obtained by traditional algorithms,” Matusik says, “and they’re also faster.” This work represents “a breakthrough solution to a longstanding problem of effectively organizing 3D objects,” comments Bedrich Benes, a professor of computer science at Purdue University. “If we can increase the packing density,” he adds, “we can increase the overall efficiency of the printing process, thus reducing the overall cost of manufactured parts.” While the SIGGRAPH paper offers new and improved procedures for 3D printing, as well as for packing rigid objects, the problem of how best to arrange deformable objects or articulated objects — the latter consisting of more than one rigid part connected by joints — is still open, and may be addressed in future work.

REFERENCES

[1] New computational method facilitates the dense placement of objects inside a rigid container (2023, July 6) retrieved 28 August 2023 from MIT.