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An efficient technique for importing complex geometry into block-structured adaptive mesh refinement codes. HSIAOCHI LI, RYAN W. HOUIM, University of Florida, AFOSR GRANT NO. FA9550-19-1-0023 COLLABORATION — Immersed boundary methods (IBM) are becoming viable alternatives to traditional unstructured meshes for embed complex geometry on structured meshes. We present an efficient method to import geometry from a STL file and generate a signed distance function. The method uses a ray-tracing algorithm to find the intersection of the STL triangles along grid lines in all three directions. Usually, each ray requires searching through the entire list of triangles, which is prohibitively expensive for large STL files. The efficiency of triangle search is increased dividing the domain into prisms using a quad-tree data structure. The ray-tracing algorithm is then performed over a reduced triangle list in each prism. The resulting triangle-ray intersection points are used to directly form a signed distance function. Results show that the proposed algorithm is up to 20 times faster. Adaptive mesh refinement introduces additional challenges where the grid can dynamically change on the embedded surface. We present a technique that reforms the signed distance function only on AMR boxes that contain new data during regridding. The results show a computational saving of up to 2.3 over forcing grid refinement on the entire surface.

HsiaoChi Li
University of Florida

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