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Shooting and Bouncing Rays (SBR) and Integration with ANSYS HFSS Solver

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Abstract

The shooting and bouncing rays (SBR) method extends back to the 1980s as an asymptotic technique for solving RCS and installed antenna problems on electrically large structures. In this presentation, SBR is understood to be a technique where geometrical optics (GO) rays are launched from a radiation source to a scattering object, and these rays are used to “paint” physical optics (PO) currents on the target. The scattered field is determined by radiating the currents. SBR can be summarized as an efficient technique for extending PO to multiple bounces using GO ray tracing.

An important limitation of traditional SBR is its exclusive reliance on GO as the mechanism for capturing interaction effects between different parts of the scatterer. However, a more general understanding SBR, which we distinguish as SBR+, allows the full array of well-established UTD techniques, such as edge diffraction and creeping wave rays, to be deployed to model interactions within the scatterer. That is, any legitimate UTD ray path can be used to paint PO-like equivalent currents, not just the GO rays at the foundation of a UTD solution. This is particularly important where regions of the scattering geometry in the shadow of GO rays have surface currents that create significant field contributions to a region’s observation points or angles.

This presentation focuses on the implementation of SBR+ and its integration with ANSYS HFSS, including these enhancements that help allow SBR to reach its full potential. Numeric examples are presented based on ANSYS HFSS and Savant commercial packages for installed antenna performance and RCS prediction.

BIOGRAPHY



Dr. Cantata received a B.S. (2004) and a M.S. (2007) in Telecommunications Engineering from the Politecnico di Milano, Italy. He earned a M.S. (2009) and Ph.D. (2010) in Electrical and Computer Engineering at the University of Illinois at Chicago. His Ph.D. dissertation was on extending the Incremental Theory of Diffraction for Complex Point Sources.

From 2010 to 2014, Dr. Cantata served as an antenna research specialist with SSL, formerly Space Systems/Loral, LLC (SS/L), of Palo Alto, California, where he contributed to the design of several reflector configurations for C, Ku and Ka-band commercial applications, while also researching novel ways to minimize cross-polarization in dual-reflector configurations.

In February 2014, Dr. Cantata joined Delcross Technologies, which was acquired by ANSYS, Inc in 2015. His research and development work at ANSYS has centered on implementation and enhancement of SBR for installed antenna and RCS applications, including hybridization with full-wave solvers. His current interests include the integration of SBR+ with the full-wave HFSS solver, enhancing SBR with novel scattering mechanism formulations, and accelerating SBR via a combination of hardware, software and algorithmic improvements.