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Title:Adaptive aperture partition in shooting and bouncing ray method
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Abstract:The shooting and bouncing ray (SBR) method may give rise to a divergence problem when ray tubes intersect discontinuous parts of the target, such as the boundary, and this affects the accuracy to some extent. This paper proposes an adaptive aperture partition algorithm to solve this problem. The proposed algorithm adaptively splits the virtual aperture into continuous irregular beams instead of discrete uniform ray tubes according to the geometry of the target during the recursive beam tracing. These beams form a beam tree, the level of which represents the number of reflections. Geometric optics is applied to the representative propagation path of each leaf beam to obtain the exit field, and then physical optics is used to evaluate each leaf beam's scattered field. The proposed algorithm could generate the convergent solution of the SBR method when the ray-tube size tends toward infinitesimal. Additionally, this paper describes the beam-triangle intersection in detail and utilizes the kd-tree to accelerate the beam-target intersection. Numerical experiments demonstrate that adaptive aperture partition can greatly improve the accuracy of the SBR method, and the computational efficiency can be also significantly enhanced in several applications, such as the RCS prediction in the THz band. © 2006 IEEE.