ARIA
APPLIED RESEARCH IN ACTION

Exact Geometry Processing Kernel using Integer Barycentric Coordinates

By utilizing an alternative coordinate system based on Integer Barycentric Coordinates for representing meshes, we are able to robustly and efficiently apply certain geometry processing algorithms.

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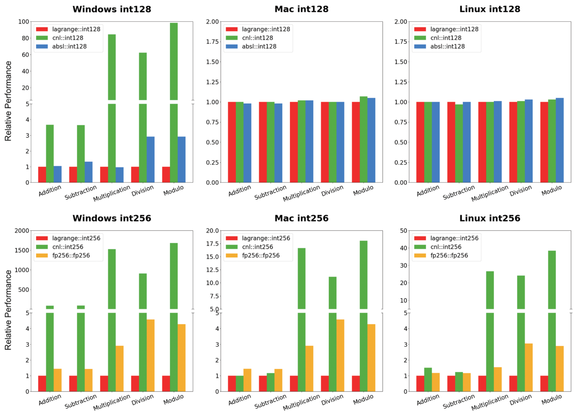

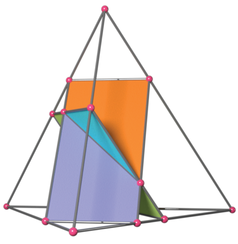

PROJECT SUMMARY

Mesh boolean operations (also known as constructive solid geometry operations) are crucial tools that are used in many diverse geometry processing tasks, including computer aided design, computer graphics, and finite element analysis. They can be thought of as logical operations between two or more 2D or 3D meshes. These boolean operations include finding the union, intersection, or difference of geometric objects. While it is trivially easy to perform such operations on implicitly defined shapes, it is much more difficult to do the same with explicit representations and, in particular, with triangle-based meshes. In particular, our area of focus is to perform these operations exactly (without rounding errors). Recent methods have used integer based representations (such as rational numbers) rather than floating point numbers to enable exact computations, at the cost of reducing performance. We designed a novel method that utilizes barycentric integer coordinates which harnesses the exact nature of integers with fewer performance drawbacks. In order to facilitate this project, we have also developed a highly optimized cross-platform large-integer (256 bit) arithmetic operations library.

REFERENCES

Zhou, Qingnan, et al. "Mesh arrangements for solid geometry." ACM Transactions on Graphics (TOG) 35.4 (2016): 1-15.
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